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APEC 技術予測プロジェクト

新興感染症克服のための収れん技術のロードマッピング

第 1 回テクノロジーロードマップワークショップ

（2007 年 5 月 22 日～23 日、都市センターホテル、東京）

開催報告

APEC-wide Foresight Project

Converging Technologies to Combat Emerging Infectious Diseases

The 1st Technology Roadmap Workshop

(22 May-23 May, 2007 at Toshi Center Hotel, Tokyo)

REPORT

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文部科学省　科学技術政策研究所
科学技術動向研究センター

July 2007
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National Institute of Science and Technology Policy

Report for the Converging Technologies to Combat Emerging infectious Diseases
The 1st Technology Roadmap Workshop (22 May - 23 May 2007) REPORT

July 2007

Science & Technology Foresight Center
National Institute of Science and Technology Policy (NISTEP)

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概　要

本調査資料は、科学技術政策研究所が 2007 年 5 月 22 日～23 日に都市センターホテルにおいて開催した、「新興感染症克服のための収れん技術のロードマッピング」ワークショップについての報告書である。本ワークショップは、タイの APEC 技術予測センターおよびタイ国立電子コンピュータ技術センター(NECTEC)との共催、GATIC Japan の協賛で開催された。

近年、アジアを中心に重症急性呼吸器症候群(SARS)や高病原性鳥インフルエンザが相次いで発生している。このような状況に対し、技術予測の手法を用いて、新興感染症の克服を可能にする科学技術や技術開発の方向性を検討することが重要になってきている。

科学技術政策研究所は、タイ APEC 技術予測センターと共同提案で、APEC 産業科学技術部会の採択プロジェクトである「新興感染症克服のための収れん技術のロードマップ」を 2006 年から 2 年間の予定で実施しており、今回のワークショップ開催は、本プロジェクトにおける活動の一環である。

プロジェクトでは、3 回のワークショップの開催が企画され、既に 2007 年 2 月にタイにおいて 1 回目のワークショップ（シナリオ作成ワークショップ）が開催された。今回は 2 回目（第 1 回テクノロジーロードマップワークショップ）であり、3 回目（第 2 回テクノロジーロードマップワークショップ）は 2007 年 10 月に台湾で開催予定である。

今回のワークショップの目的は、「ある共通の目的を達成するために、二つまたはそれ以上の異種のテクノロジーや学問分野が収れんしている技術」である“収れん技術(コンバージング・テクノロジー，converging technology)”を用いて、新興感染症を防ぐ、あるいは制御（発生後迅速に制圧等）する技術の中長期的な戦略的テクノロジーロードマップを作成することである。特に、本ワークショップでは、現在の先端科学技術である「バイオ」・「ナノ」・「IT」の融合領域に生じる収れん技術を対象とした。

2007 年 2 月にタイで開催されたシナリオ作成ワークショップでの討論において、「ユビキタス」、「治療技術」、「診断技術（検出技術）」が、新興感染症克服のキーとなる重要な科学技術領域であるとされた。さらに、これらは、収れん技術そのもの、または収れん技術を含む領域であると考えられた。

今回のワークショップでは、これら 3 つの技術に対する今後 5 年から 15 年までのテクノロジーロードマップの作成が試みられた。

ワークショップ当日には、日本、タイ、カナダ、インドネシア、台湾などの 9 つの APEC 加盟国メンバーから、感染症、IT、科学技術政策など様々なバックグランドを持った 42 人（内、19 人が海外から）の専門家が集まった。

國谷実所長の開会挨拶の後に、まず、プロジェクトの全体概要をタイAPEC技術予測センター長

の Nares Damrongchai 氏が発表し、その後に科学技術動向研究センターの伊藤裕子主任研究官が本ワークショップのプログラム内容について述べた。

ロードマップ作成に必要な知識や認識の参加者間の共有のために、国立感染症研究所感染情報センター長の岡部信彦氏から「世界および日本の感染症の現状とサーベイランス」について、および理化学研究所感染症研究ネットワーク支援センター長の永井美之氏および情報チームの岡本仁子氏から、「アジアの感染症研究のネットワークおよび感染症の迅速診断技術」について発表が行われた。また、タイの NECTEC の Chalermpol Charnsripinyo 氏から「最先端 IT 技術」について、同じく NECTEC の Suthee Phoojaruenchanachai 氏からは「収れん技術とは何か？」について、北陸先端科学技術大学院大学教授の亀岡秋男氏からは、「戦略的テクノロジーロードマップの作成理論」、立命館大学教授の香月祥太郎氏からは「テクノロジーロードマップ作成の具体的な事例」についての発表が行われた。

また、テクノロジーロードマップの作成は、前述した科学技術（ユビキタス、治療技術、診断技術）領域ごとにグループに分かれて実施し、その結果、計 3 つのテクノロジーロードマップが作成された。

ロードマップ作成を通して、技術の連携や各国との共同研究のあり方など、活発な討論が実施され、感染症克服のために APEC 地域においてより強い連携が必要であることが認識された。

ワークショップの内容

本ワークショップは、科学技術政策研究所とタイの APEC 技術予測センターおよびタイ国立電子コンピュータ技術センターとの共催、GATIC Japan の協賛で実施された。

ワークショップ参加者

ワークショップの内容

1 日目（5 月 22 日）

○イントロダクション

APEC 産業科学技術部会プロジェクト
「新興感染症を克服するための収れん技術のロードマッピング」の概要と進捗状況
ナレス・ダムロンチャイ博士（タイ APEC 技術予測センター長）
Introduction of "Roadmapping Converging Technologies to Combat Emerging Infectious Diseases (EID)," the APEC-wide project and the progress and activities
Dr. Nares Damrongchai (Executive director, APEC CTF)

本ワークショップは、タイ APEC 技術予測センターと科学技術政策研究所との共同提案で、2006 年から 2 年間の予定で実施している APEC 産業科学技術部会プロジェクト「新興感染症克服のための収れん技術のロードマップ」における活動の一環である。

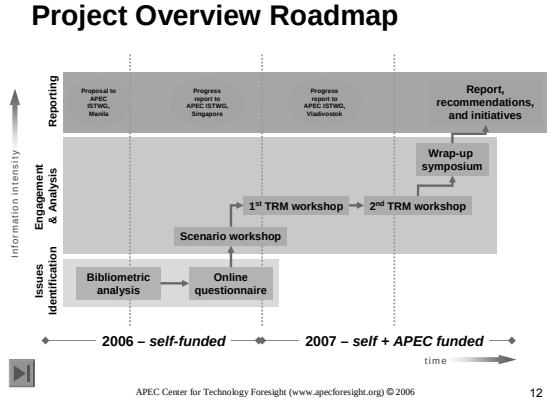
ワークショップ参加者の大部分は、プロジェクトの内容についてほとんど知らないので、まず、プロジェクトの全体概要の紹介が行われた。

ここ 10 年間、多くの新興・再興感染症が世界中で発生している。特にアジア太平洋地域では、SARS や高病原性トリインフルエンザなど重篤な症状をもたらすものが発生している。

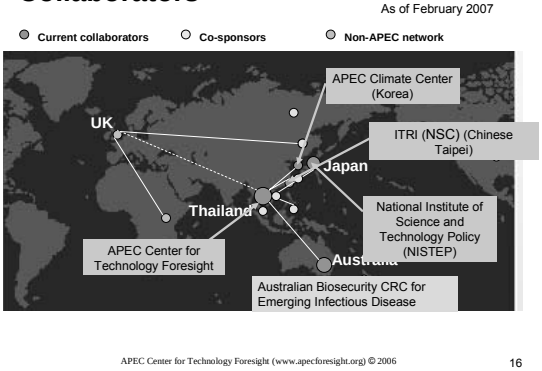
本プロジェクトは、新興・再興感染症（やバイオテロ）に対する中長期的なロードマップを示すことで、アジアを中心とする APEC 地域におけるセキュリティーを保つことを目的とする。

具体的には、新興・再興感染症を防ぐ、または管理するために"converging technology"（コンバージング・テクノロジー、収れん技術）が使えるか否か、その可能性を模索する。すなわち本プロジェクトでは、具体的な感染症対策を論じるのではなく、"converging technology"の効果がどの程度期待できるのか、情報システムの発展で感染症監視体制はどのように高度化していくのか等も論じる。

手法としては、科学技術の発展を"マルチプルフォーサイトツール"（論文分析、シナリオプランニング等）を用いて分析し、これらを基にして新興・再興感染症に対する情報や社会システムを含めた科学技術の中長期的なロードマップを作成するプロジェクトである。



（プロジェクトの全体内容）

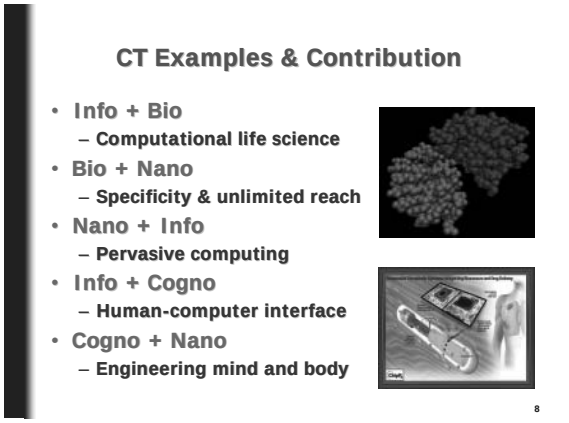


（プロジェクトの実施体制）

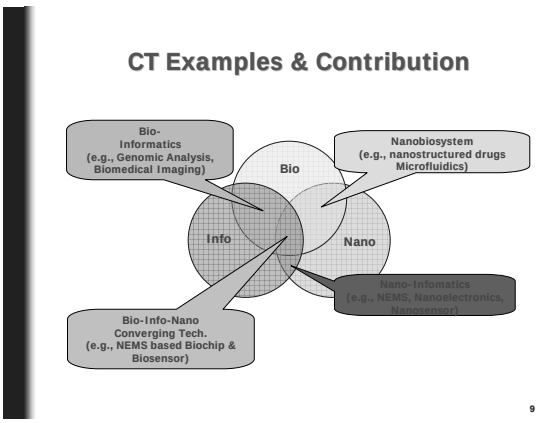
収れん技術(コンバージングテクノロジー):概念と具体例
サテー・プージャルエンチャナチャイ博士(タイ国立電子コンピュータ技術センター)
Converging Technologies: Concept and Examples
Dr. Suthee Phoojaruenchanachai (NECTEC)

次に、プロジェクトのキーテクノロジーである「収れん技術(コンバージング・テクノロジー)」についての概念や例など簡単な解説がされた。

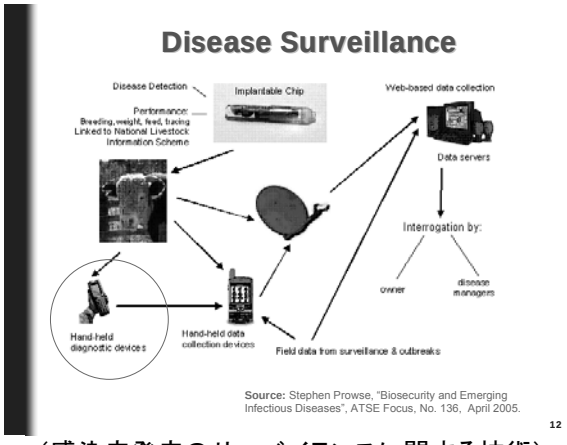
収れん技術は、「enabling technologies(今まで不可能であったことを可能にする技術)であり、共通の目的を追求する際にお互いにそれを可能にさせる knowledge systems(知的システム)である」と概念が説明された。
また、現在の収れん技術は、バイオ、ナノ、IT の境界領域で生じている。バイオ、ナノ、IT の3領域の収れん技術としては、NEMS に基づいたバイオチップやバイオセンサー技術が考えられる。
新興感染症の克服に利用できると考えられる具体的な収れん技術の例として、Flu Chip(罹ったインフルエンザのタイプを識別するチップ)、リアルタイムの感染症発生状況のサーベランス、リモートセンシング等が紹介された。



（収れん技術の例1）



（収れん技術の例2）



（感染症発症のサーベイランスに関する技術）

○Session 1：知識の共有

本ワークショップでは、既に述べたように、異分野の科学技術の境界から生じる「収れん技術のロードマップ」を作成することが目的である。そのため、参加者の内、1/3 が感染症の治療や対策を専門とする者、1/3 が IT 技術を専門にする者、残りの 1/3 がバイオテクノロジー、社会科学、科学技術政策を専門とする者など、参加者の専門性が偏らないようにした。

従って、参加者には感染症や IT に関する共通な知識および現状の把握が必要であると考え、参加者全員で知識を共有するために、Session 1 では 3 つの基調講演を実施した。

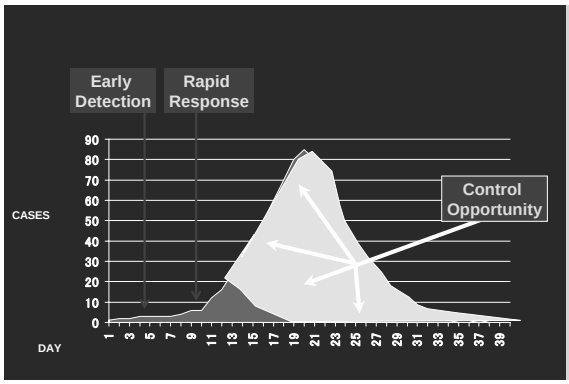
基調講演1： 新興感染症のサーベイランス
岡部信彦博士（国立感染症研究所・感染症情報センター長）
Keynote speech 1: The Surveillances of EID
Dr. Nobuhiko Okabe (Director, Infectious Disease Surveillance Center, National Institute of Infectious Disease)

50 年から 200 年以上前の天然痘やポリオなどの感染症対策と撲滅の歴史から、近年、発生して問題になっている新興感染症（デング熱、HIV、ニパウイルス感染症、SARS、鳥インフルエンザ）および再興感染症（多剤耐性結核、薬剤耐性マラリア）の世界的な発生数などを示し、感染症の世界的な移り変わりの状況が示された。

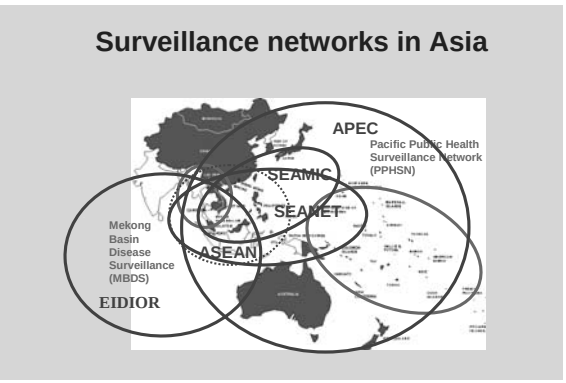
また、日本では感染症を原因とする死亡者数は 50 年以上前と比較すると少なくなっているが、世界では貧困地域を中心に、2001 年では 5 億 3,900 万人が感染症で亡くなっている。しかし、日本の結核発症率は、欧米の 3 倍以上あり、さらに HIV 感染者も年々増加傾向、はしかの集団発生を克服できていない等、感染症にまだ多くの課題が存在することが示された。

さらに、感染症の集団発生は 1998 年から 2003 年の間だけでも、世界中で発生しており、次にどこに発生するのか予測ができないため、感染症の制御は容易ではない。

感染症の制御には、「予防」、「診断」、「治療」、「サーベイランス」が必要であり、中でも「サーベイランス」は重要である。発生の早期に発見できれば、集団発生を制御する機会が増えるからであるという。世界規模の疫病を制御するために必要なことは、(1)強力な国家レベルの公衆衛生システム、(2)重要であると考えられる疾病に対して、診断、治療、ワクチンなどを準備しておく、(3)協調して警戒や応答ができるような有効な国際的なシステムおよびパートナーシップを確立しておくこと、であると発表された。



（サーベイランスによる早期発見が重要）

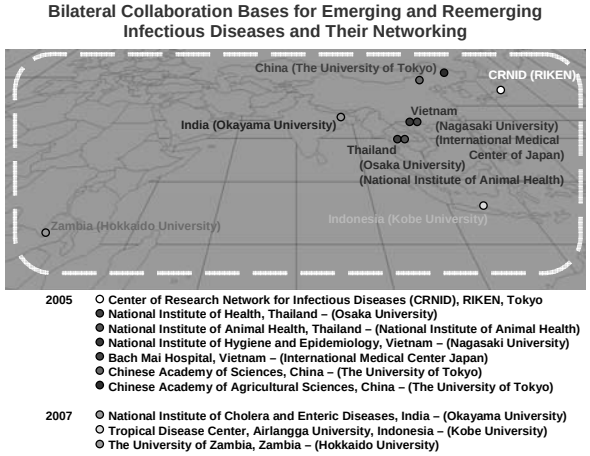


（アジアにおけるサーベイランスネットワーク）

基調講演2： 感染症研究のためのアジア研究ネットワーク:その概念・目的・活動
永井美之博士(理研・感染症研究ネットワーク支援センター長)
岡本仁子博士(理研・感染症研究ネットワーク支援センター)
Keynote speech 2: Asian Research Network for Infectious Disease:
Its Concept, Aims and Activities
Dr. Yoshiyuki Nagai (Director, Center of Research Network for Infectious Disease, RIKEN) & Dr. Yoshiko Okamoto (CRNID, RIKEN)

感染症研究の再興と人材の育成のために、2005 年度より文部科学省の委託事業として理研・感染症ネットワーク支援センターで実施されている「新興・再興感染症研究拠点形成プログラム」の活動について、永井センター長から紹介された。

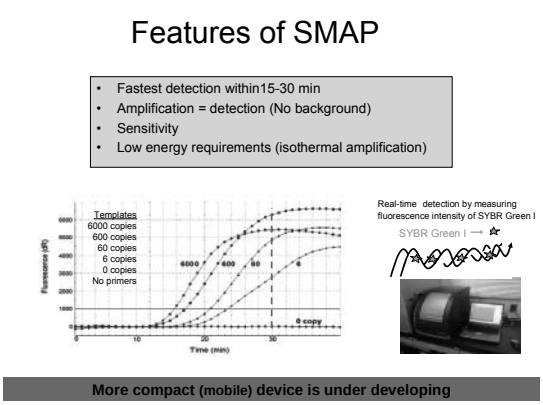
プログラムでは、日本国内の感染症研究拠点としていくつかの研究機関を整備し、新興・再興感染症の発生している、または発生源となり得る国に、連携海外研究拠点設置し、当該国との両方向性の共同研究の実施やパートナーシップを結ぶことを推進している。感染症ネットワーク支援センターは、プログラム全体の支援・運営・協力を実施している。



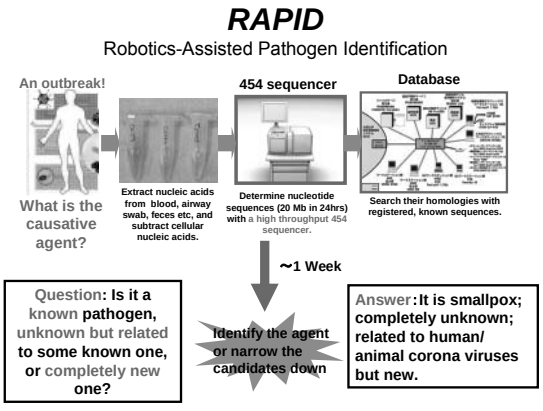
（両方向性の共同研究を基盤とした感染症ネットワーク）

（感染症における日本と中国の共同研究）

また、染色・培養などの感染症の原因を知るための従来技術に、塩基配列決定法などの現代技術を融合(収斂)することにより、感染症の原因(病原体など)をもっと早く精確に検出(診断)することを可能とする、理研で研究開発されている最先端バイオテクノロジー(SMAP, RAPID 等)の原理や応用について、岡本博士から紹介された。



（一塩基置換を迅速に検出できる SMAP）



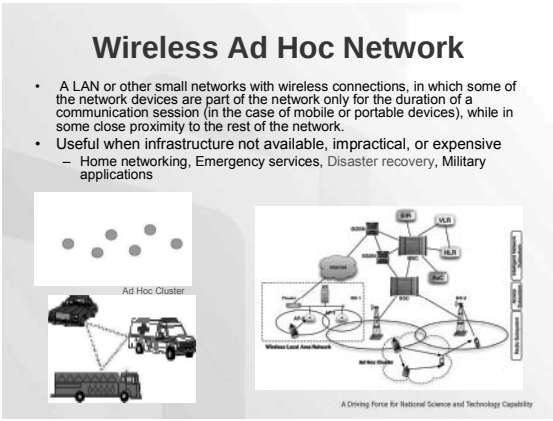
（未知の病原体の同定を可能とする RAPID）

基調講演3： 新興感染症の共同研究に有力な情報コンピュータ技術基盤
チャレルンポル・チャルンスリピニョ博士（タイ国立電子コンピュータ技術センター）
Keynote speech 3: Potential ICT Infrastructure for EID Research Collaboration
Dr. Chalermpol Charnsripinyo (NECTEC)

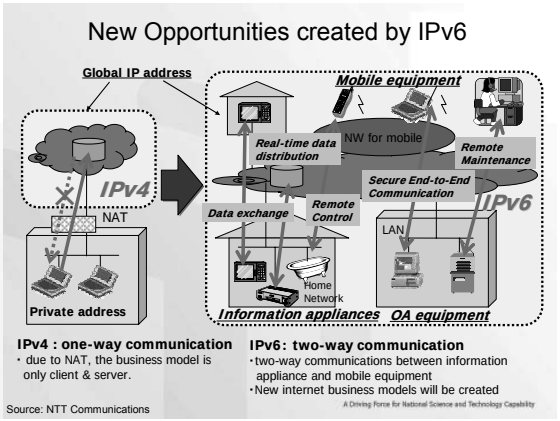
情報コンピュータ技術(ICT)における新技術(emerging technologies)、および共同研究の実施に有力なICTインフラが紹介され、これらは新興感染症の克服に重要であると述べられた。

新技術の中では、特に、現在のIPv4に代わる次世代インターネットプロトコルである「IPv6」、電波などを用いて個々の物品の追跡や同定をする「RFID」、ネットワークを介して複数のコンピュータを繋いで仮想的に高性能コンピュータをつくる「Grid Computing」について詳しく紹介された。また、携帯電話などのワイヤレス接続のネットワークが、将来的に、災害等でインフラ基盤が利用できない時の有効なネットワークとして活用できるようになると述べられた。

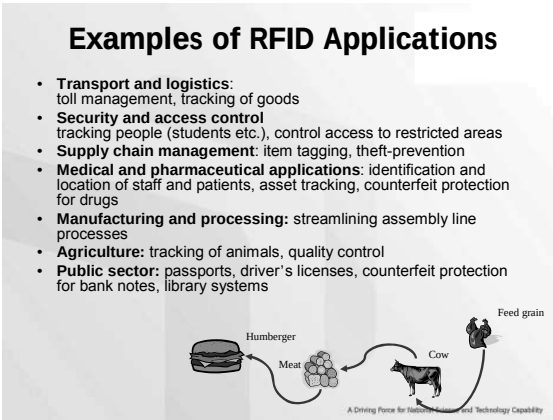
さらに、ICTと新技術を用いた新興感染症対策プロジェクトのリストを示した：感染症の前兆をサーベイするシステムである「BipSense（米国感染症制御予防センター）」および「Electronic Surveillance System for the Early Notification of Community-based Epidemics（米国国防総省）」、食物由来の感染症をサーベイするシステムである「Foodborne Disease Active Surveillance Network（米国感染症制御予防センター、米国農務省、FDA 等）など、12 のネットワークシステムが紹介された。



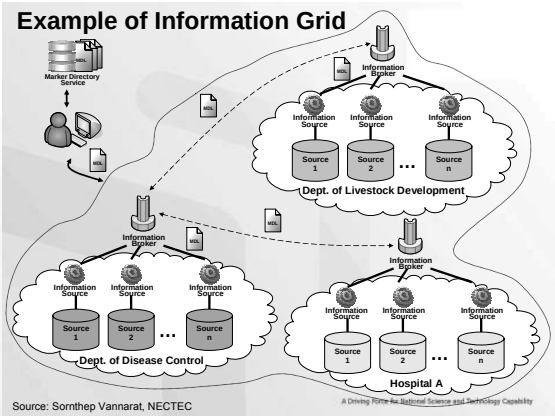
（携帯電話によるワイヤレス・ネットワーク）



（二方向性のコミュニケーションを可能とする IPv6）



（RFID の応用例）



（情報共有構造としての Information Grid の例）

○Session 2:シナリオワークショップの成果＆グループワーク1

科学技術政策研究所とタイ APEC 技術予測センターは、2006 年の前半までに、それぞれの手法で感染症に関するビブリオメトリクス分析を実施し、その結果について意見交換を行った。その後、タイは双方の結果を統合して、これを基に、感染症克服に効果的と想定される先端技術の抽出を目的としたウェブアンケート調査を設計し、2006 年 11 月～2007 年 1 月までタイ APEC 技術予測センターのホームページ上でアンケート調査が実施された(回答数 21)。

2007 年 2 月には、タイにおいてシナリオワークショップが開催された。上記の分析やアンケート調査結果を出発点として、参加者全員で今後 10 年間の感染症とその克服技術の発展および予想される効果などに関する複数のシナリオを考えた。

今回のテクノロジーロードマップワークショップでは、シナリオワークショップでの成果を出発点として、新興感染症の克服に有効な“技術”に焦点を絞り、これらの技術のロードマップを作成した。

大部分の参加者は前回のタイのワークショップに参加していなかったため、ナレス博士から前回のワークショップの概要と成果が簡単に報告された。

シナリオワークショップにおける成果
ナレス・ダムロンチャイ博士(タイ APEC 技術予測センター長)
Recap from the Scenario Workshop
Dr.Nares Damrongchai (APEC CTF)

2 月にタイで開催されたシナリオワークショップでは、参加者は 4 グループに分かれて、新興感染症のリスクに影響を与える"Drivers (driving factors)" (要因)を Social, Technological, Economical, Environmental, Political の項目ごとに検討し、さらに、災害などの Uncertainties(不確定)な要因についても検討することによって、感染症の対策への認識を共有した。

シナリオは、アジア太平洋地域の将来のシナリオとして、グループごとに作成され、「どのように(な)収斂技術を用いて、アジア太平洋地域の新興感染症を克服するか？」が主題にされた。結果として、4 つのシナリオが作成された:「地球温暖化の影響で新型のマラリアがマイアミで出現して大流行するシナリオ」、「食用の遺伝子改変アヒルから未知のウイルス性疾患が出現し大流行するシナリオ」、「未知のジュラシックウイルスの大流行のシナリオ」、「新興感染症である Rain Forest シンドロームが克服されたシナリオ」。

さらに、完成したシナリオから、技術要素を抽出して分類し、「ユビキタス」、「治療」、「診断」の 3 つの研究領域の技術が、新興感染症対策において重要な技術であるという結果が得られた。

（新興感染症のリスクを増大させる要因1）

（新興感染症のリスクを増大させる要因2）

グループワーク1（ニーズの抽出とその解決）
Exercises 1

本ワークショップでは、前回のシナリオワークショップにおいて抽出された、「ユビキタス(Ubiquitous)」、「治療(Treatment)」、「診断(Diagnosis)」の 3 領域における技術のロードマップを作成するために、3 回のグループワーク(Exercise)を実施した。

参加者を「ユビキタス」、「治療」、「診断」を検討対象とする 3 つのグループに分け、各グループにおいてブレインストーミングを行った。1 グループの人数は 13 名程度で、その内 2 名程度をファシリテイターとした。ファシリテイターの役割は、グループ員の発言を促すこと、議論の方向性を調整すること、発言の記録および結果をまとめること等、である。

Research domain	Technology applications
Ubiquitous	◆Field tests networked ◆Data collection (real time) ◆Data mining ◆Mobile phone tracking ◆Data sharing ◆Modeling ◆Bioinformatics ◆Network info system countries sign up for info sharing
Treatment	◆Drug design ◆Drug Delivery Systems ◆Vaccine development ◆Personalized medicine advance in pharmaceutics ◆Nano delivery of drugs ◆Molecular medicine, Cell-based vaccine development advance in genetic engineering of virus and antiviral material ◆Conventional Drug Discovery
Diagnosis	◆Micro/Nano array molecular ◆Implantable diagnostics ◆Simple thermo-graphical scanner ◆Genotyping characterization ◆Advance in micro-fluidic device ◆Advance in genetic sequencing ◆Advance in lab on a chip

（シナリオワークショップで作成されたシナリオから抽出された研究領域と技術）

グループワークの目的は、テクノロジーロードマップの作成であるので、予め、作成フォーマットを参加者全員に提示し、各自、空欄を埋めるイメージを持って検討作業を実施して貰うようにした。

フォーマットの横軸は時間を意味する。現在（2007 年）から最短 5 年後、最長 15 年後までの将来の状況を検討した。

まず、グループワーク 1 では、グループごとに、新興感染症に対する「ユーザーのニーズ(User's Requirement)」の項目を抽出し、次いで「そのニーズを解決すること：製品およびサービス(Solutions: Products & Services)」を検討した。

Technology Roadmap Template

Research domain ( )	T: 5 years – 15 years T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

（テクノロジーロードマップ作成のフォーマット）

グループワーク(Exercises)の様子(1)

・ グループごとに机をロの字型に並べて討論する
・ ホワイトボードには、予めロードマップのテンプレートの必要部分を貼っておく
・ ファシリテイター（立ち上がっている人）は議論を誘導する
・ 個人の意見は、“付箋”に簡潔にまとめ、ファシリテイターに渡す
・ ファシリテイターは発言内容を分類し、テンプレートの適切な場所に付箋を置く
・ 類似した内容が書かれた付箋は近くに置く
・ 分類が適切かどうかについてグループメンバーの意見を求める
・ メンバーの意見等で付箋の置く位置を変える
・ ファシリテイターは全てのメンバーが発言できるように気を配る

グループワーク(Exercises)の様子(2)

2 日目(5 月 23 日)

○Session 3:戦略的テクノロジーロードマップの解説＆グループワーク 2

既に 1 日目のグループワーク 1 で、ニーズ項目の検討および抽出などの作業に着手しており、テクノロジーロードマップ作成未経験の参加者においても、テクノロジーロードマップ作成について「ぼんやりとしたイメージは出来た」と考えられた。

そこで、さらに、参加者にテクノロジーロードマップに関する高度な知識を与えるために、教授の亀岡先生(北陸先端科学技術大学院大学)からは、戦略的テクノロジーロードマップの作成理論について、香月先生(立命館大学)からは、テクノロジーロードマップ作成の具体的な事例についての発表がされた。

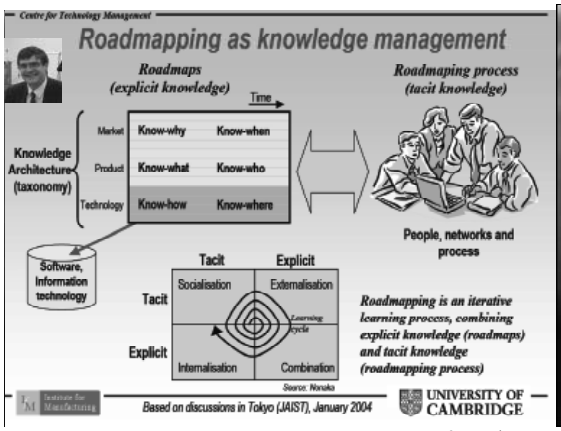
また、当初は予定に無かった発表であるが、ジャック・スミス氏(カナダ政府、科学技術予測室長)の要望により、カナダで検討された「2020 年の収斂技術」についての紹介も行われた。

戦略的テクノロジーロードマッピング
亀岡秋男教授(北陸先端科学技術大学院大学)
Strategic Technology Roadmapping
Prof. Akio Kameoka (Japan Advanced Institute of Science and Technology)

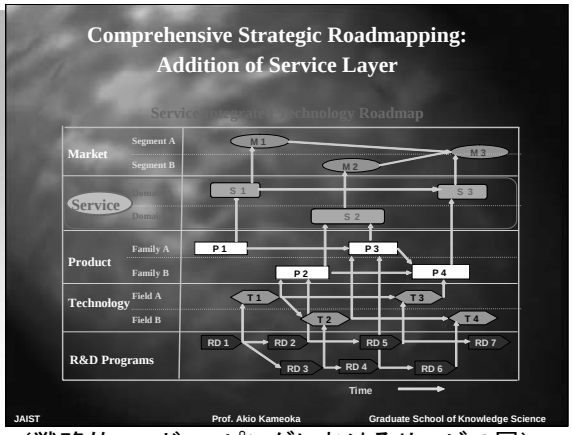
ロードマッピングは、明示的な知識(ロードマップ作成)と暗示的な知識(ロードマップ作成過程における人との対話やネットワーク)を融合する相互作用的な学習プロセスであり、知識マネジメントのツールである。従って、作成したロードマップは固定(作業工程表)ではなく、何度でも修正したり変更したりして、アイデアを明確にするために利用される。

一般的なテクノロジーロードマップでは、市場(Market)、製品(Product)、技術(Technology)、R&D プログラムの層が縦列し、横軸が時間を示す。それぞれの層における項目は、互いに関連性を持ち、その関係は矢印で示される。次世代の技術経営(MOT)では、戦略的テクノロジーロードマップにおいて、これらの層に加えて、“個人や組織が目的を達成することを助ける活動”と定義される「サービス(Services)」の層を市場と製品の層の間に入れる方向に進んでいる。

サービスは、製品を通じてもたらされる技術的サポート機能と同様に、物質的サポート機能、心理的サポート機能、知的サポート機能、スピリチュアル(宗教的)サポート機能を含み、既存の製品やシステムにより洗練したサービス機能を付加することで、消費者の満足感を改善し、その製品やシステムに高い価値を与えると考えられる。従って、「市場とサービス」、「サービスと製品」の層の間のギャップを埋めるために、「必要な機能」と「供給される機能」という新しい機能の概念を含めたサービスを融合したテクノロジーロードマップを提唱する。



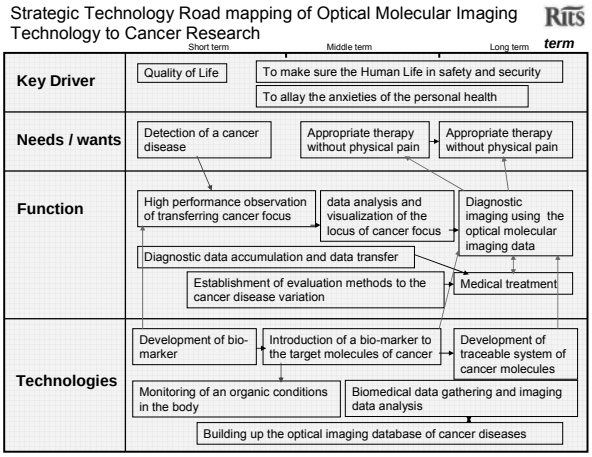
（知識マネジメントとしてのロードマッピング）



（戦略的ロードマッピングにおけるサービス層）

テクノロジーロードマップの事例：光学分子イメージング技術
香月祥太郎教授（立命館大学）
A Case of Technology Roadmapping: Optical Molecular Imaging Technology
Prof. Shotaro Kohtsuki (Ritsumeikan University)

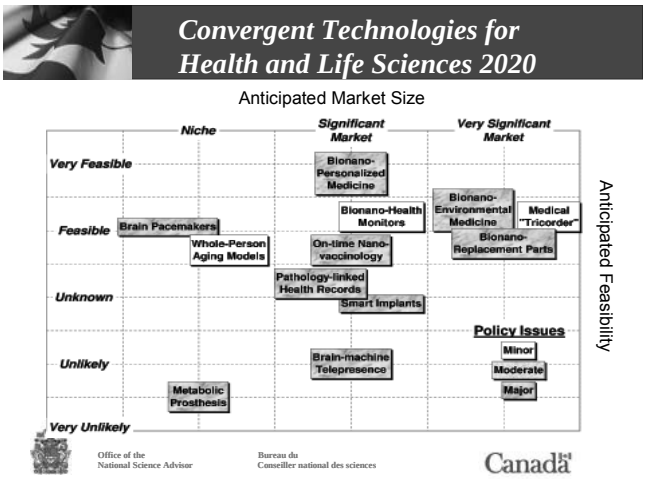
テクノロジーロードマップ作成の具体例として、光学的手法を用いて、早期癌の細胞を非侵襲で検出することを可能とする分子イメージング技術のテクノロジーロードマップが紹介された。



（光学分子イメージング技術のロードマッピング）

（追加）
2020 年の収れん技術
ジャック・スミス氏（カナダ政府、科学技術予測室長）
Converging Technologies
Jack Smith (S&T Foresight, Office of the National Science Advisor, Canada)

健康・ライフサイエンス分野における 2020 年に期待される収れん技術が挙げられた。横軸は市場規模で、縦軸は実現性であり、政策的な課題の大中小については色分けで示された。



（2020 年の健康・ライフサイエンス分野の収れん技術）

グループワーク 2
（ニーズを解決する項目とそれに対応する技術の抽出）
Exercises 2

グループワーク 2 では、グループワーク 1 の続きとして、「ニーズを解決すること：製品およびサービス(Solutions: Products & Services)」の検討を行い、さらにそれに対応する「技術応用(Technology application)」についての検討を行った。ここでは具体的な技術の名称を抽出した。

Technology Roadmap Template

Research domain ( )	T: 5 years – 15 years T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

（テクノロジーロードマップ作成のフォーマット）

○Session 4：グループワーク 3

グループワーク 3
（技術の確立における技術、社会、経済、政策上の問題やギャップの抽出）
Exercises 3

グループワーク 3 では、グループワーク 2 で示した技術についての「チャレンジ（技術的要因、社会的要因、経済的要因、政治的要因）」の項目を検討した。ここには、技術の実現に関するギャップやブレークスルーの必要性、技術の社会への適用や普及に関する障害や遅延などの問題等の検討が含まれる。さらに「APEC 域内での協力内容や協力体制」について検討した。

Technology Roadmap Template

Research domain ( )	T: 5 years – 15 years T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

（テクノロジーロードマップ作成のフォーマット）

作成されたテクノロジーロードマップ

【グループ1：ユビキタス】

Group1: Ubiquitous	5 yr	10 yr	15 yr
User's Requirements	•Information of EID •Fast detection of EID •EID preventing network system in Asia •IT for preventing social panic •Bio-terrorist alert system	•LAMP diagnostic equipment urgently needed for developing countries •Real Time (network spread) dynamics/contact maps/GIS •Animal protection •Border/airport health security arrival gate •Real time RFID Health monitoring •Analysis of long-time series land cover satellite data	•Forecast of possible pr (Forecasting model) •Smart dust (tracking pe worker
Solutions	•RFID-mediated monitoring of animals •Global sensing from space (climate) •Use of network and Grid technologies for voluminous data •Distributed data processing •Development of More robust regional climate model •Review of long-term climatic data/global data •Detection of climate oscillation and superimpose with vector population	•Study on vector pattern migration •Study for tagging/marking EID vector •Construct reliable information network •Diagnosis kit development (reasonable price) For poor country •Traditional herbs could be developed to help poor people in remote areas •Development open access database •Easy and simple system that farmer and pig breeder can use	•Build ICT infrastructu APEC economy •Research about mod process •Disposable system fo contaminate/infected
Technology Application	•RFID tagging to wild animals •Wiki-google-office-like workspace tools for EID KM •Very Small Aperture Terminal (VSAT) for communication •3G technologies for diagnosis/reporting •Regional spatial database for EID applications •Emergency Call System before going to Hospital	•EID traceability system with ubiquitous device •Micro RFID markers tagging for wild birds migration pattern •Grid computing / networked connected distributed computing •Disease outbreak early warning modeling •Pod-casting resource on reliable network – push web •Integration alert systems to detect emerging disease (for airport) = smart LAMP and sensor	•ID tag with electronic p purpose •Telemetry/sensor enha phone •Context aware KM tec (Knowledge engineerin human behavior)) •Emergency Social con (monitoring peoples mo provide suitable sugges

Group1: Ubiquitous

Challenges		
	Science and Technology factor	**•Tele-presence •Practical (and portable) tools (for detection/reporting/diagnostic) to fields/rural areas •Information Standards/protocol and sharing technology •Smart dynamic Reactive → Predicting model (for impact/possible hotspot/ •Fast mutation of disease → basic research**
	Social factor	•Educating/dissemination/communication to all levels: children/public/train the trainer/local volunteer/officer/community leader •Resistance nature (of human) to new things (system/drug/process)
	Economic factor	•Rich-poor gap •$$$ (to invest) •Assessment model (in term of $$$) •$$$ (to subsidize)
	Policy factor	•Compliance of member economies •Info Standard & sharing policy •Open source •Neutral APEC center/company (drugs/testing/services) •Controlling law/policy during outbreak/disaster event •Rich-poor gap (between nation) – conflict of interest/IPR •Expansion / strengthening international ICT Infrastructure

【グループ 2:治療】

Group2: Treatments

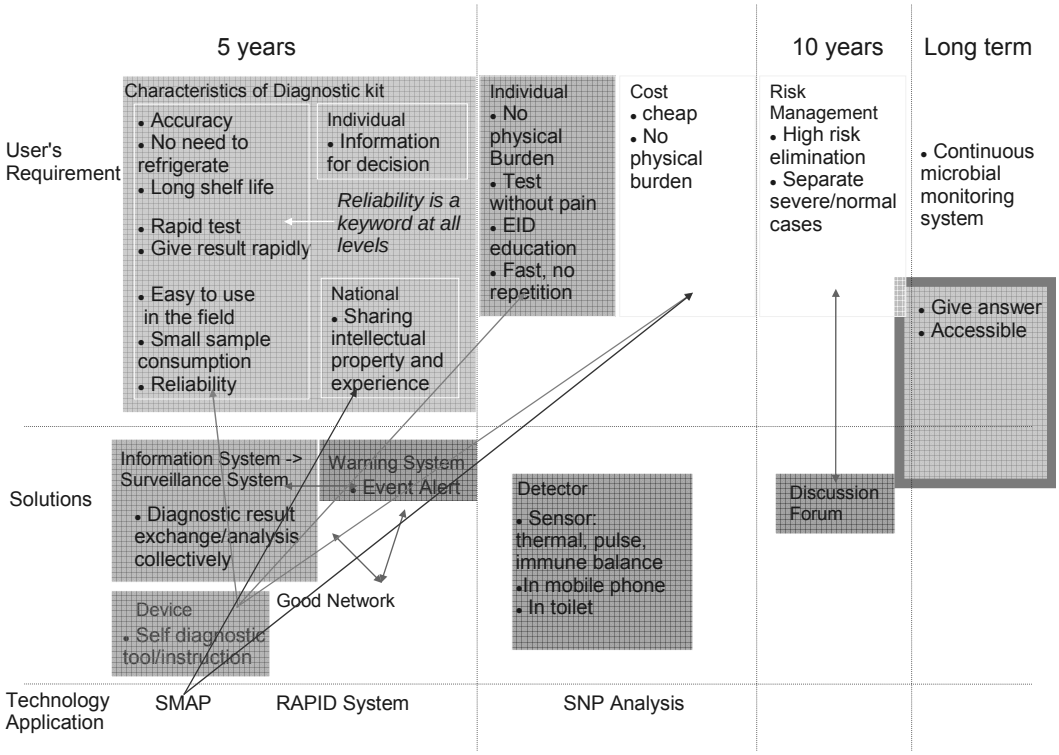
	5 yr	10 yr	15 yr
User's requirements	**Improvement of existing drug/vaccine to reduce side effect and provide proper treatment**	**Development of effective and safe drugs**	**Development for stable, long lasting, safe and affordable drugs**
Solutions	S.11 Find the new adjuvants that can reduce side effects S.12 Purify all the ineffective component S.13: Implement QC&QA for production control S.14: Develop a post-marketing monitoring system for detecting side effects	**Use of new drug ingredients** S.21: Exploration of new changing targets for EID treatment; Infected pathogen, Infected human cell and Host immunology S.22: Search for new alternative ingredient such as plant extraction, along with development screening library **Apply the new process** S.23: New Testing Process: The best/rapid way to characterize new pathogen In silico experiment to improved existing drugs, In vitro testing and Animal model, In vivo Human immune response system testing	•S.31: Personalized drug •S.32: GM drug & vaccine •S.33: Molecular modelling •S.34: Bio-model simulation •S.35: Reliable production
Technology Applications	S.11 Tech. for detect drug resistance S.11 Sensors that detect physiological effect of the patients S.11 Pharmacogenomics (Bioinformatics) S.12 Drug delivery system S.12 Biosensors S.12 Small scale filter S.12 Micro pore size S.12 Ventilation system S.12 Material sciences S.12 High speed & safety production system S.12 Automatics production S.13 Detect immune response for adjuvant effect S.13 Smart separator (rapid separator that can rapidly eliminate unwanted containment) Immunological tech. that can activate drug effect	S.21 3D design of Crystallography S.21 Proteomics S.21 Cell-based High throughput screening active compound S.21 Computer- assisted design for new ingredient searching (super computer/ high speed/automatic) S. 23 New testing process S. 23 New animal model testing	S 31 Tailor-made vaccine S 32 Recombinant vaccine S 32 Room temp. vaccine tech. S 32 Multivalent vaccine S 32 DNA vaccine S 35 GM animal model

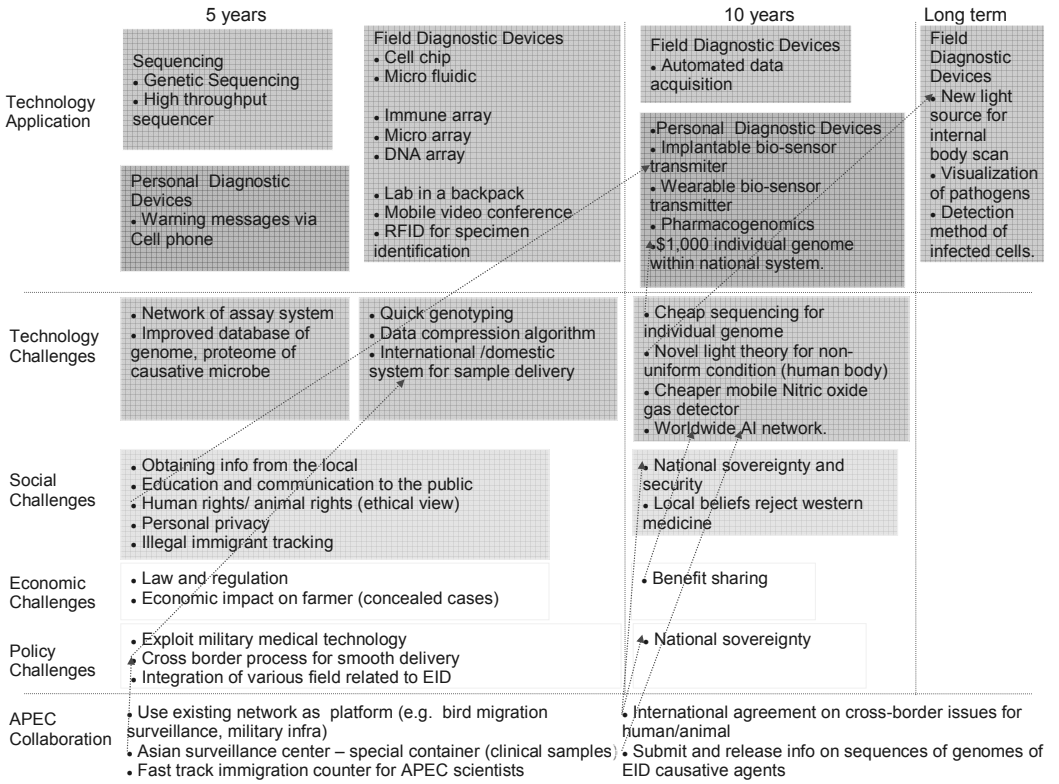
Group2: Treatments

Challenges	Technology factors	High performance computing system New tech for evaluation system Transportation (Material transfer) Efficient professional Development of new material for filter Limited interface among engineer, biologist and etc.	Need a lot of collaboration Difficulty to detection & identifying for new pathogen Prepare public to be aware of unknown future Advance algorithm Specific system to identify pathogen (virus/bacteria/fun gi (super system) Sharing tech. among APEC economics Insufficient of knowledge in host factor	Ability to evaluate the safety impact ON Environmental and animal aspect Eradicating system for important diseases
	Social factors	Information sharing among experts Personal info. Accession Training & Education Ethical issue Public awareness	Ethical issue Public education in GMO	Educate people for GM materials
	Economic factors	Financial support from government Sufficient incentive to industries (as some of them start shifing their interest to develop medicine for curing life style diseases)	Market need for drug/vaccine	
	Policy factors	Enforcement of GMP Patent protection Restructure trading regulation to support the exchange material and specimens across the border Commitment from the policy maker	Public education in GMO	
Collaboration & Collaborators		Sharing information, Research collaborations, Standardization, Harmonization, Universal Pandemic preparedness		

【グループ 3:診断】

Group 3: Diagnosis





○Session 5：作成したテクノロジーロードマップの評価と次回のアナウンス

テクノロジーロードマップの評価
Evaluation of TRMs

作成したテクノロジーロードマップを基に、参加者の国の APEC 域における感染症対策に対する期待される貢献、および将来的な APEC 域での協力関係などについて意見交換を実施した

共通した意見としては、「感染症対策は APEC 域において重要な課題であり、国内においても同様に重要な課題であるので、国として何らかの貢献ができる」、「APEC 域での協力体制を強化したい（して貰いたい）」、「今後も感染症に関する同様なワークショップなどの集まりを継続して開催して貰いたい」などであった。

また、「新興感染症だけではなく、通常の感染症の対策も重要である」、「現実に問題になっている感染症（トリインフルエンザなど）に対する戦略的なテクノロジーロードマップを作成すべき」、「最先端技術だけに注目するのではなく、従来技術の転用や改善などにも焦点をあてるべき」、「発展途上国における問題を考慮したテクノロジーロードマップが必要」などの意見が示された。

セッション座長の亀岡教授の進行により討論が進められた

参加者の発表

第 2 回テクノロジーロードマップワークショップ（台湾）の開催案内
イーヨー・ファン博士（国立台湾大学教授）
The 2nd Technology Roadmapping Workshop in Chinese Taipei
Dr. Yi-You Huang (National Taiwan University)

次回、台湾で 10 月開催予定の第 2 回テクノロジーワークショップについて、ファン博士からアナウンスがされた。ワークショップのテーマや詳細な内容については未定である。

The 2nd technology roadmapping workshop in Taipei

Main Theme

The Converging Technologies to Combat Emerging Infectious Disease (EID): Technology Roadmap Workshop

Program

- **Opening Remark**: Minster of National Science Council
  Chien-Jen Chen Sc.D., 陳建仁 主委
  Also an Expert of Epidemiology, Hygiene and Public Health

- **Opening Remark**: Minster of Department of Hea
  Sheng-Mou Hou MD PhD 侯勝茂 署長

- **Keynote speech**: Director of Dept Intl Cooperation, NSC 林光隆處長

Summary

This Research Material is a report on the "Roadmapping Converging Technologies to Combat Emerging Infectious Diseases" workshop held by the National Institute of Science and Technology Policy on May 22 and 23, 2007, at the Toshi Center Hotel. This workshop was sponsored jointly with Thailand's APEC Center for Technology Foresight and National Electronics and Computer Technology Center (NECTEC), and with the cooperation of GATIC Japan.

In recent years, severe acute respiratory syndrome (SARS) and highly-pathogenic avian influenza have appeared in succession, centered in Asia. Under these circumstances, use of technology foresight methods to study the direction of science and technology and technical development that can make it possible to combat emerging infectious diseases has become very important.

As a co-proposal with the APEC Center for Technology Foresight Thailand, the National Institute of Science and Technology Policy is carrying out the "Roadmap of Converging Technologies to Combat Emerging Infectious Diseases" project adopted by the APEC Industrial Science and Technology Working Group over two years beginning in 2006. The holding of this workshop is one of the activities of the project.

Three workshops are planned for the project. The first, the scenario creation workshop, was already held in Thailand in February 2007. This workshop, the first technology roadmap workshop, is the second. The third, the second technology roadmap workshop, is to be held in October 2007 in Taiwan.

The purposes of the workshop were to use "converging technology," which is "technology that merges two or more different technologies or disciplines for a common goal," to create a medium- and long-term strategic technology roadmap for technology to prevent or control（quickly suppress outbreaks, etc.）emerging infectious diseases. In particular, this workshop targeted converging technology in integrated domains of "bio," "nano," and "IT," which are state-of-the-art science and technology today.

At the scenario creation workshop held in Thailand in February 2007, "ubiquitous," "treatment technology," and "diagnosis technology（detection technology）" were seen as the important science and technology areas that are keys to combating emerging infectious diseases. Furthermore, these areas were considered converging technology in themselves, or areas that include converging technology.

This workshop attempted to create 5- to 15-year technology roadmaps for these three technologies.

On the day of the workshop, 42 experts (19 from outside Japan) with backgrounds in infectious diseases, IT, and science and technology policy gathered from nine APEC countries, including Japan, Thailand, Canada, Indonesia, and Taiwan.

Following Director General Kuniya's greeting, first, Nares Damrongchai, Executive Director of the APEC Center for Technology Foresight Thailand gave an overview of the entire project. Subsequently, Science and Technology Foresight Center Senior Researcher Yuko Ito described the workshop's program.

To provide participants with the shared knowledge and awareness necessary for roadmap creation, Nobuhiko Okabe, Director of the Infectious Diseases Surveillance Center, National Institute of Infectious Disease, spoke on the "Status and surveillance of infectious diseases in Japan and the world." Yoshiyuki Nagai, Director of the Center of Research Network for Infectious Diseases, RIKEN, and Yoshiko Okamoto of the Center's Information Section presented on "The Asian Research Network for Infectious Disease and early diagnosis technology for infectious diseases." In addition, Chalermpol Charnsripinyo of Thailand's NECTEC described "State-of-the-art IT technology," while NECTEC's Suthee Phoojaruenchanachai discussed "What is converging technology?" Participants further heard from Professor Akio Kameoka of the Japan Advanced Institute of Science and Technology on "Theory of strategic technology roadmap creation" and Professor Shotaro Kohtsuki of Ritsumeikan University on "A case of technology roadmapping ".

Creation of the technology roadmaps was carried out as groups divided according to the abovementioned science and technology areas (ubiquitous, treatment technology, diagnosis technology). As result, the workshop created three technology roadmaps.

Through this roadmap creation, active discussions were held on technical cooperation and the proper form of joint research with each country. Participants became aware of the need for stronger cooperation in the APEC region on combating infectious diseases.

Overview of Workshop

＊This workshop was organized and sponsored by NISTEP, Ministry Education, Culture, Science and Technology (MEXT), Japan, and APEC Center for Technology Foresight and National Electronics and Computer Technology Center (NECTEC), National Science and Development Agency (NASDA), Thailand

Participants of the Workshop

Overview of Workshop

Day 1 (May 22)

○Introduction

Introduction of "Roadmapping Converging Technologies to Combat Emerging Infectious Diseases (EID)," the APEC-wide project and the progress and activities Dr. Nares Damrongchai (Executive director, APEC CTF)

The workshop is a part of the activities of the APEC Industrial Science and Technology Working Group project "Roadmap of Converging Technologies to Combat Emerging Infectious Diseases," a joint proposal of the APEC Center for Technology Foresight Thailand and the National Institute of Science and Technology Policy being carried out over two years starting in 2006.

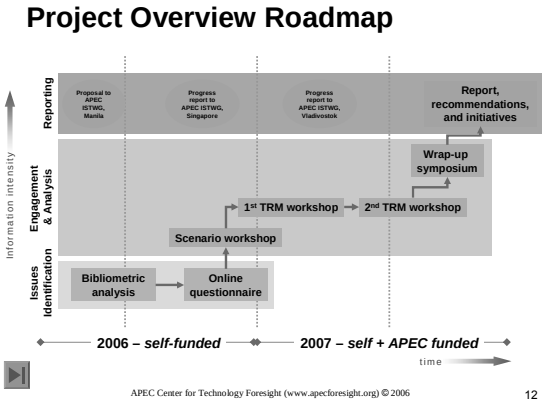
Most of the participants in the workshop were unaware of the details of the project, so the first step was to give them an overview of the whole thing.

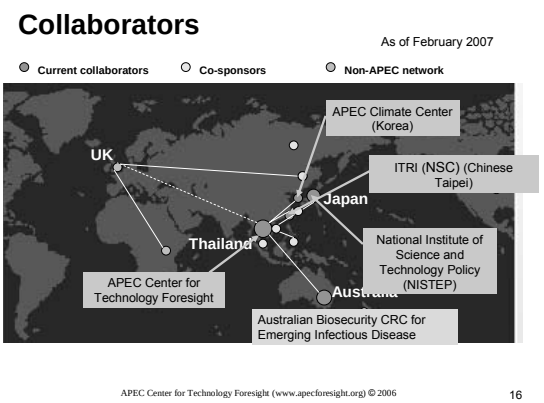
During the past 10 years, many emerging and reemerging infectious diseases have appeared all over the world. In the Asia-Pacific region in particular, SARS and highly-pathogenic avian influenza have appeared with severe symptoms.

The goal of this project is to maintain the security of the APEC region, especially Asia, by showing a medium- and long-term roadmap against emerging and reemerging infectious diseases (and bioterrorism).

In concrete terms, it explores whether "converging technology" can be used to prevent and manage emerging and reemerging infectious diseases. In other words, rather than discussing concrete measures against infectious diseases, this project discusses subjects on how much can be expected from "converging technology" and how the infectious diseases surveillance system will advance with the development of information systems.

The methods are analysis of science and technology development using "multiple foresight tools" (bibliometric analysis, scenario planning, etc.) and the creation of a medium- and long-term roadmap on science and technology including information and social systems to combat emerging and reemerging infectious diseases.



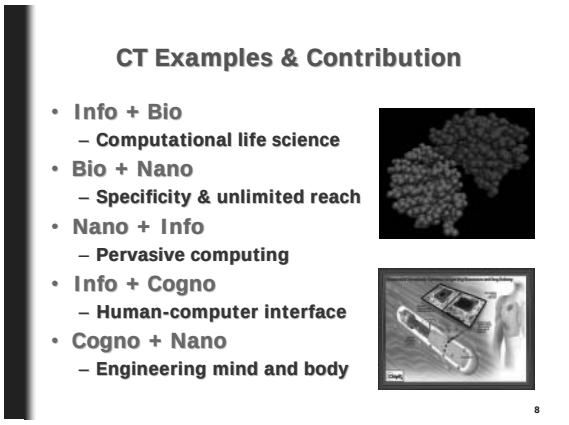


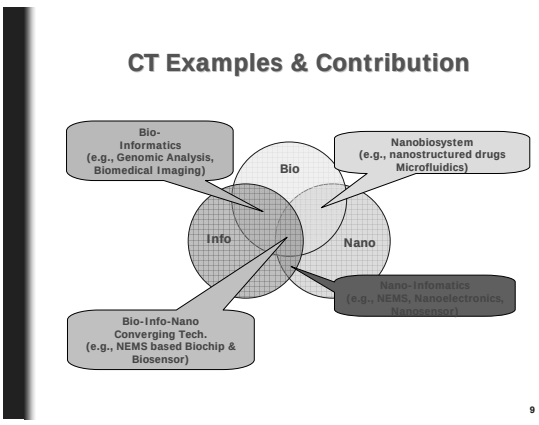
Converging Technologies: Concept and Examples
Dr. Suthee Phoojaruenchanachai (NECTEC)

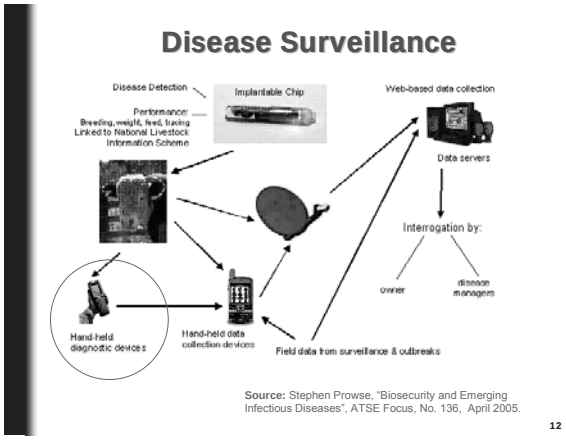
Next, there was a brief explanation of the concept and some examples of the project's key technology, "converging technology."

The concept of converging technology was explained as "enabling technologies (technologies that make possible things that were previously impossible) and knowledge systems that make them possible each other when pursuing shared goals."
Furthermore, today's converging technology is occurring in the interdisciplinary fields of bio, nano, and IT. Converging technology in the fields of bio, nano, and IT includes biochip and biosensor technology based on NEMS.

The Flu Chip (a chip used to determine the type of influenza a person has suffered), real-time surveillance of infectious disease outbreaks, and remote sensing were discussed as concrete examples of converging technology that can be used to combat emerging infectious diseases.







○Session 1: Sharing Knowledge

As discussed above, the purpose of the workshop was to create a "converging technology roadmap" generated from the boundaries between different science and technology fields. Participants were therefore selected so that one-third were specialists in infectious disease treatment, one-third in IT, and the remaining third in biotechnology, social sciences, science and technology policy, and so on. This was so that expertise would be balanced.

Therefore, because shared knowledge of infectious diseases and IT and understanding of current conditions were considered necessary for participants, three keynote addresses were delivered to all participants in Session 1.

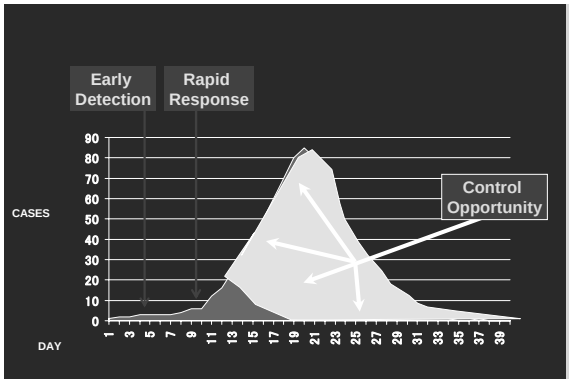
Keynote speech 1: The Surveillances of EID Dr. Nobuhiko Okabe (Director, Infectious Disease Surveillance Center, National Institute of Infectious Disease)

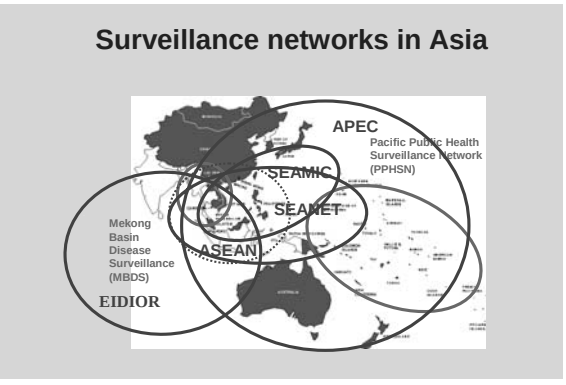
The worldwide changeability of infectious diseases was described, from the history of measures against infectious diseases such as smallpox and polio 50 to 200 years ago and their extermination, to the appearance in recent years of emerging infectious diseases (dengue fever, HIV, Nipah virus infectious diseases, SARS, avian influenza) and reemerging infectious diseases (multidrug-resistant tuberculosis, drug-resistant malaria) around the world.

Furthermore, although in Japan the number of people who die from infectious diseases is lower than it was 50 or more years ago, the number of people who died of infectious diseases in poverty areas of the world numbered 539 million in 2001. However, the tuberculosis rate in Japan is more than three times that in Europe and the United States of America, the number of HIV-positive patients is increasing annually, and mass outbreaks of measles still occur. This indicates that Japan still has many issues with infectious diseases.

In addition, during 1998 through 2003 alone, mass outbreaks of infectious diseases occurred all over the world. Because it is impossible to predict where the next will occur, control of infectious diseases is not easy.

Control of infectious diseases requires "prevention," "diagnosis," "treatment," and "surveillance." Among these, "surveillance" is vital. This is because when outbreaks are detected at an early stage, the chances of controlling mass outbreaks increase. In order to control worldwide epidemics, the following were described as necessary: 1) a strong public health system at the national level, 2) preparation for diagnosis, treatment, and vaccination against diseases considered important, 3) establishment of an effective international system and partnerships that can cooperate on alerts and responses.

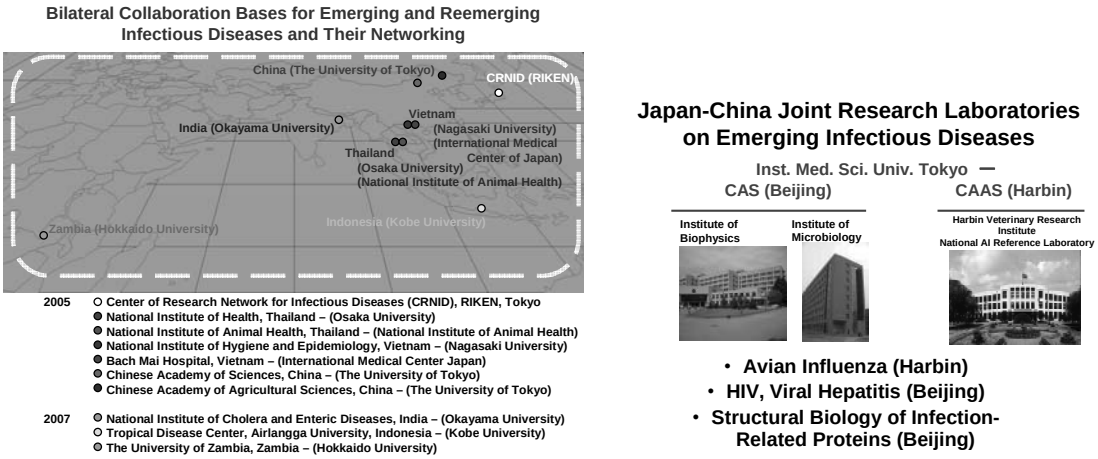




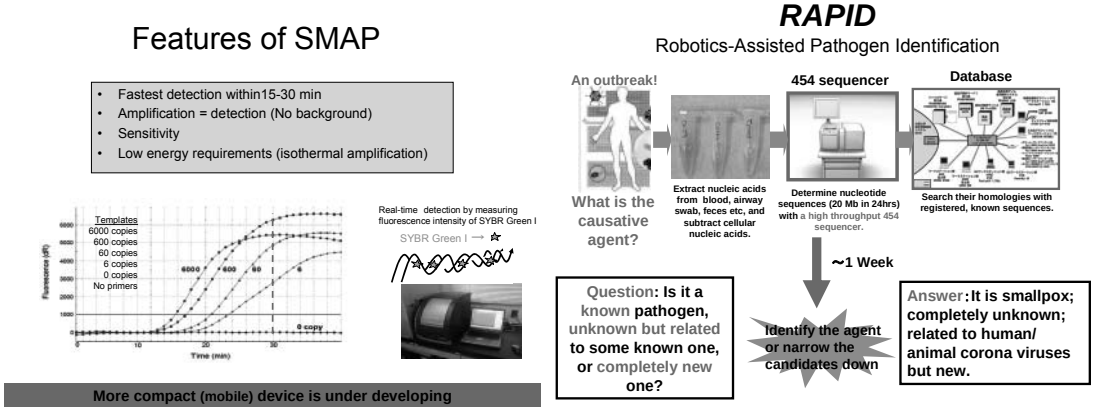
Keynote speech 2: Asian Research Network for Infectious Disease:
Its Concept, Aims and Activities
Dr. Yoshiyuki Nagai (Director, Center of Research Network for Infectious Disease, RIKEN) & Dr. Yoshiko Okamoto (CRNID, RIKEN)

Director Nagai of RIKEN's Center of Research Network for Infectious Disease introduced the Center's "Program of Founding Research Centers for Emerging and Reemerging Infectious Diseases," which was commissioned by the Ministry of Education, Culture, Sports, Science and Technology in 2005 in order to revive research on infectious diseases and develop human resources.

This program establishes research institutions as infectious disease research centers in Japan and collaborative research centers in countries where there are emerging or reemerging infectious diseases or where they are likely to occur. It promotes two-way joint research and partnerships with relevant countries. The Center of Research Network for Infectious Disease supports, operates, and cooperates with the program as a whole.



Furthermore, Dr. Okamoto explained that integration (convergence) of contemporary technologies such as sequencing with conventional technologies such as staining and cultivation enables earlier and more accurate detection (diagnosis) of the causative agents (pathogens, etc.) of infectious diseases. Dr. Okamoto described the principles and applications of state-of-the-art biotechnology (SMAP, RAPID, etc.) being researched and developed at RIKEN.

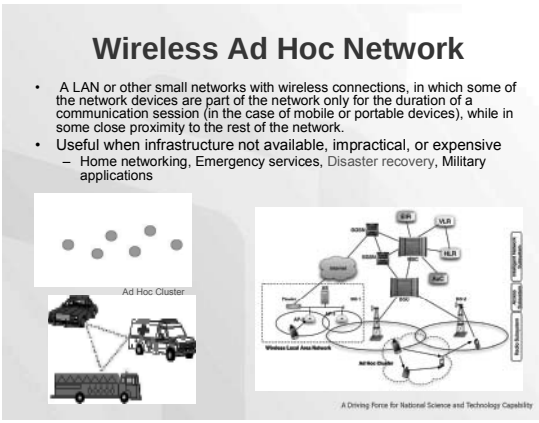


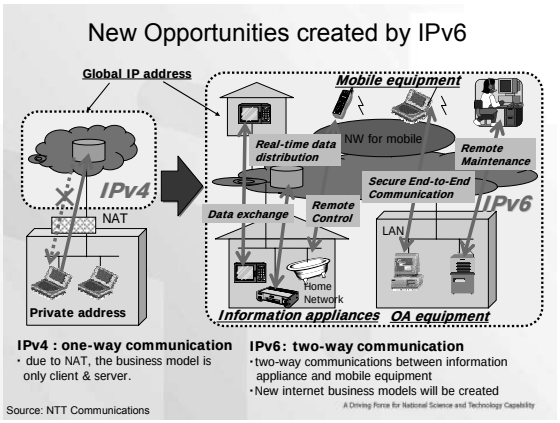
Keynote speech 3: Potential ICT Infrastructure for EID Research Collaboration
Dr. Chalermpol Charnsripinyo (NECTEC)

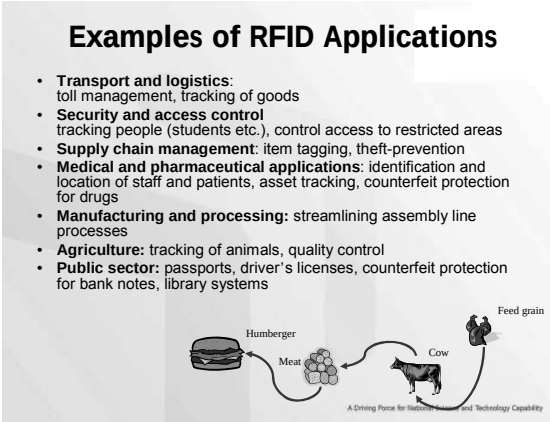
Dr. Chalermpol described new (emerging) technologies in information and computer technology (ICT) and ICT infrastructure that is useful for the implementation of joint research. Dr. Chalermpol stated that ICT is important in combating emerging infectious diseases.

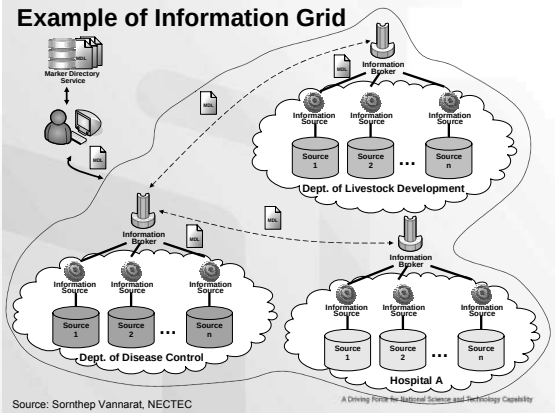
Among new technologies, Dr. Chalermpol emphasized the next-generation internet protocol "IPv6" that will replace the current IPv4, "RFID" that tracks and identifies individual articles using radio waves, and "Grid Computing" that links multiple computers through a network to create virtual supercomputers. Furthermore, in the future, mobile telephones and other wireless-connection networks can be used as effective networks when infrastructure bases are unavailable following natural disasters and so on.

In addition, Dr. Chalermpol introduced a list of 12 network systems that use ICT and new technologies in projects against emerging infectious diseases. They include "BipSense", a surveillance system for precursors of infectious diseases (US Centers for Disease Control and Prevention), "the Electronic Surveillance System for the Early Notification of Community-based Epidemics" (US Department of Defense), and "the Foodborne Disease Active Surveillance Network " that looks for foodborne infectious diseases (US Centers for Disease Control and Prevention, US Department of Agriculture, FDA, etc.).









○Session 2：Scenario Workshop results and Exercises 1

Through the first half of 2006, the National Institute of Science and Technology Policy and the APEC Center for Technology Foresight Thailand carried out bibliometric analysis on infectious diseases through a variety of methods and exchanged opinions on the results. Subsequently, Thailand integrated the results. Based on this, it designed an internet questionnaire with the goal of extracting advanced technologies thought effective for combating infectious diseases. From November 2006 through January 2007, the questionnaire was implemented on the website of the APEC Center for Technology Foresight Thailand (21 responses).

In February 2007, a scenario workshop was held in Thailand. Starting with the results of the above analysis and questionnaire, participants considered multiple scenarios regarding the development of infectious diseases and technologies to combat them over the coming 10 years and the predicted results.

This technology roadmap workshop began from the results of the scenario workshop. It focused on "technologies" useful for combating emerging infectious diseases and created roadmaps for them.

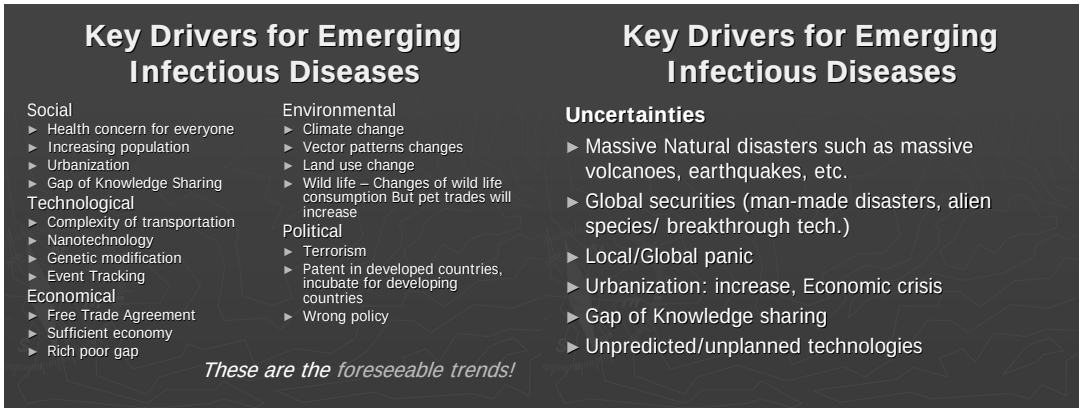
Because most participants did not attend the previous workshop in Thailand, Dr. Nares gave a brief report on that workshop and its results.

Recap from the Scenario Workshop
Dr.Nares Damrongchai (APEC CTF)

At the February scenario workshop in Thailand, participants divided into four groups. They examined, respectively, social, technological, economical, environmental, and political aspects of "drivers" (driving factors) that influence the risks of emerging infectious diseases. In addition, they examined uncertainties such as natural disasters, sharing their awareness of infectious disease countermeasures.

The scenarios are for the future of the Asia-Pacific region. They were created in each group, with the primary question being "What converging technology would you use to combat emerging infectious diseases in the Asia-Pacific region?" Four scenarios were created as a result: "A new type of malaria appears and spreads in Miami due to the influence of global warming," "An unknown viral disease from genetically-modified ducks appears and spreads," "An epidemic of an unknown Jurassic virus," and "The emerging infectious disease Rainforest Syndrome is contained."

Furthermore, technical elements were extracted from the completed scenarios and classified. This resulted in technologies in the three research fields of "ubiquitous," "treatment," and "diagnosis" as the important technologies for measures against emerging infectious diseases.



Exercises 1
(Extraction of requirements and their solutions)

This workshop carried out three rounds of group work (exercises) in order to create technology roadmaps for the three research domains "ubiquitous," "treatment," and "diagnosis" extracted at the previous scenario workshop.

Participants are divided into three groups to examine "ubiquitous," "treatment," and "diagnosis," and each group brainstormed. Each group had about 13 members, two of whom served as facilitators. The role of the facilitators was to urge group members to speak, to adjust the direction of the discussions, to record and summarize discussions and results, and so on.

Research domain	Technology applications
Ubiquitous	◆Field tests networked ◆Data collection (real time) ◆Data mining ◆Mobile phone tracking ◆Data sharing ◆Modeling ◆Bioinformatics ◆Network info system countries sign up for info sharing
Treatment	◆Drug design ◆Drug Delivery Systems ◆Vaccine development ◆Personalized medicine advance in pharmaceutics ◆Nano delivery of drugs ◆Molecular medicine, Cell-based vaccine development advance in genetic engineering of virus and antiviral material ◆Conventional Drug Discovery
Diagnosis	◆Micro/Nano array molecular ◆Implantable diagnostics ◆Simple thermo-graphical scanner ◆Genotyping characterization ◆Advance in micro-fluidic device ◆Advance in genetic sequencing ◆Advance in lab on a chip

(Research domains and Technology applications)

Because the purpose of the group work was to create technology roadmaps, templates were passed out to all members in advance. Each member was to perform the work with the idea of filling in the blank spaces.

The template's horizontal axis represents time. The anticipated situation from the present (2007) a minimum of 5 to a maximum of 15 years into the future was examined. First, in Exercises 1, each group derived "User's Requirements" for emerging infectious diseases. Next, they examined "Solutions: Products & Services."

Technology Roadmap Template

Research domain ( ) T: 5 years – 15 years

	T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

Scene from group work (exercises) (1)

- Each group formed its desks into a square for discussion
- The necessary parts of roadmap templates were placed in advance on whiteboards
- Facilitators (standing) led the discussions
- Group members summarized individual opinions on slips and handed them to the facilitators
- Facilitators classified the content of the statements and placed them appropriately in the templates
- Facilitators placed similar-content slips close together
- Facilitators sought opinions on the appropriateness of classifications
- Facilitators rearranged slips based on member opinions
- Facilitators took care so that all members could speak

Scene from group work (exercises) (2)

Day 2 (May 23)

○Session 3: Explanation of Strategic Technology Roadmap and Exercises 2

Exercises 1 on the first day already began working on examining and deriving needs, possibly helping participants who had never created a technology roadmap grasp the vague image of technology roadmap creation.

Therefore, in order to give participants further advanced knowledge regarding technology roadmaps, Professor Kameoka (Japan Advanced Institute of Science and Technology) gave a presentation on the theory behind strategic technology roadmap creation, and Professor Kohtsuki (Ritsumeikan University) gave one on a concrete example of technology roadmapping.

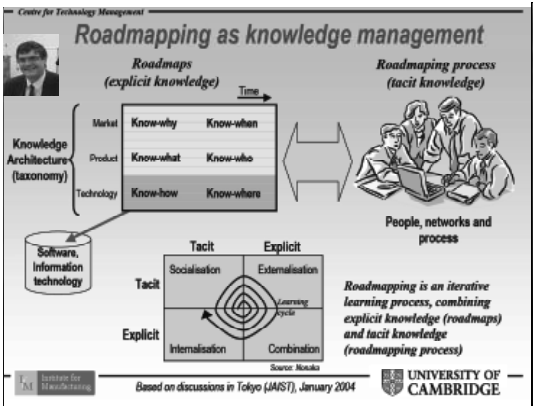
Furthermore, although not originally scheduled, at his own request, Jack Smith (S&T Foresight, Office of the National Science Advisor, Canada) gave a presentation on "Converging technology in 2020" discussed in Canada.

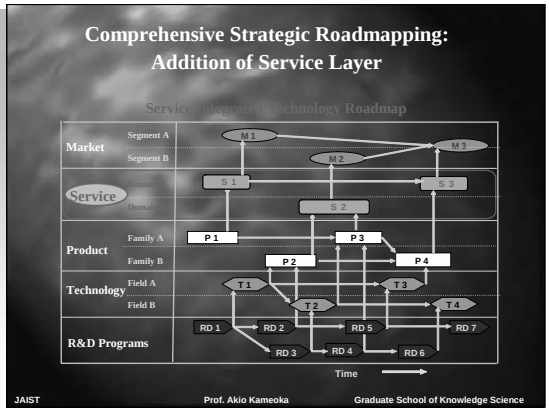
Strategic Technology Roadmapping
Prof. Akio Kameoka (Japan Advanced Institute of Science and Technology)

Roadmapping is an interactive learning process that integrates explicit knowledge (roadmap creation) and implicit knowledge (human conversation and networks in the roadmap creation process). It is a knowledge management tool. Therefore, the roadmaps created are not fixed (operating schedules). They are revised, changed, and used to clarify ideas.

Generally, technology roadmaps stack markets, products, technology, and R&D programs on the vertical axis, with time as the horizontal axis. The categories in each layer are interrelated, with the relationships indicated by arrows. In strategic technology roadmaps in next-generation management of technology (MOT), a layer for "services," defined as "activities that help individuals and organizations achieve their goals," is being placed between "markets" and "products."

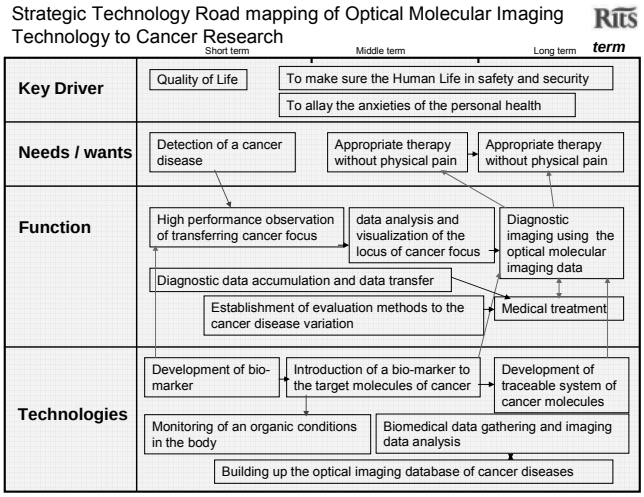
Like technical support functions brought about through products, services include physical support functions, psychological support functions, intellectual support functions, and spiritual (religious) support functions. Adding refined services to existing products and systems can improve consumer satisfaction, adding value to those products and systems. In order to close the gaps between "markets and services" and "services and products," he therefore advocates technology roadmaps that integrate services including the concepts of the new functions "necessary functions" and "supplied functions."





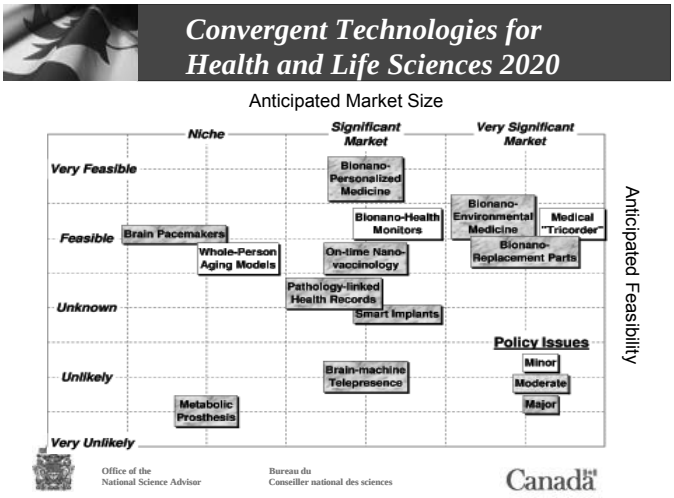
A Case of Technology Roadmapping: Optical Molecular Imaging Technology
Prof. Shotaro Kohtsuki (Ritsumeikan University)

As a concrete example of technology roadmapping, Professor Kohtsuki described a technology roadmap for molecular imaging technology that uses optical methods for non- or low-invasive detection of early-stage cancer.



(Additional presentation)
Converging Technologies
Jack Smith (S&T Foresight, Office of the National Science Advisor, Canada)

Converging technologies for the health and life science expected in 2020 were described. The horizontal axis represents market scale, while the vertical axis represents feasibility. Darkness colors represent the degree to which policy issues exist.



Exercises 2
(Categories that meet requirements and derivation of responsive technologies)

In Exercises 2, the groups continued from Exercises 1, examining "Solutions: Products & Services." They added study of responsive "Technology application." Here, they derived the names of concrete technologies.

Technology Roadmap Template

Research domain ( )	T: 5 years – 15 years T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

○Session 4: Exercises 3

Exercises 3
(Derivation of technical, social, economic, and policy problems and gaps in establishing technologies)

In Exercises 3, group members examined "Challenges (technical factors, social factors, economic factors, political factors)" facing the technologies indicated in Exercises 2. This included problems such as gaps related to the realization of technology, the necessity of breakthroughs, and obstacles and delays in application and diffusion of technology in society. Furthermore, the groups examined "Types of cooperation and systems for cooperation within APEC."

Technology Roadmap Template

Research domain ( )	T: 5 years – 15 years T_1 ( )	T_2 ( )	T_3 ( )
User's Requirements			
Solutions (Products & Service)			
Technology applications			
Challenges Technological factor Social factor Economic F Policy F			
Collaborator (APEC)			

Results

Group1: Ubiquitous	5 yr	10 yr	15 yr
User's Requirements	•Information of EID •Fast detection of EID •EID preventing network system in Asia •IT for preventing social panic •Bio-terrorist alert system	•LAMP diagnostic equipment urgently needed for developing countries •Real Time (network spread) dynamics/contact maps/GIS •Animal protection •Border/airport health security arrival gate •Real time RFID Health monitoring •Analysis of long-time series land cover satellite data	•Forecast of possible pr (Forecasting model) •Smart dust (tracking pe worker
Solutions	•RFID-mediated monitoring of animals •Global sensing from space (climate) •Use of network and Grid technologies for voluminous data •Distributed data processing •Development of More robust regional climate model •Review of long-term climatic data/global data •Detection of climate oscillation and superimpose with vector population	•Study on vector pattern migration •Study for tagging/marking EID vector •Construct reliable information network •Diagnosis kit development (reasonable price) For poor country •Traditional herbs could be developed to help poor people in remote areas •Development open access database •Easy and simple system that farmer and pig breeder can use	•Build ICT infrastructu APEC economy •Research about mod process •Disposable system fo contaminate/infected
Technology Application	•RFID tagging to wild animals •Wiki-google-office-like workspace tools for EID KM •Very Small Aperture Terminal (VSAT) for communication •3G technologies for diagnosis/reporting •Regional spatial database for EID applications •Emergency Call System before going to Hospital	•EID traceability system with ubiquitous device •Micro RFID markers tagging for wild birds migration pattern •Grid computing / networked connected distributed computing •Disease outbreak early warning modeling •Pod-casting resource on reliable network – push web •Integration alert systems to detect emerging disease (for airport) = smart LAMP and sensor	•ID tag with electronic p purpose •Telemetry/sensor enha phone •Context aware KM tec (Knowledge engineerin human behavior)) •Emergency Social con (monitoring peoples mo provide suitable sugges

Group1: Ubiquitous

Challenges		
	Science and Technology factor	•**Tele-presence** •**Practical (and portable) tools (for detection/reporting/diagnostic) to fields/rural areas** •**Information Standards/protocol and sharing technology** •**Smart dynamic Reactive → Predicting model (for impact/possible hotspot/** •**Fast mutation of disease → basic research**
	Social factor	•Educating/dissemination/communication to all levels: children/public/train the trainer/local volunteer/officer/community leader •Resistance nature (of human) to new things (system/drug/process)
	Economic factor	•Rich-poor gap •$$$ (to invest) •Assessment model (in term of $$$) •$$$ (to subsidize)
	Policy factor	•Compliance of member economies •Info Standard & sharing policy •Open source •Neutral APEC center/company (drugs/testing/services) •Controlling law/policy during outbreak/disaster event •Rich-poor gap (between nation) – conflict of interest/IPR •Expansion / strengthening international ICT Infrastructure

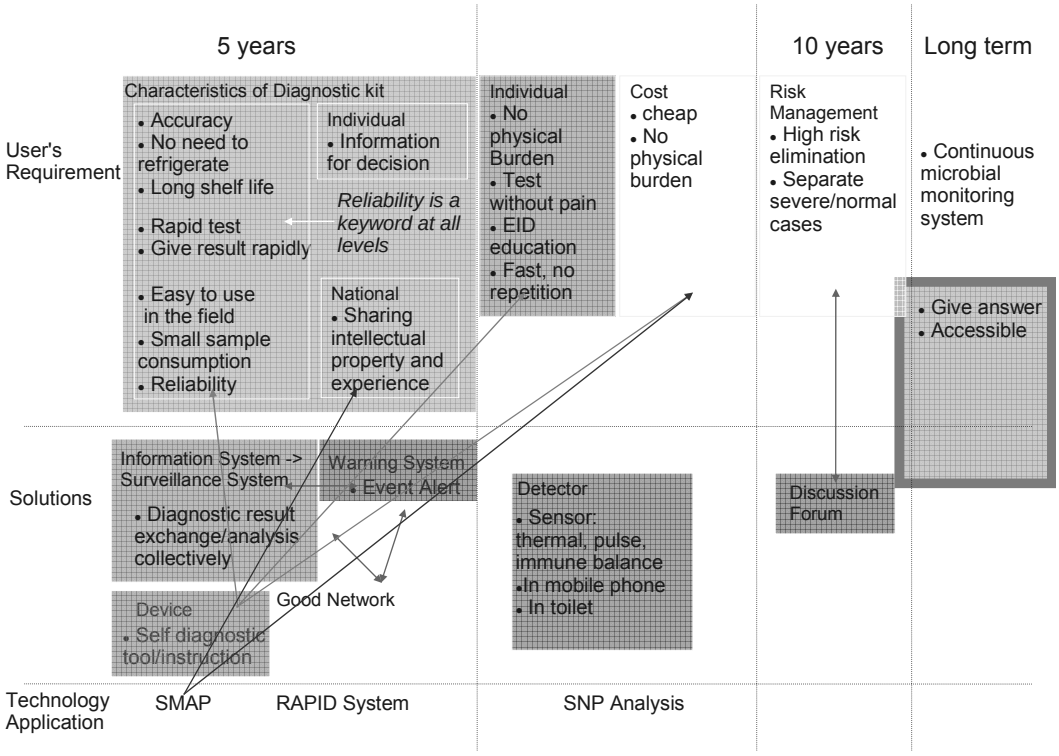
Group2: Treatments

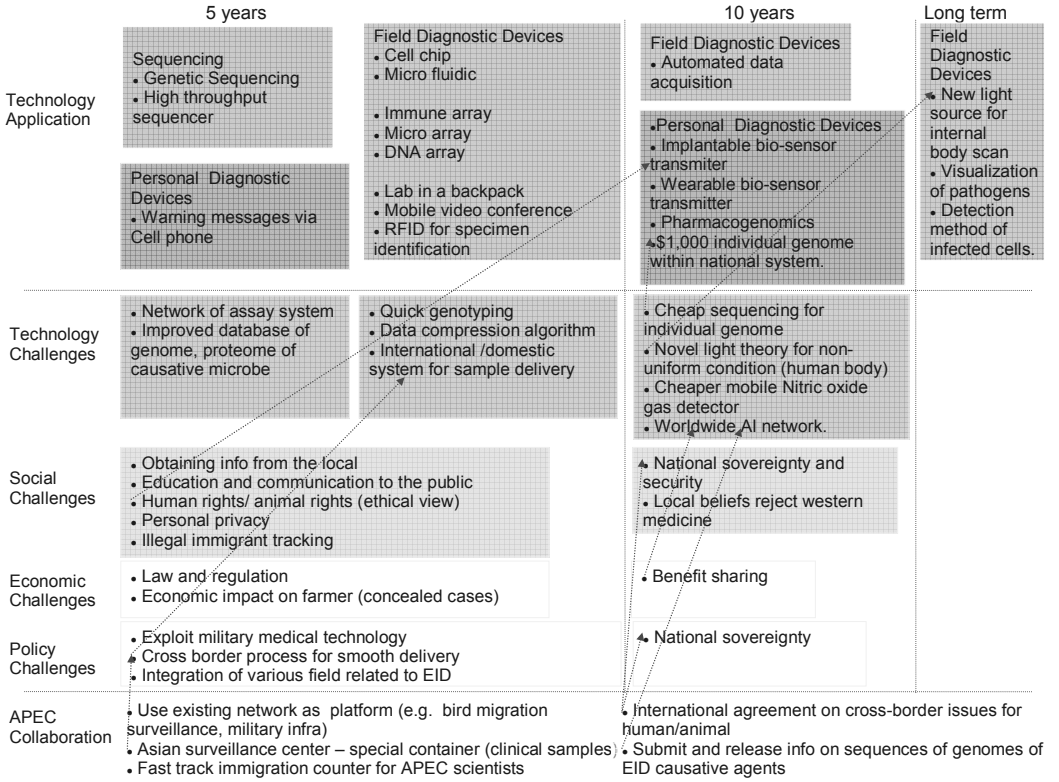
	5 yr	10 yr	15 yr
User's requirements	**Improvement of existing drug/vaccine to reduce side effect and provide proper treatment**	**Development of effective and safe drugs**	**Development for stable, long lasting, safe and affordable drugs**
Solutions	S.11 Find the new adjuvants that can reduce side effects S.12 Purify all the ineffective component S.13: Implement QC&QA for production control S.14: Develop a post-marketing monitoring system for detecting side effects	**Use of new drug ingredients** S.21: Exploration of new changing targets for EID treatment; Infected pathogen, Infected human cell and Host immunology S.22: Search for new alternative ingredient such as plant extraction, along with development screening library **Apply the new process** S.23: New Testing Process: The best/rapid way to characterize new pathogen In silico experiment to improved existing drugs, In vitro testing and Animal model, In vivo Human immune response system testing	•S.31: Personalized drug •S.32: GM drug & vaccine •S.33: Molecular modelling •S.34: Bio-model simulation •S.35: Reliable production
Technology Applications	S.11 Tech. for detect drug resistance S.11 Sensors that detect physiological effect of the patients S.11 Pharmacogenomics (Bioinformatics) S.12 Drug delivery system S.12 Biosensors S.12 Small scale filter S.12 Micro pore size S.12 Ventilation system S.12 Material sciences S.12 High speed & safety production system S.12 Automatics production S.13 Detect immune response for adjuvant effect S.13 Smart separator (rapid separator that can rapidly eliminate unwanted containment) Immunological tech. that can activate drug effect	S.21 3D design of Crystallography S.21 Proteomics S.21 Cell-based High throughput screening active compound S.21 Computer- assisted design for new ingredient searching (super computer/ high speed/automatic) S. 23 New testing process S. 23 New animal model testing	S 31 Tailor-made vaccine S 32 Recombinant vaccine S 32 Room temp. vaccine tech. S 32 Multivalent vaccine S 32 DNA vaccine S 35 GM animal model

Group2: Treatments

Challenges	Technology factors	High performance computing system New tech for evaluation system Transportation (Material transfer) Efficient professional Development of new material for filter Limited interface among engineer, biologist and etc.	Need a lot of collaboration Difficulty to detection & identifying for new pathogen Prepare public to be aware of unknown future Advance algorithm Specific system to identify pathogen (virus/bacteria/fun gi (super system) Sharing tech. among APEC economics Insufficient of knowledge in host factor	Ability to evaluate the safety impact ON Environmental and animal aspect Eradicating system for important diseases
	Social factors	Information sharing among experts Personal info. Accession Training & Education Ethical issue Public awareness	Ethical issue Public education in GMO	Educate people for GM materials
	Economic factors	Financial support from government Sufficient incentive to industries (as some of them start shifing their interest to develop medicine for curing life style diseases)	Market need for drug/vaccine	
	Policy factors	Enforcement of GMP Patent protection Restructure trading regulation to support the exchange material and specimens across the border Commitment from the policy maker	Public education in GMO	
Collaboration & Collaborators		Sharing information, Research collaborations, Standardization, Harmonization, Universal Pandemic preparedness		

Group 3: Diagnosis





○Session 5: Evaluation of TRMs and Announce for Next Workshop

Evaluation of TRMs

Based on the technology roadmaps created, participants exchanged opinions on their countries' expected contributions to combat infectious diseases in the APEC region and on future cooperative relations in the region.

Commonly-held opinions included "Combating infectious diseases in the APEC region are important issues. Because they are just as important domestically, the national government can make a contribution." "I'd like to strengthen APEC's cooperation system (for it to be strengthened)." "I hope the same kind of workshops on infectious diseases will continue to be held in the future."

Other opinions included "Combating ordinary infectious diseases as well as emerging infectious diseases are important." "Strategic technology roadmaps should be created for specific infectious diseases (avian influenza, etc.) that are actual problems." "The focus shouldn't be placed exclusively on cutting-edge technology. Diversion and improvement of existing technology should also be a focus." "Technology roadmaps that consider the problems of developing countries are necessary."

The discussion advances with the encouragement of session Chair, Prof. Kameoka

Presentation of participant

The 2nd Technology Roadmapping Workshop in Chinese Taipei
Dr. Yi-You Huang (National Taiwan University)

Dr. Huang announced the second technology workshop, scheduled for October in Taiwan. The workshop theme and detailed content are to be arranged.

The 2nd technology roadmapping workshop in Taipei

Main Theme

The Converging Technologies to Combat Emerging Infectious Disease (EID): Technology Roadmap Workshop

Program

- **Opening Remark**: Minster of National Science Council
  Chien-Jen Chen Sc.D., 陳建仁 主委
  Also an Expert of Epidemiology, Hygiene and Public Health

- **Opening Remark**: Minster of Department of Hea
  Sheng-Mou Hou MD PhD 侯勝茂 署長

- **Keynote speech**: Director of Dept Intl Cooperation, NSC 林光隆處長

講演スライド

Presentation Slides

Asia-Pacific Economic Cooperation

An APEC-wide Technology Foresight Project:

Roadmapping Converging Technologies to Combat Emerging Infectious Diseases

Proposed to APEC Industrial Science and Technology Working Group (ISTWG)

Dr. Nares Damrongchai
Director
APEC Center for Technology Foresight

22 May 2007, Tokyo, Japan

Rationale 1 – Why Emerging Infectious Disease?

Emerging and re-emerging infections are increasing in the Pacific Rim. These include both diseases that are new (e.g. SARS, Avian Influenza) and diseases that are old but re–emerging as health threats (e.g. Tuberculosis). They are important to our APEC community because:

- They cause preventable illness and death
- They drain our economies through the direct costs of treatment and hospitalization
- They generate indirect costs from time lost from work and reduced purchasing power
- They lead to unfounded trade sanctions that hinder economic activity

Source: APEC Emerging Infections Network (EINet)

2

Rationale 2 – Why Converging Technologies?

- The risk of region-wide/global pandemic is very high. For APEC to have sufficient pandemic preparedness, besides building drug stockpiles, both pharmaceutical and non-pharmaceutical control options must be considered and fully explored.
- Converging aspects of relatively familiar technologies (e.g. Bio-Info-Nano-Material), that is starting to show importance to the future of key policy domains such as health, security and new industrial development, will be key to build such effective control options to combat these emerging infectious diseases and perhaps help to prevent/manage the coming pandemic.

Rationale 3 – Why Roadmapping?

- Technology Roadmapping (TRM) is a suitable tool to explore the different pathways to actually develop key future technologies that are important for the future and identify barriers and gaps in developing and using them. The TRM process is highly collaborative and has previously been used successfully in APEC in the energy area by ISTWG in cooperation with EWG.
- Other foresight tools such as Bibliometric Analysis, Scenario Planning, and Delphi Survey have been assisting policy makers and technology developers in many APEC member economies to identify and assess such rapidly developing technologies.

Definition 1

What Are Emerging Infectious Diseases?

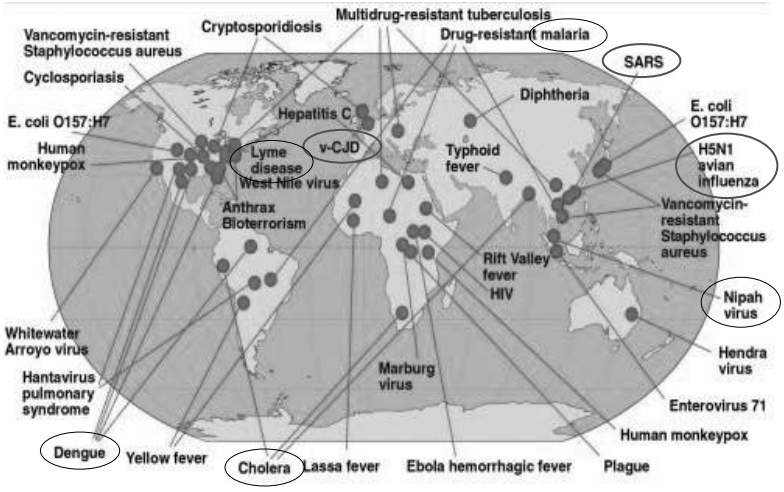
Emerging Infectious Diseases (EID) are infectious diseases that have recently become more prevalent or threaten to do so.

Source: DoD Global Emerging Infections Surveillance and Response Program

Prime examples of such infections include Severe Acute Respiratory Syndrome (SARS), Highly Pathogenic Avian Influenza (HPAI), Dengue, Tuberculosis, and enterotoxigenic *E Coli*.

Source: APEC Emerging Infections Network (EINet)

Examples of Emerging and Re-Emerging Infectious Disease: past 10 years



Source: A Fauci, NIAID/NIH, 2005

Definition 2

What Are Converging Technologies?

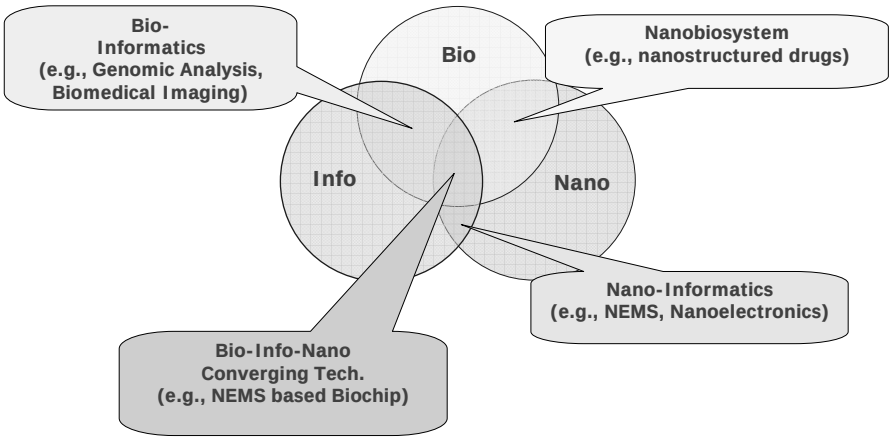
Converging technologies are enabling technologies and knowledge systems that enable each other in the pursuit of a common goal.

Source: Converging Technologies – Shaping the Future of European Societies, The European Commission Research (2004)

The coming together of two or more disparate disciplines or technologies.

Source: Toward Understanding Science and Technology Convergence, Science and Technology Foresight Directorate, Government of Canada (2005)

Examples of Converging Technologies



Source: Suthee Phucharoenchanachai, NECTEC (2005)

How Converging Technologies Could be Applied to Combat EID: The Application Perspective

- **Prevention of EID**
  - Risk assessment of EID
    - Travel & trade, agriculture, climate & ecological change
  - Assessing tools
    - patient's respiratory and health status
  - Disease Surveillance
    - Local, regional, global
  - Early warning & Remote sensing of EID
    - Traceability of tiny outbreak
  - Rapid & field diagnosis
    - Reagents & test kits
  - Pathogen Identification
  - Vaccination & Tech-based barriers

- **Management of EID**
  - Infection data management
  - Strategy for drug administration
  - Preparedness & Rehearsal
  - Treatment Facilities (Hospitals)
  - On-demand Experts/ Pub Services
  - International Collaboration
  - Policy Supporting Framework
  - Public Supply (e.g. water) Network Management

The project aims to...

Explore the possibility of using **converging technologies*** that can cross discipline and should **contribute** to the prevention and management of **emerging infectious diseases** that are (and could become) widespread in the APEC region.

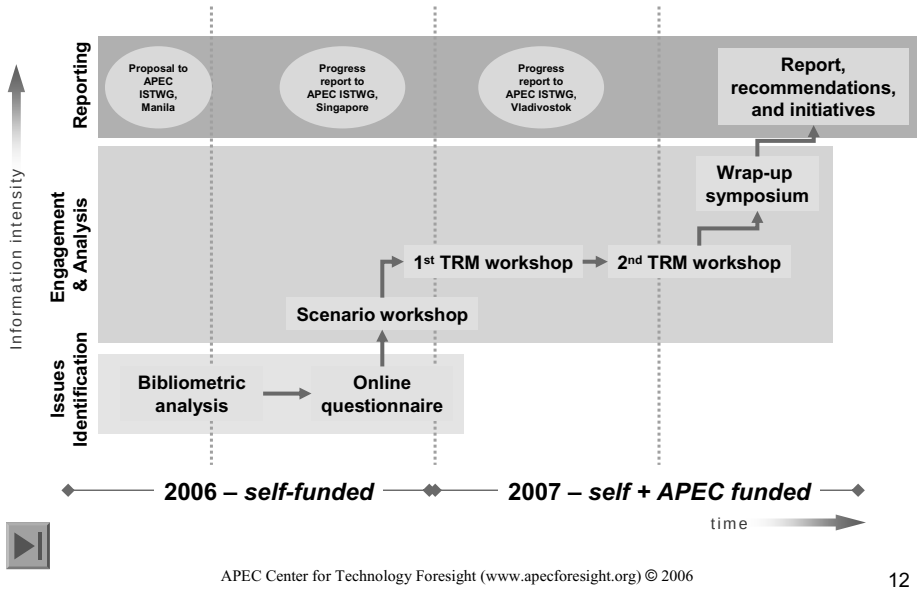
Use multiple **foresight tools** e.g. Bibliometric Analysis, Scenario Planning, Delphi Survey, and TRM. These could be applied **region-wide** or to specific groups of economies or **geographical areas** where infectious diseases are currently a problem.

Recommend the resulting **scenarios** and **technology roadmaps** to related APEC groups, member economies, and industry for further implementing, especially to **develop the technologies**

* If necessary the project may focus on specific converging technology-application fields e.g. nanofilters, RFID, sensor networking, biomedical imaging and telemedicine etc.

- We expect that this series will help the APEC region to jointly identify necessary research themes and formulate collaborative network between different field of scientists and industry experts.

Project Overview Roadmap



Expected Output

Multiple Scenarios of the Future

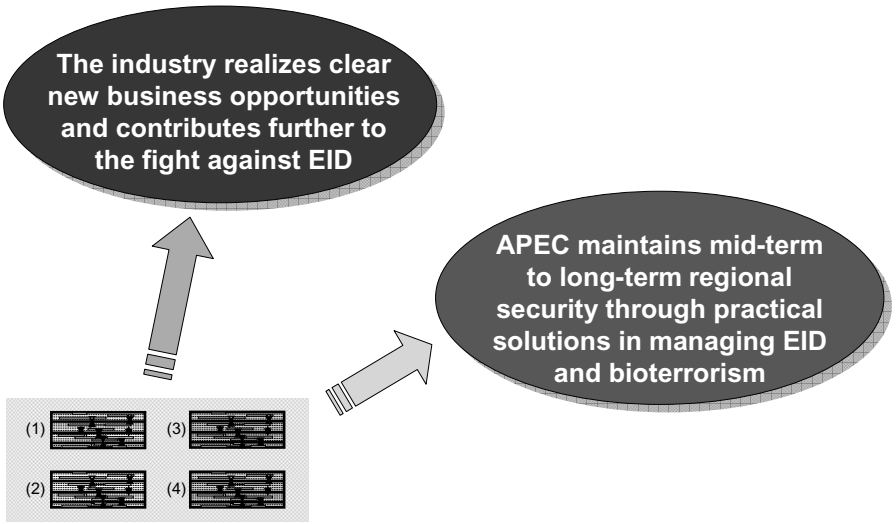
with policy recommendations for APEC member economies

Source: Siemens "Pictures of the Future" 2005

A Technology Roadmap Links the future to present, and resources to market/applications

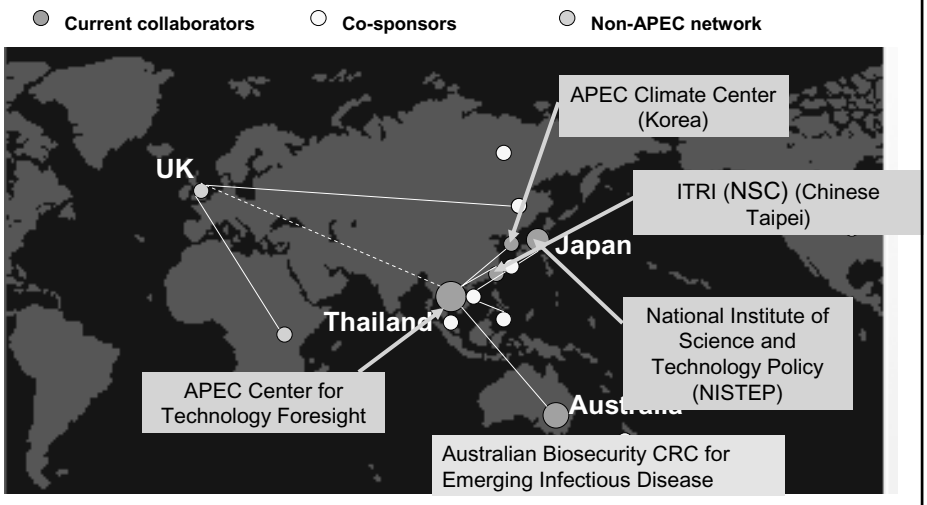
Source: Centre for Technology Management, University of Cambridge

Possible impact of the project

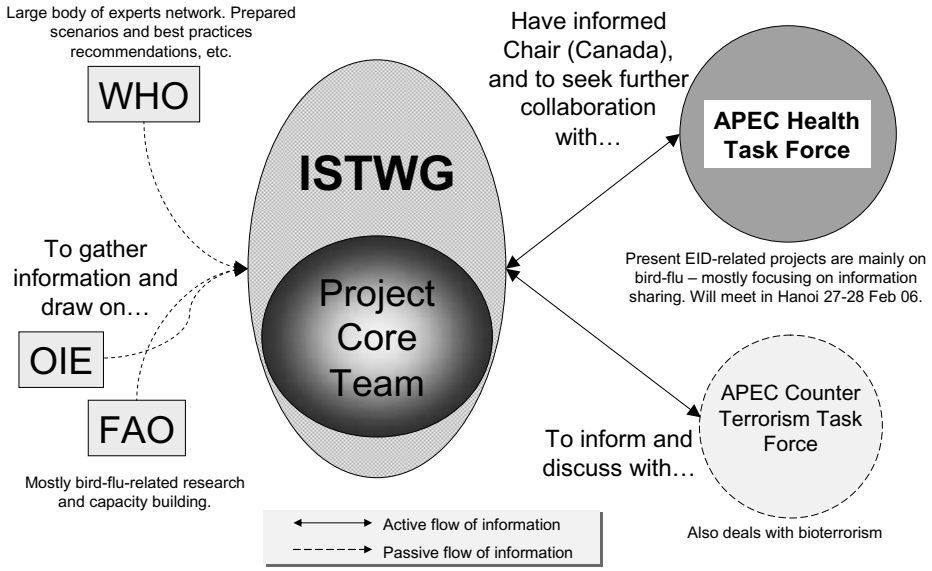


Collaborators

As of February 2007



Relationship with Other Groups



This workshop is…

- The second step -- a technology roadmapping stage -- to review technological important applications that could converge in the combat against emerging infectious diseases.
- To address the challenges for these technological development over the next 5-15 years.
- An input to the technology roadmapping workshop planned to be held next in Chinese Taipei, and finally again in Thailand.

Roles of participants

- During the 2-day workshop participants will have an opportunity to:
  - listening to invited lectures in many different area of expertise and exchange views in a facilitated small group discussion.
  - Brainstorm within the small groups and help in formulating the Asia-Pacific technology roadmap to combat EID.
  - Networking with other experts in the same and different area of expertise.

NECTEC
a member of NSTDA

Converging Technologies:
Concept & Examples

Suthee Phoojaruenchanachai

National Electronics and Computer Technology Center

22 May 2007

Outline

- **Rationale**
- **Concept**
- **Recent Advances**
- **Potential to Converging**
- **Examples & Contribution**
- **Concluding Remarks**

2

Rationale

- Technologies drive socio-economic impact
- Many of them are converging
  - Interdisciplinary; Info-Bio-Nano-Cogno
  - Interface; Macro-Micro-Nano
- Understanding of convergence assists strategic management of
  - Innovation
  - Technology
  - R&D

3

Concept

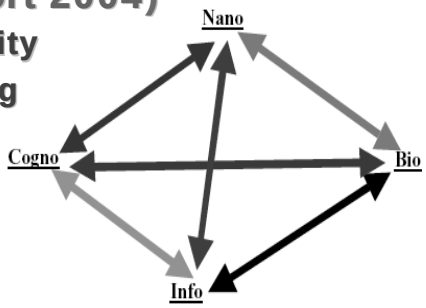
Converging technologies are enabling technologies and knowledge systems that enable each other in the pursuit of a common goal

Source: *EC Report ; "Converging Technologies - Shaping the Future of European Societies" 2004*

4

Recent Advances

- CT for Improving Human Performance (NSF Report 2002)
  - Nano-Bio-Info-Cogno (NBIC) for Human
- CT for Shaping the Future of European Societies (EC Report 2004)
  - Treatment of Obesity
  - Intelligent Dwelling



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Recent Advances(2)

- CT for Agriculture & Environment (AUS Report 2004)
  - Intelligent Sensor Network
  - Precision and Sustainable Agriculture
- Infectious Diseases: preparing for the future (UK Foresight Report 2006)
  - Detection, Identification, and Monitoring
- Converging Technologies to Combat EID (APEC Foresight Report 2007)
  - Scenario Workshop on Converging Technologies to combat EID

6

Potential to Converging

- **General purpose characteristics:**
  - **Pervasive in applications**
  - **Complement with other technologies**
  - **Further room for improvement**
- **Potential technologies:**
  - **Nano -> Atoms**
  - **Bio -> Genes**
  - **Info -> Bits**
  - **Cogno -> Neurons**

Source: Greg Tegart, "Converging Technologies-Characteristics and Examples", APEC CTF Workshop on Converging Technologies to Combat EID, Feb 2007.

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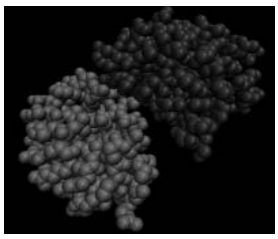
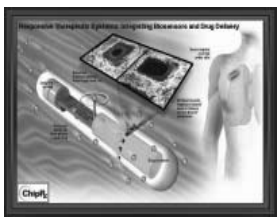
CT Examples & Contribution

- **Info + Bio**
  - **Computational life science**
- **Bio + Nano**
  - **Specificity & unlimited reach**
- **Nano + Info**
  - **Pervasive computing**
- **Info + Cogno**
  - **Human-computer interface**
- **Cogno + Nano**
  - **Engineering mind and body**





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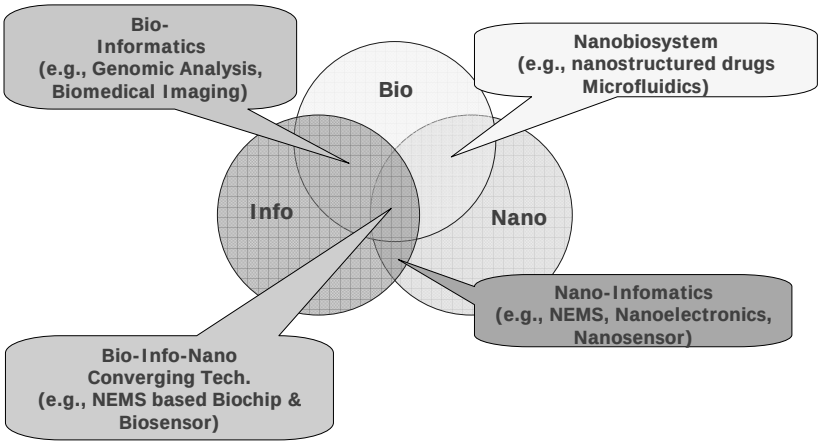
CT Examples & Contribution



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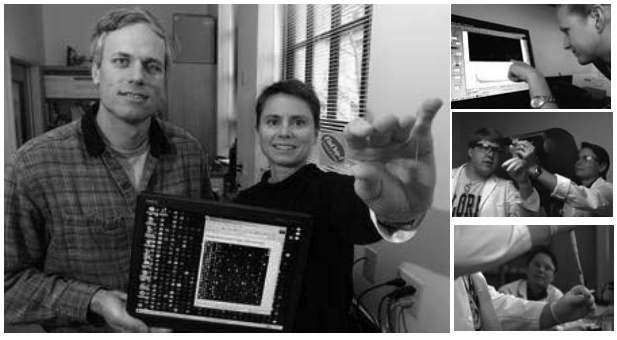
Flu Chip

A novel "Flu Chip" developed at the University of Colorado at Boulder that can **determine the genetic signatures of specific influenza strains from patient samples within hours** may help world health officials combat coming epidemics and pandemics.



Colorado
University of Colorado at Boulder

Source I: http://pda.physorg.com/lofi-news-flu-chip-said_7948.html
Source II: http://www.colorado.edu/ocg/reports/2003-04/flu.html

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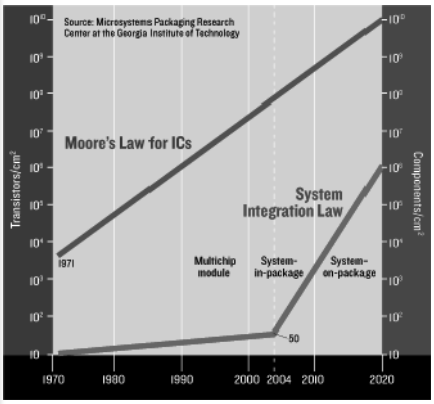
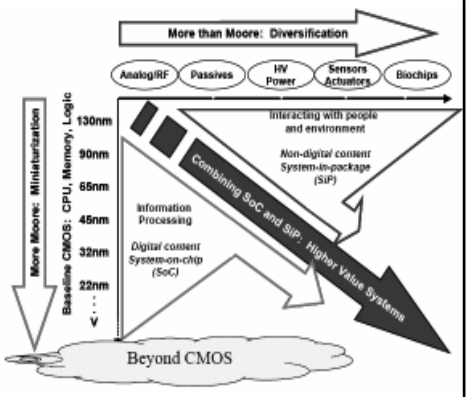
More than Moore





Source I: Moore's law meets its match; *IEEE Spectrum*, June 2006
Source II: Prof. Claeys, "Trends in Si based sensor", NAC2007

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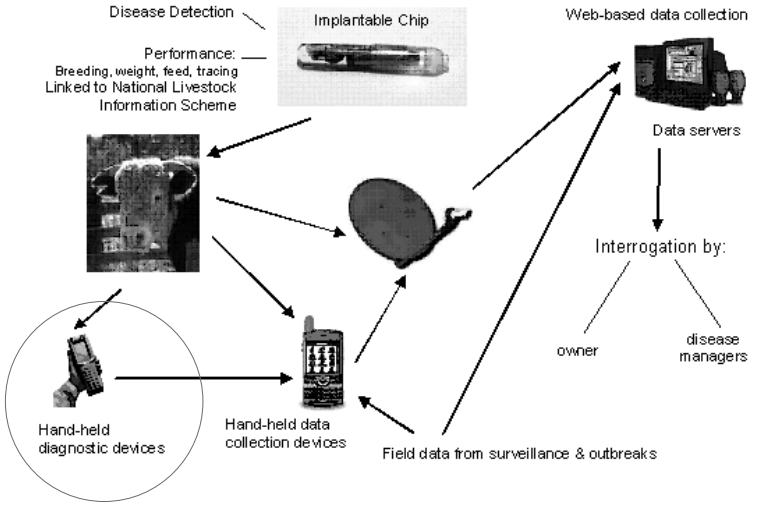
Disease Surveillance



Source: Stephen Prowse, "Biosecurity and Emerging Infectious Diseases", ATSE Focus, No. 136, April 2005.

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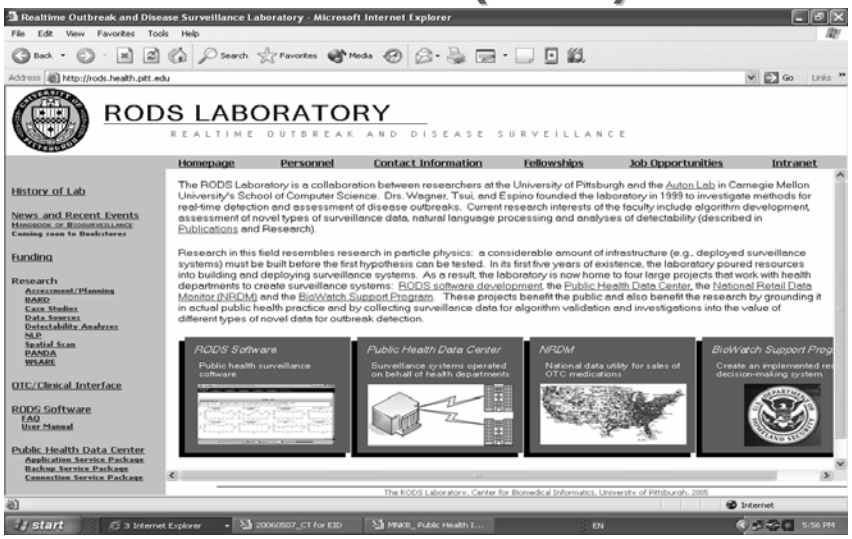
Real-time Outbreak and Disease Surveillance (RODS)



Source: http://rods.health.pitt.edu

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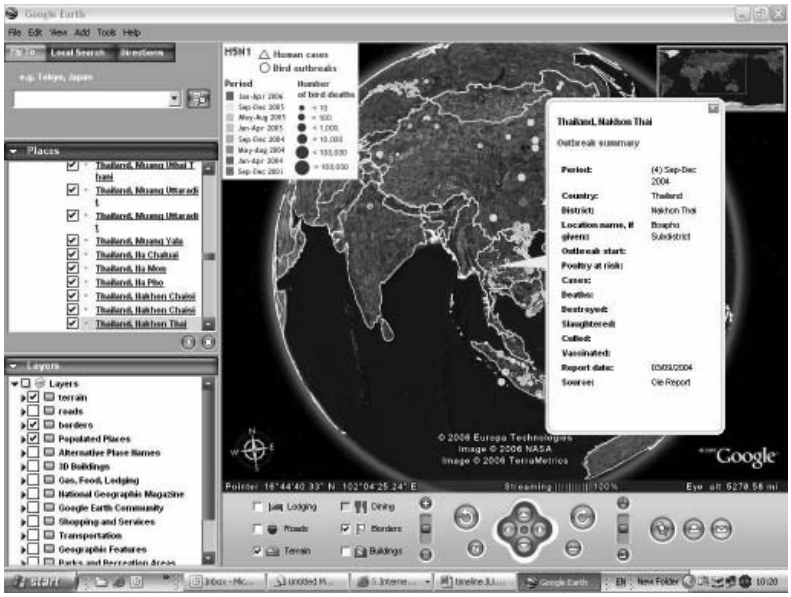
Remote Sensing and GIS



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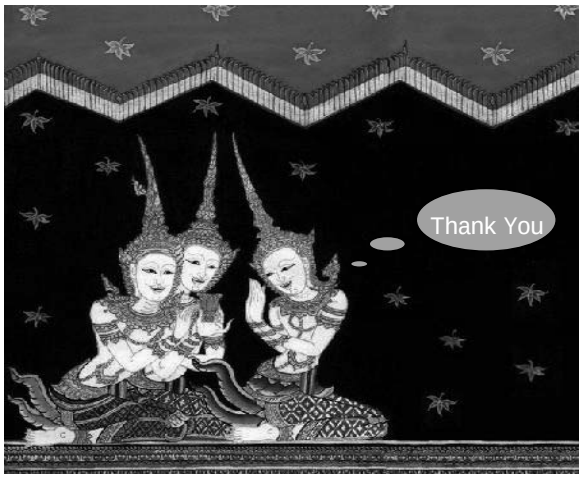
Concluding Remarks

- **Key Technologies are Converging**
  - **Bio-Info-Nano-Cogno Convergence**
  - **Demand Driven by Society & Industry**
  - **Enabling each other**
- **Key Challenge & Approach**
  - **Need to educate society**
  - **Need to improve collaboration and networking**
  - **Need supporting tools for cooperative work**
  - **Foresight and TRM could be a good approach in dealing with these converging technologies**

15



www.nectec.or.th

16

IDSC Infectious Disease Surveillance Center 国立感染症研究所 感染症情報センター

Convering Technologies to Combat Emerging Infectious Diseases:
Technology Roadmap Workshop

"The Surveillance of EID"
Infectious Diseases as Global Issues and Human Security

Nobuhiko OKABE, MD, PhD
Infectious Disease Surveillance Center
National Institute of Infectious Diseases, Japan
22 May 2007, Tokyo

Infectious diseases caused by transmission of micro-organisms. It should be spread widely among human.

Prevention of Infectious Diseases

- **not contact with infected patients (isolation)**
- **to clean materials contaminated (disinfection)**
- **to give immunity (vaccination), if available**

- **to keep healthy and clean condition**

Disinfection　滅菌・消毒・焼却

Isolation　　隔離

天然痘（痘瘡）の予防接種
＝種痘（しゅとう） immunization

1796

50 y. later →

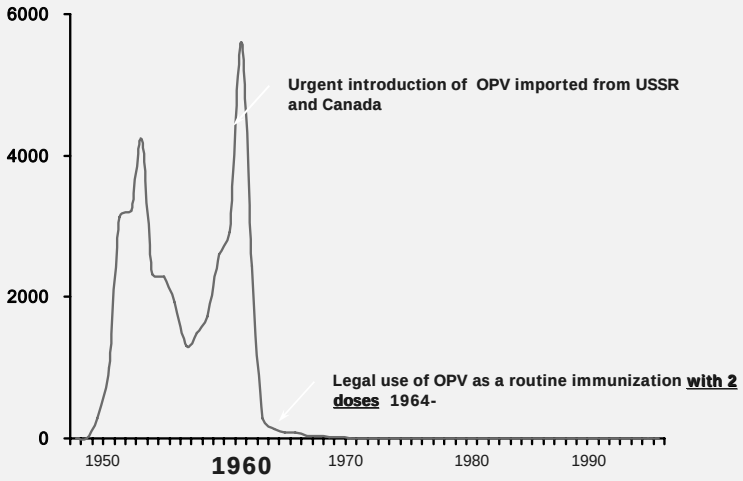
1849

Measles in Japan at 1800`s

Every 20-40 years, big outbreak of measles occurred
Many people both young children and adults were suffered by this fatal disease
The could only prayed not to be suffered by measles

Treatment of Poliomyelitis: 1940's USA

Number of Reported Polio by Year in Japan (1947-2006)



Last case of wild-polio in the Region

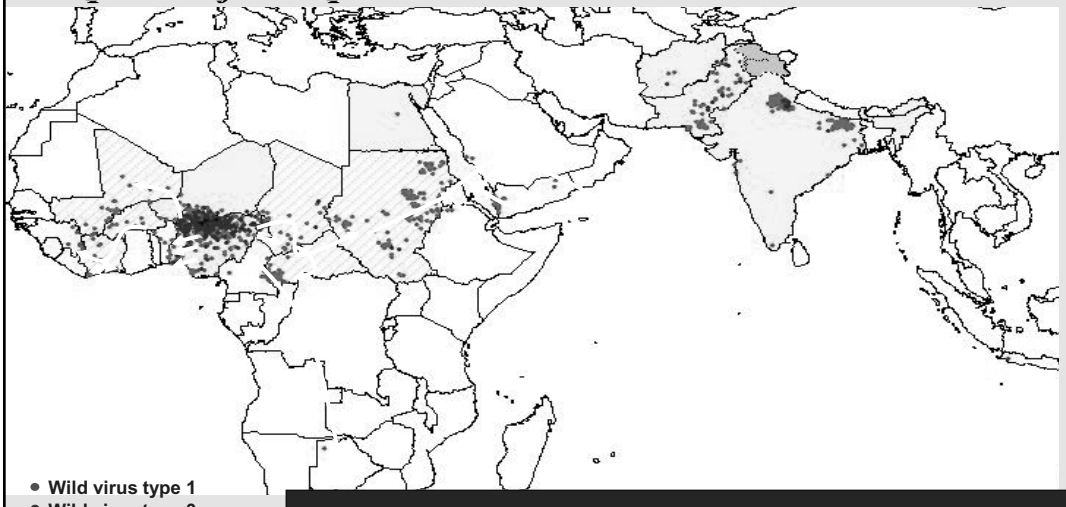
Americas Region
Luis Fermin Tenorio
Peru 1991

Western Pacific Region
Mum Chanty
Cambodia 1997

European Region
Melik Minas
Turkey 1998

Polio Eradication

Spread of wild polio virus 2004-2005　ポリオ輸入例



- Wild virus type 1
- Wild virus type 3

Endemic countries
Re-established transmission countries
Case or outbreak following importation

16 polio-free countries had importations from Nigeria.
Polio was 're-established' in 5 of these polio-free countries

In HQ as of 4 May 2005

Leading Causes of Death in Japan

1950	2001
1.TB	1. Malignant diseases
2.Brain vascular disease	2. Brain vascular disease
3.Pneumonia	3. Cardiovascular diseases
4.Gastro-enteritis	4. Pneumonia
5. Malignant diseases	5. Accident

NIID
NATIONAL INSTITUTE OF INFECTIOUS DISEASES

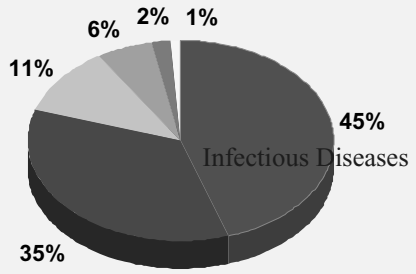
Sakai outbreak July,1996

Hospital in panic with diarrheal children

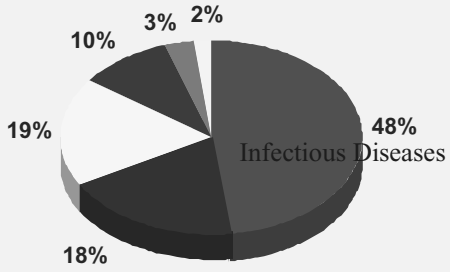
IDSC

Leading causes of mortality, 2001
Total = 53.9 million

Low-income nations
(South-East Asia & Africa)

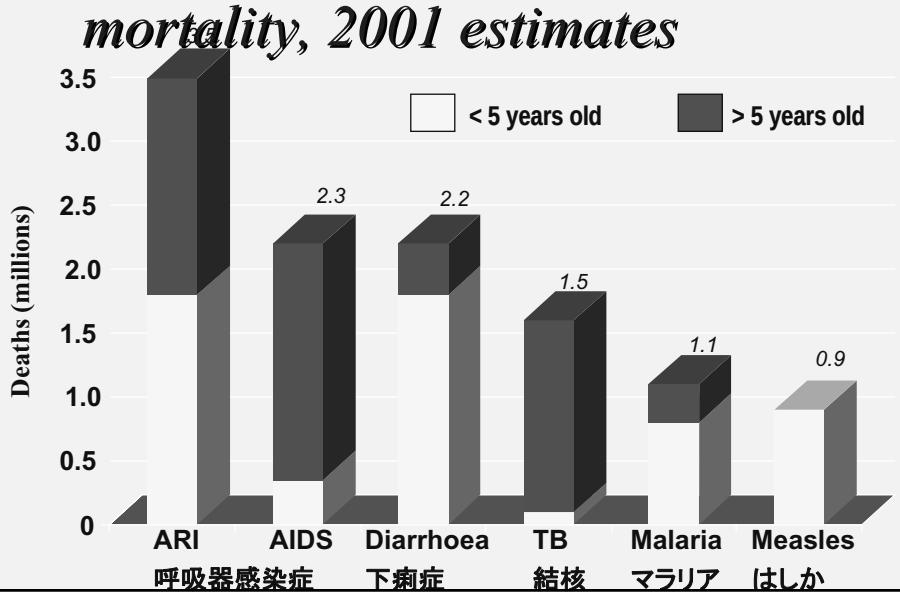


Premature mortality
(worldwide, 0–44 years)

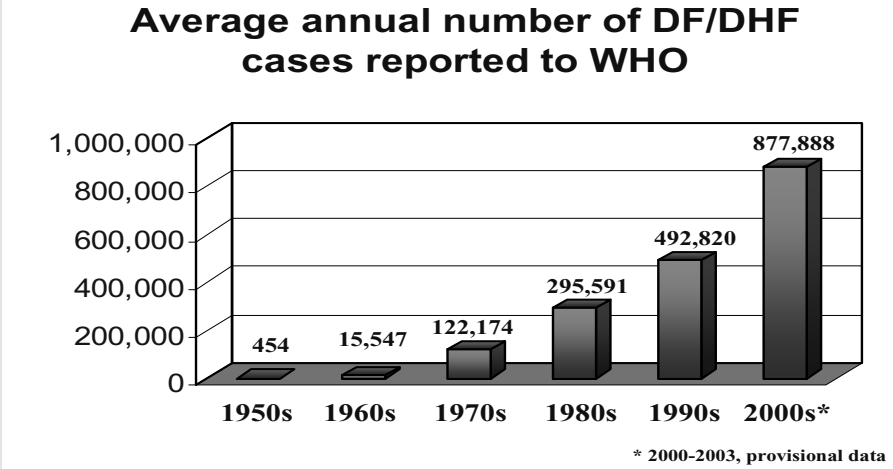


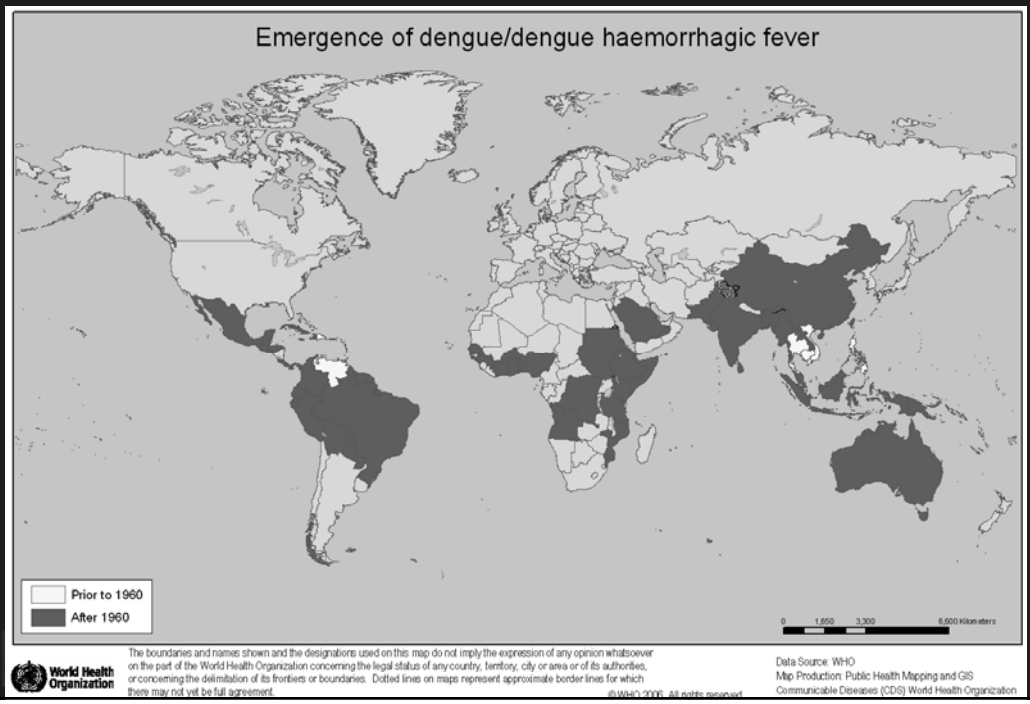
Infectious dis
Non-communicable
Injuries
Perinata
Maternal
Nutritiona

Leading infectious causes of mortality, 2001 estimates

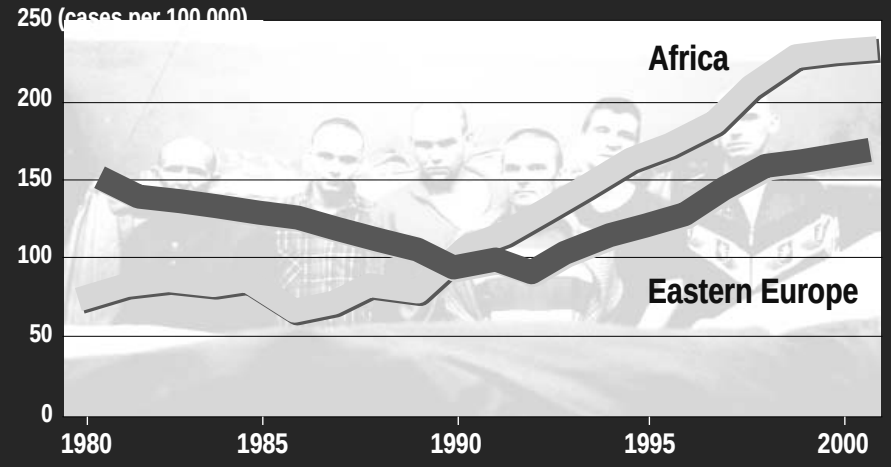


Dengue/Dengue fever　デング熱





TB trends in Eastern Europe and Africa
結核



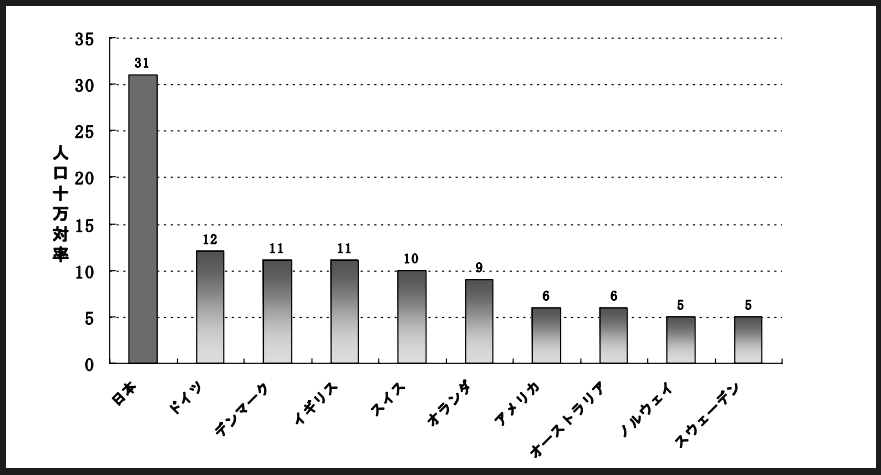
Multidrug-resistant TB (MDR-TB) *薬剤耐性結核*

Cost of treating multidrug-resistant TB:

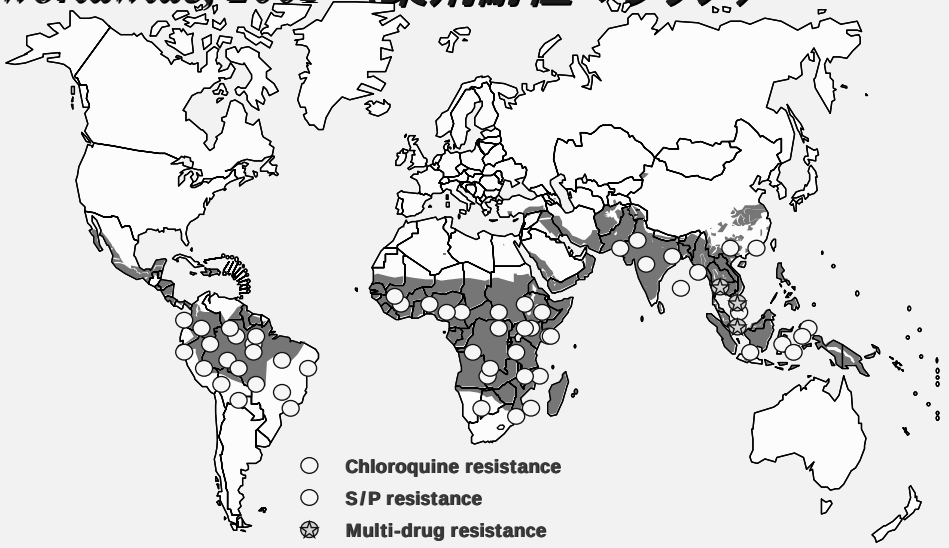
- US$ 250 000 per patient in industrialized countries,
- US$ 1 000 –$ 10 000 in developing countries

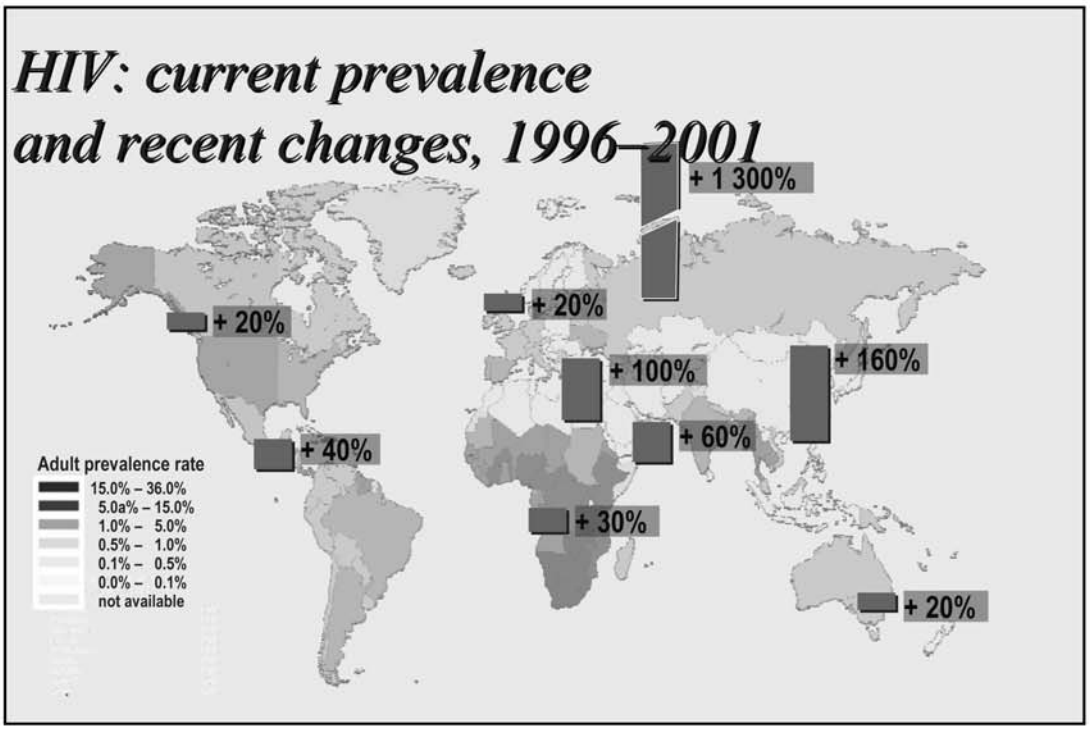
TB in Japan （結核）

middle level in the world



Anti-malarial drug resistance to treatment worldwide, 2001 （薬剤耐性マラリア）




HIV: current prevalence
and recent changes, 1996–2001
+ 1 300%
+ 20%
+ 20%
+ 100%
+ 160%
+ 60%
+ 40%
+ 30%
+ 20%
Adult prevalence rate
15.0% – 36.0%
5.0a% – 15.0%
1.0% – 5.0%
0.5% – 1.0%
0.1% – 0.5%
0.0% – 0.1%
not available

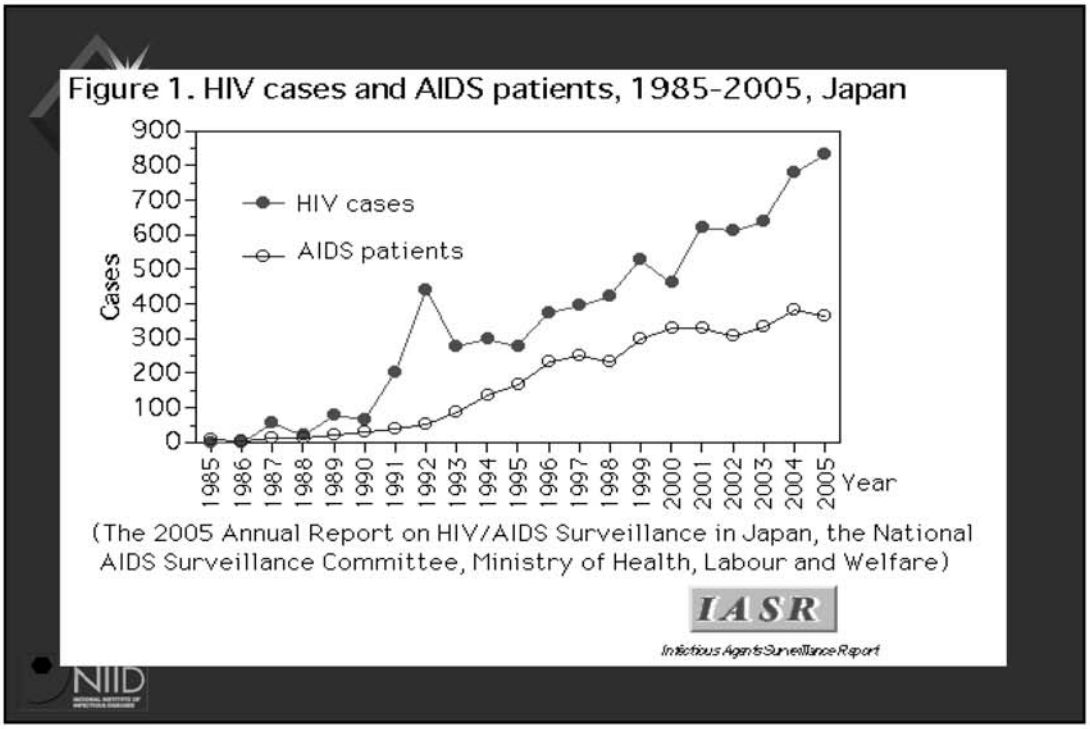
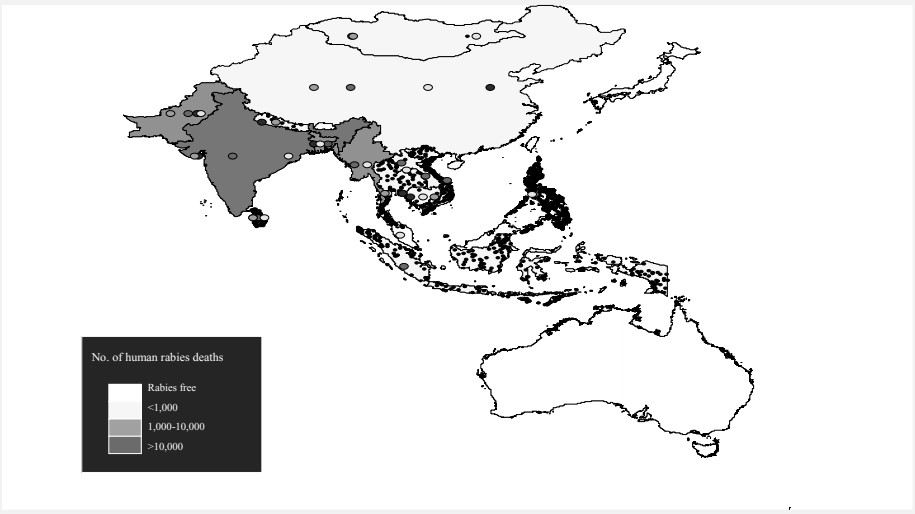
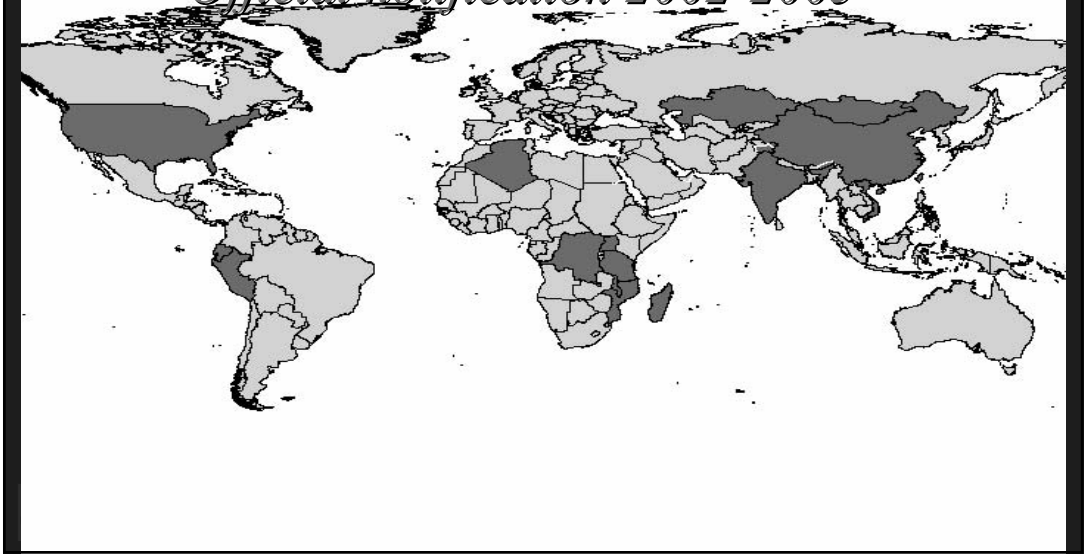


Figure 1. HIV cases and AIDS patients, 1985-2005, Japan
900
800
700
600
500
400
300
200
100
0
Cases
HIV cases
AIDS patients
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
(The 2005 Annual Report on HIV/AIDS Surveillance in Japan, the National AIDS Surveillance Committee, Ministry of Health, Labour and Welfare)
IASR
Infectious Agents Surveillance Report
NIID

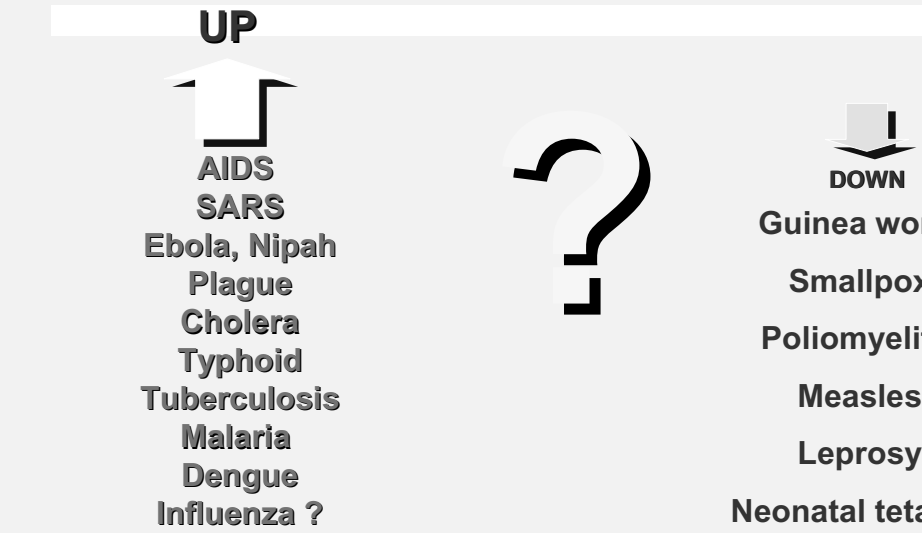
Rabies in Asia, 狂犬病



Human cases of plague
Official notification 2002-2005



Infectious Diseases: A World in Transition



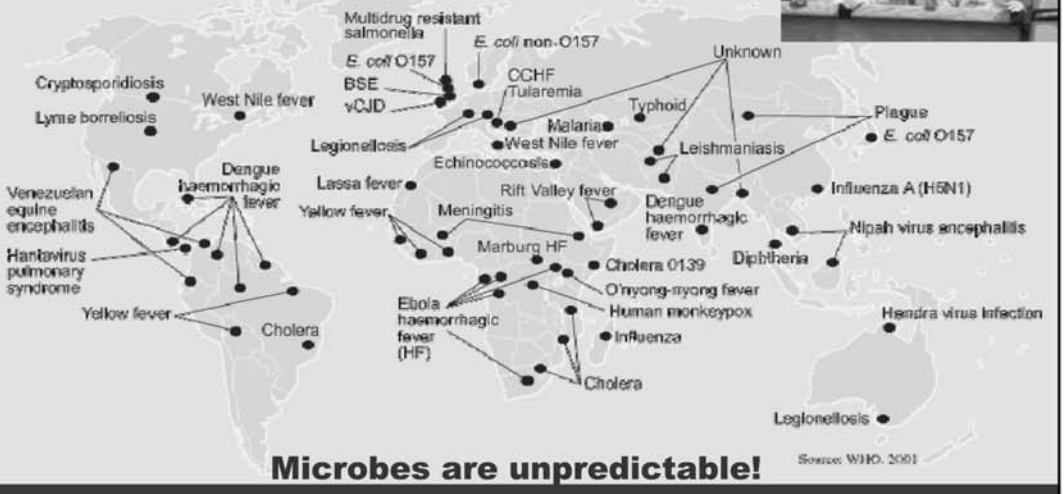
◆Emerging Infectious Diseases
新興感染症

EID are those due to newly identified and previously unknown infections which cause public health problems either locally or Internationally.

◆Re-emerging Infectious Diseases
再興感染症

REID are those due to the reappearance and increase of infections which are known, but had formerly fallen to levels so low that they were no longer considered a public health problem.

WHO-facilitated outbreak responses in the field, 1998–2003



Microbes are unpredictable!

World Health Organization

A Changing World !

- Collapse of public health infrastructure Poverty, urbanisation and population displacement
- Environmental exploitation and degradation
- omplex and natural disasters

A Changing World !

- Development of antimicrobial resistance
- Animal diseases crossing into human populations
- Globalisation of travel and trade
- Inappropriate social, political and economic responses to outbreaks

Acute encephalitis, cause unknown, outbreak in Malaysia 1998-1999

Novel virus named Nipah virus was found.

◆ Nipah virus infection

Fruit Bat　no illness

↓

Pig　pneumonia, encephalitis

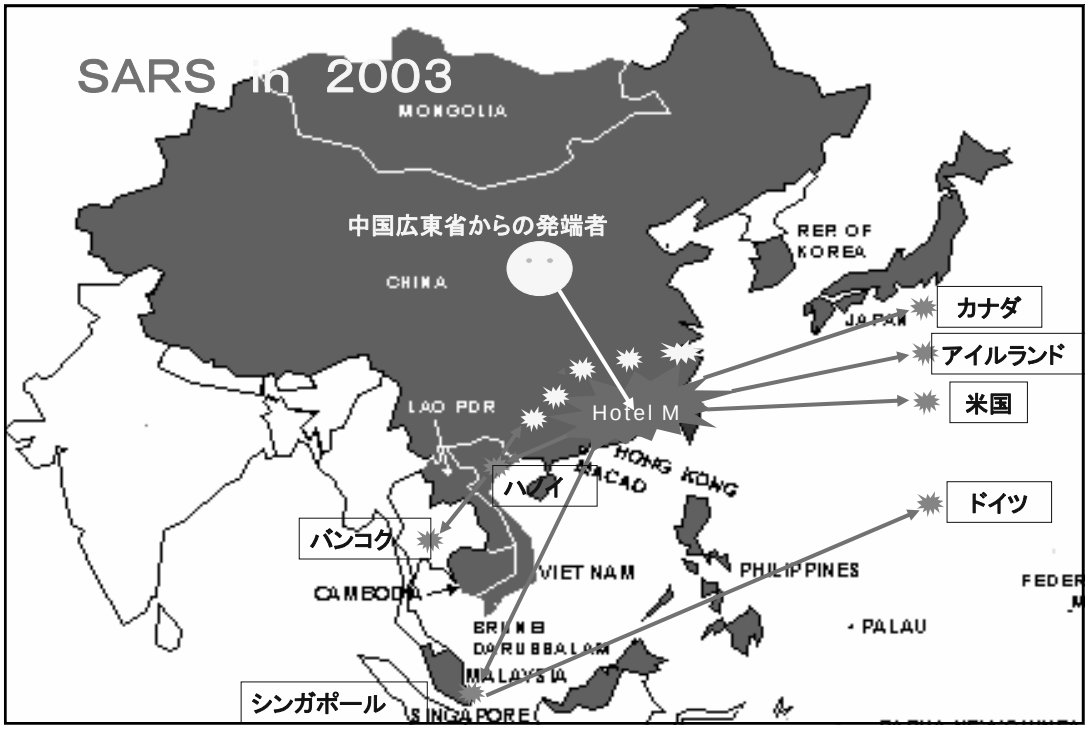
↓

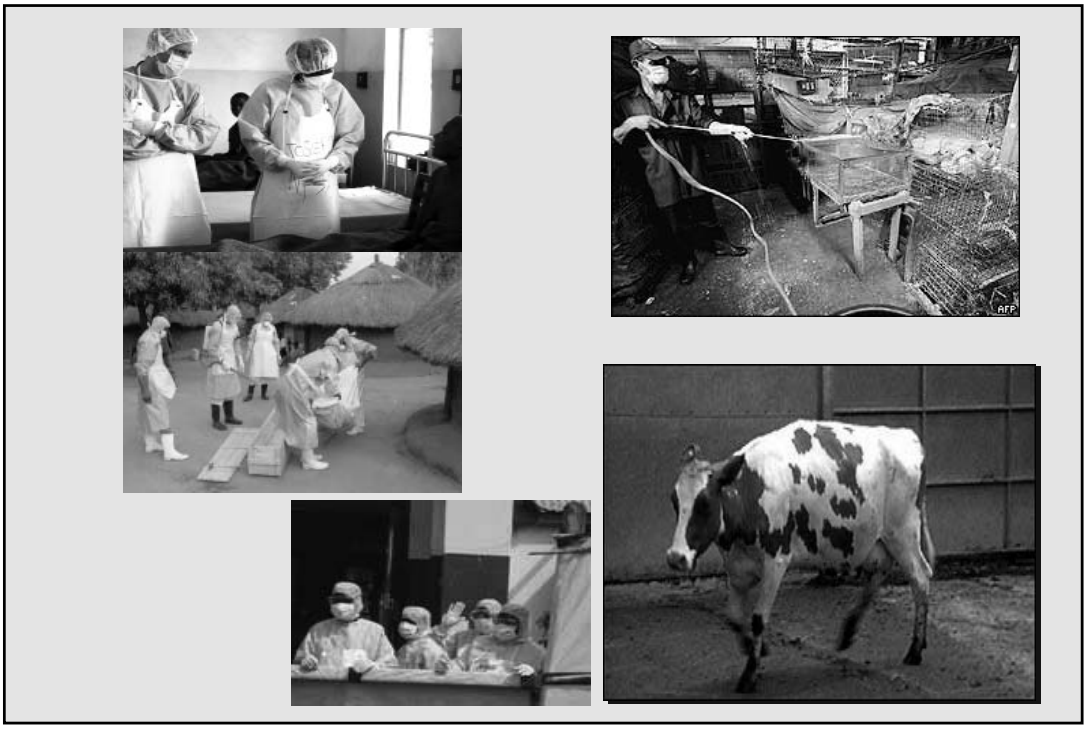
Human　encephalitis

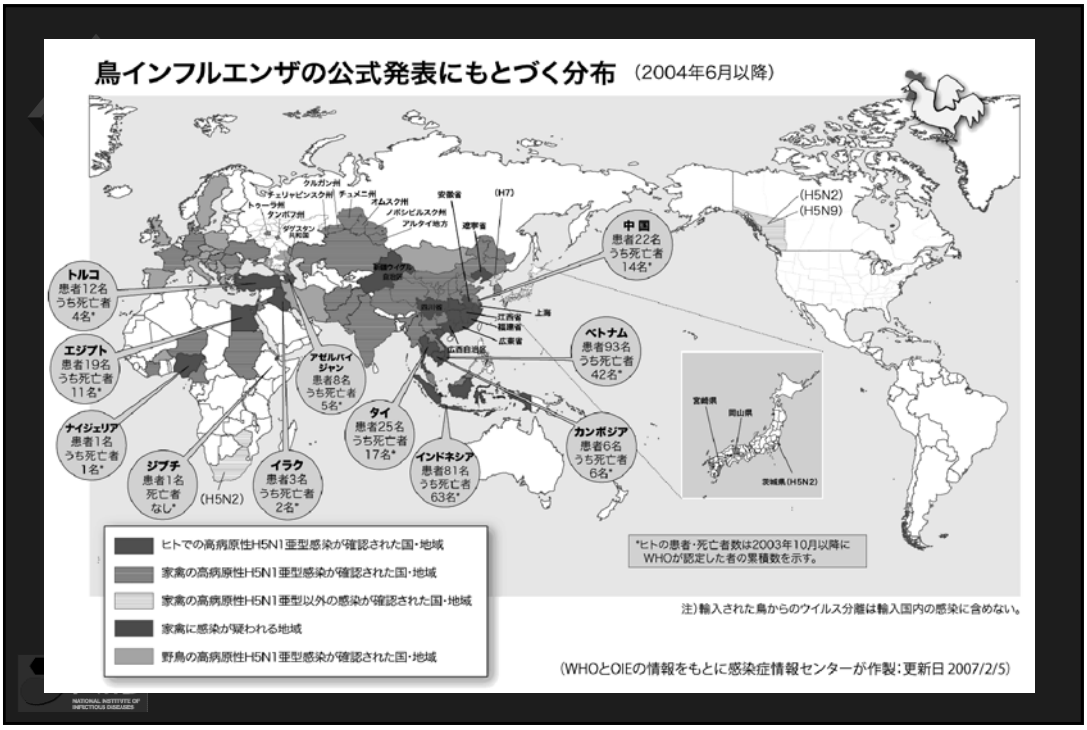
1999　Malaysia

2005　Bangladesh

2007　India？

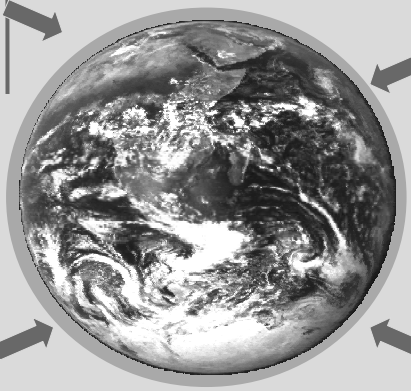





鳥インフルエンザの公式発表にもとづく分布 (2004年6月以降)
トルコ
患者12名
うち死亡者
4名*
エジプト
患者19名
うち死亡者
11名*
ナイジェリア
患者1名
うち死亡者
1名*
ジブチ
患者1名
死亡者
なし*
(H5N2)
イラク
患者3名
うち死亡者
2名*
アゼルバイジャン
患者8名
うち死亡者
5名*
タイ
患者25名
うち死亡者
17名*
インドネシア
患者81名
うち死亡者
63名*
カンボジア
患者6名
うち死亡者
6名*
ベトナム
患者93名
うち死亡者
42名*
中国
患者22名
うち死亡者
14名*
(H5N2)
(H5N9)
(H7)
ヒトでの高病原性H5N1亜型感染が確認された国・地域
家禽の高病原性H5N1亜型感染が確認された国・地域
家禽の高病原性H5N1亜型以外の感染が確認された国・地域
家禽に感染が疑われる地域
野鳥の高病原性H5N1亜型感染が確認された国・地域
*ヒトの患者・死亡者数は2003年10月以降にWHOが認定した者の累積数を示す。
注)輸入された鳥からのウイルス分離は輸入国内の感染に含めない。
(WHOとOIEの情報をもとに感染症情報センターが作製:更新日 2007/2/5)

Additoinal Situation on Infectious Diseases: Bioterolism

Fungal infections
- **Coccidioidomycosis**



Bacterial infections
- **Plague**
- **Anthrax（炭疽）**
- **Tularaemia**

Ricketsial infections
- **Typhus**
- **Rocky Mountain spotted fever**

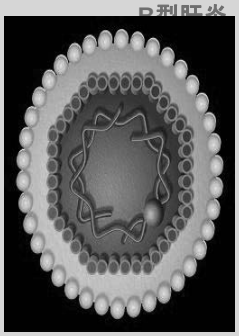
Virus infections
- **Arbovirus**
- **Filoviruws**
- **Small pox（天然痘）**

A region where no children suffer from……

Polio（ポリオ）

Measlesはしか

Hepatitis B
B型肝炎



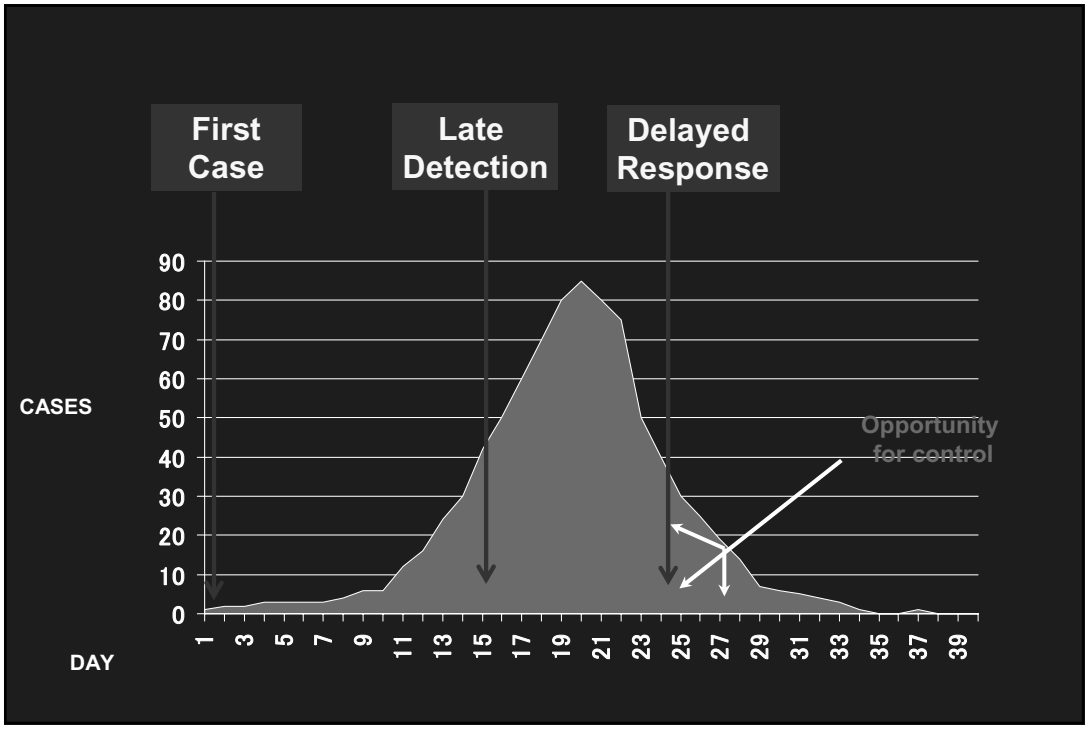
Neonatal Tetanus
破傷風

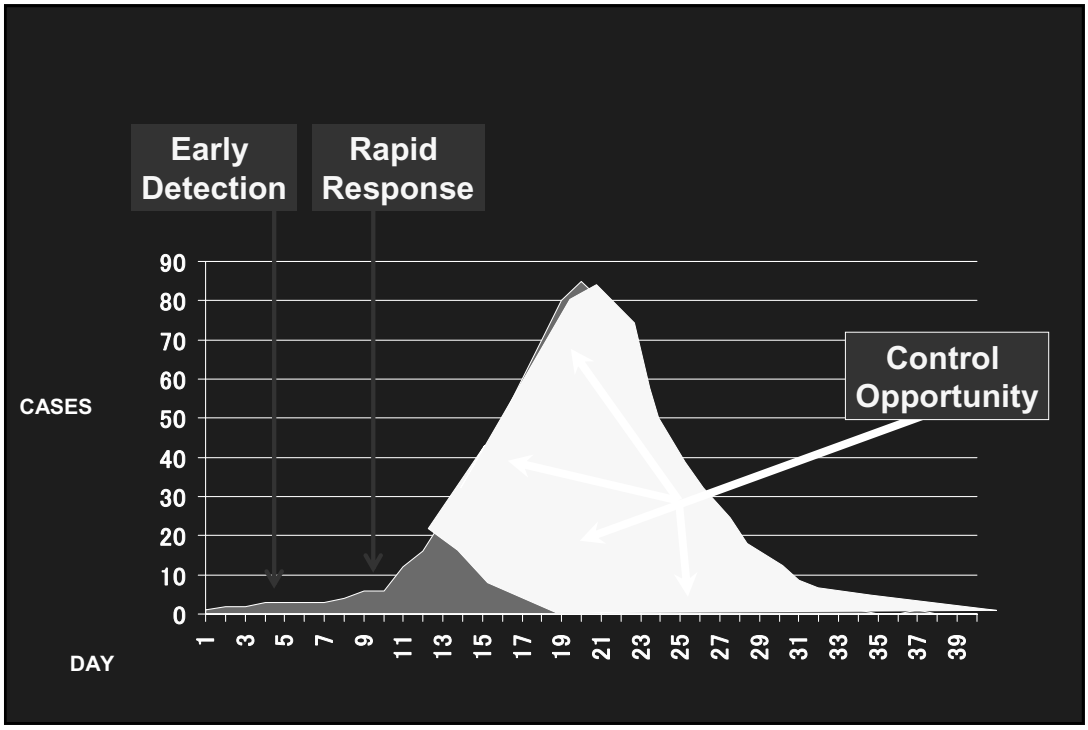
and diphtheria, pertussis & infant tuberculosis

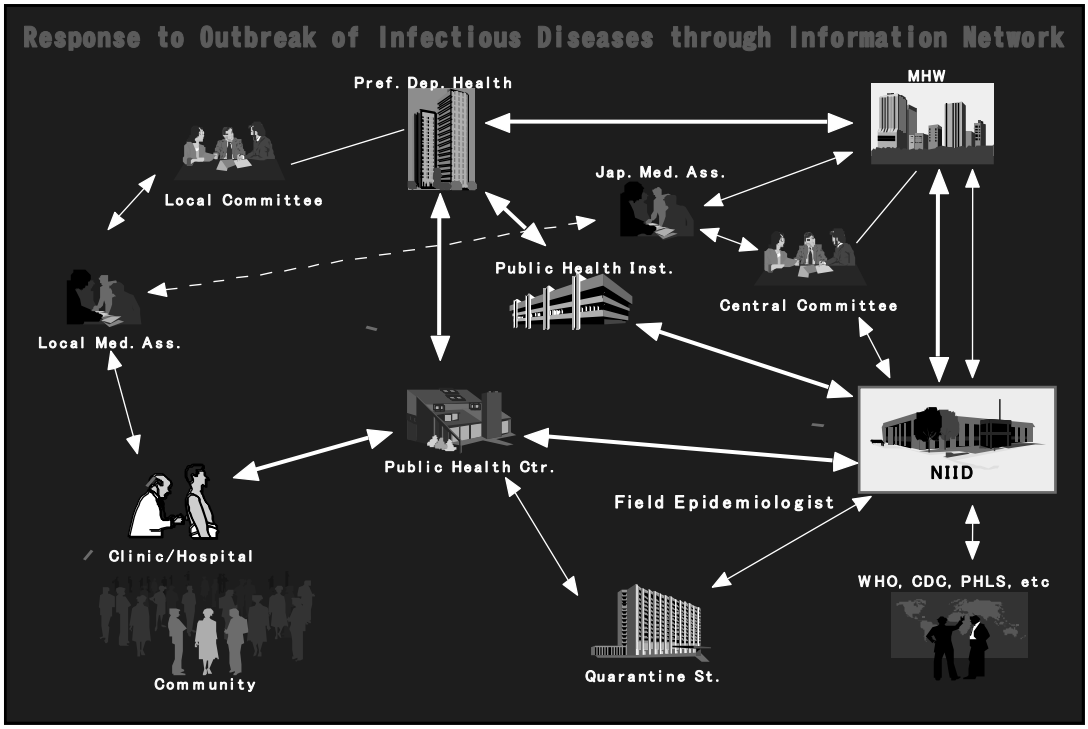
WHO Regional Measles Elimination Targets（はしか　排除）

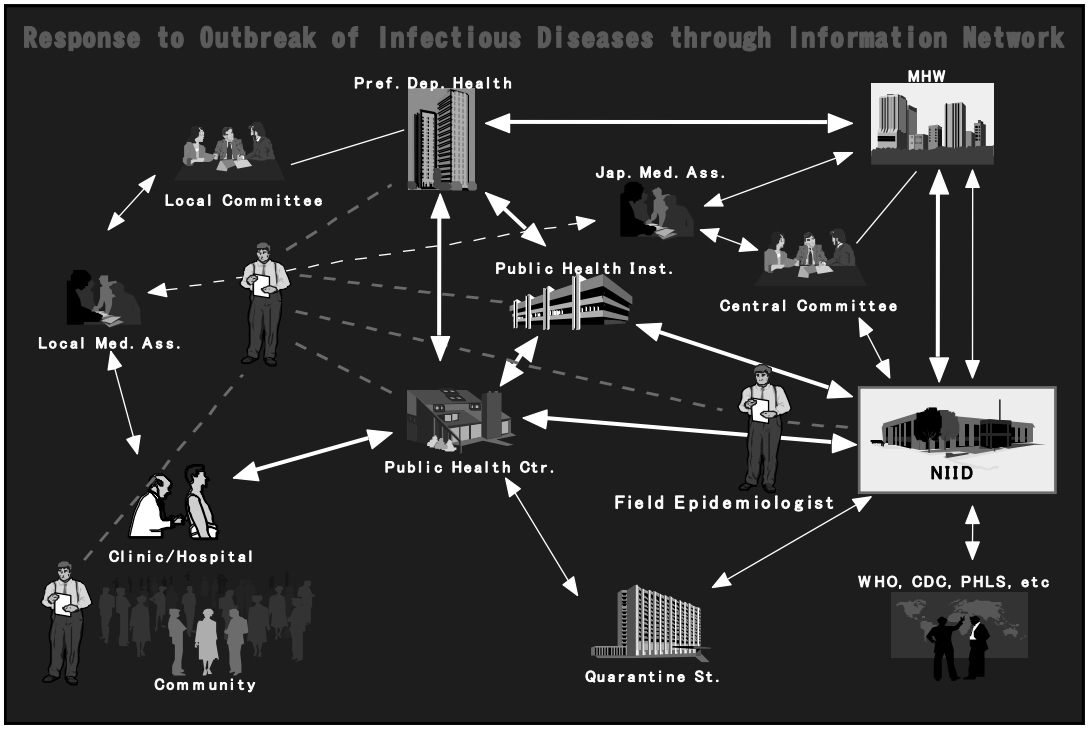
Infectious Diseases Control

- **Prevention**
  - **Hygiene (personal, public)**
  - **Immunization**
- **Diagnosis**
  - **Clinical Diagnosis**
  - **Microbiological Diagnosis**
- **Treatment**
- **Surveillance**


First Case
Late Detection
Delayed Response
CASES
DAY
Opportunity for control


Early Detection
Rapid Response
CASES
DAY
Control Opportunity


Response to Outbreak of Infectious Diseases through Information Network
Pref. Dep. Health
MHW
Local Committee
Jap. Med. Ass.
Public Health Inst.
Central Committee
Local Med. Ass.
Public Health Ctr.
NIID
Field Epidemiologist
Clinic/Hospital
WHO, CDC, PHLS, etc
Community
Quarantine St.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Central Committee
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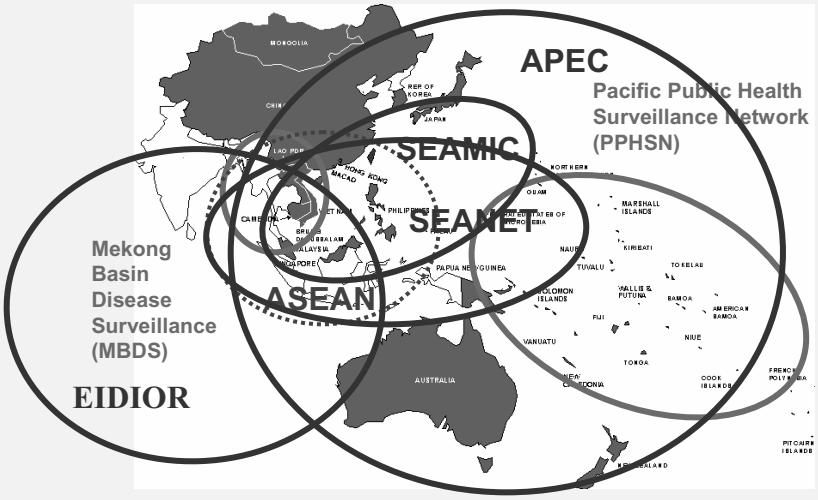
Public Health Ctr.
NIID
Field Epidemiologist
Clinic/Hospital
WHO, CDC, PHLS, etc
Community
Quarantine St.

Epidemic/Pandemic Control Requirements

1. Strong national public health systems and capacity
2. Specific preparedness for key priority disease threats (e.g. diagnostics, therapies, vaccines, containment measures)
3. *An effective international system and partnership for coordinated alert and response*

Surveillance networks in Asia



Global health protection - the challenges

No single institution has all the capacity!

Thank you !

Arigatou

ありがとうございました

IDSC Infectious Disease Surveillance Center 国立感染症研究所 感染症情報センター

NIID NATIONAL INSTITUTE OF INFECTIOUS DISEASES 国立感染症研究所

Converging Technologies to Combat Emerging Infectious Diseases (EID): Technology Roadmap Workshop

May 22-23, 2007,Toshi Center Hotel, Tokyo

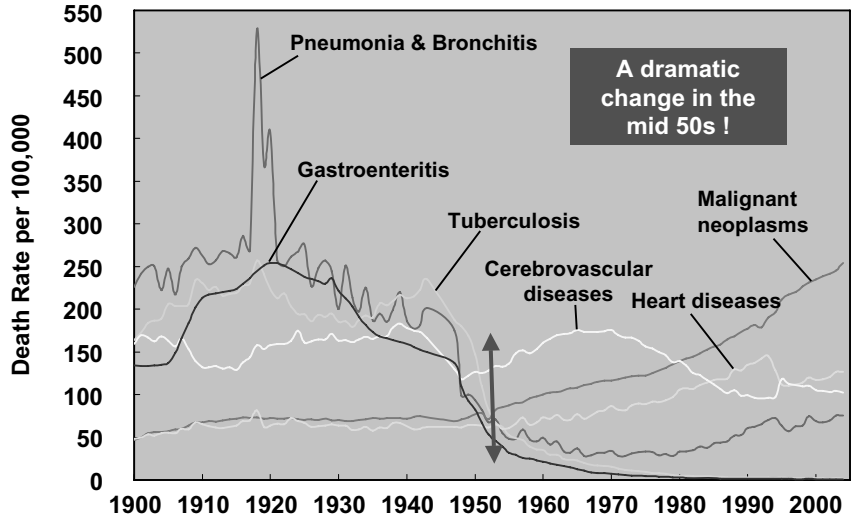
Keynote speech 2

Asian Research Network for Infectious Diseases. Its Concept, Aims and Activities

Yoshiyuki Nagai and Yoshiko Okamoto

Center of Research Network for Infectious Diseases (CRNID), RIKEN Institute

Mortality Trends for Leading Causes of Death in Japan

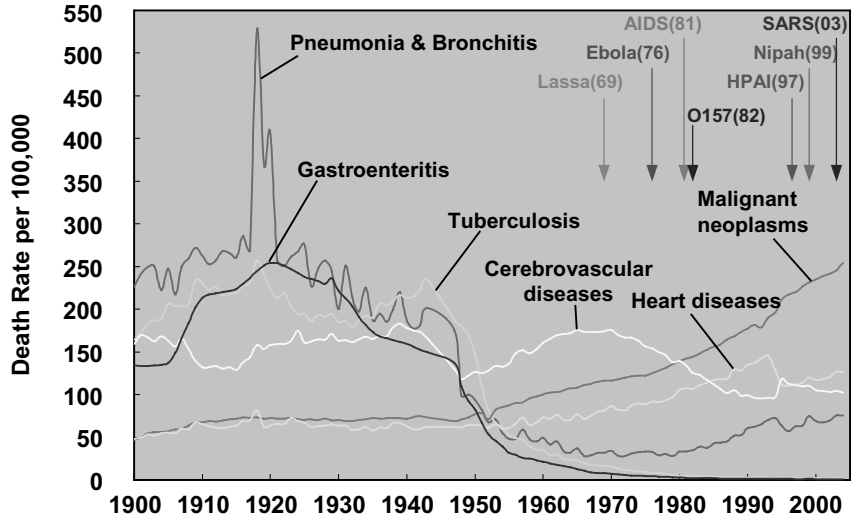


Source: Vital Statistics of Japan, Statistics and Information Dept., Minister's Secretariat, Ministry of Health, Labour and Welfare

The society believed that mankind had overcome major infectious diseases.

Consequently, the focus on research into infectious diseases lost its prominence and human resources eager to carry out research in this area declined, resulting in the compromise of Japan's readiness in taking measures against emergency public health situations caused by infectious diseases.

Mortality Trends for Leading Causes of Death in Japan



(Source: Vital Statistics of Japan, Statistics and Information Dept., Minister's Secretariat, Ministry of Health, Labour and Welfare)

The subsequent turn of events including the recent global outbreak of SARS and emergence and spread of HPAI was enough to make us once again keenly realize that infectious diseases represent one of the most pressing medical issues and seriously reconsider the Japan's readiness against infectious diseases.

More conventional diseases such as AIDS, malaria, tuberculosis continue to be major threats to mankind worldwide.

We have learned from these circumstances that infectious diseases have no border and the need of close international research collaboration to cope with them, especially the collaboration among Asian countries.

Against these backdrops, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) determined to revitalize research and train human resources in the research area by launching in the 2005 fiscal year the PROGRAM OF FOUNDING RESEARCH CENTERS FOR INFECTIOUS DISEASES.

The PROGRAM

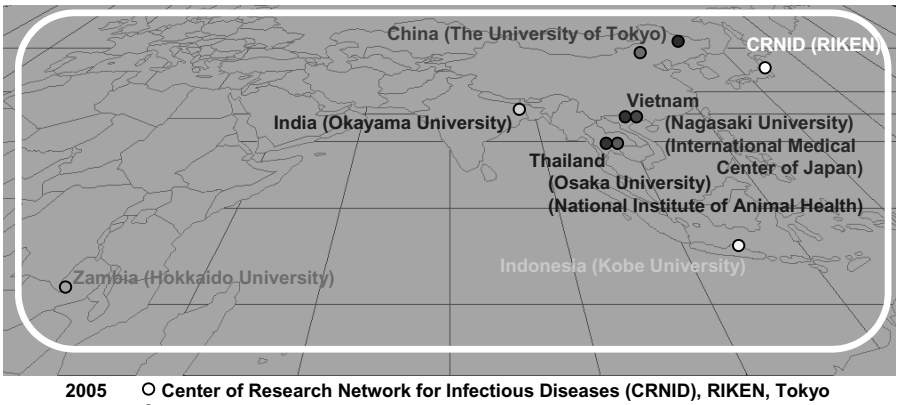
(1)selects some domestic institutions (Research Centers) that have a potential to become a strong research point for emerging and reemerging infections (ERI) and reinforces their infrastructures and facilities,

(2)promotes bilateral joint efforts by encouraging each Research Center to establish a overseas collaboration base in partnership with the local institution in a country where ERI are breaking out or will likely break out,

and

(3)sets up the Center of Research Network of Infectious Diseases (CRNID) at RIKEN as a support, operation and coordination center of the whole program.

Bilateral Collaboration Bases for Emerging and Reemerging Infectious Diseases and Their Networking



2005
- ○ Center of Research Network for Infectious Diseases (CRNID), RIKEN, Tokyo
- ● National Institute of Health, Thailand – (Osaka University)
- ● National Institute of Animal Health, Thailand – (National Institute of Animal Health)
- ● National Institute of Hygiene and Epidemiology, Vietnam – (Nagasaki University)
- ● Bach Mai Hospital, Vietnam – (International Medical Center Japan)
- ● Chinese Academy of Sciences, China – (The University of Tokyo)
- ● Chinese Academy of Agricultural Sciences, China – (The University of Tokyo)

2007
- ○ National Institute of Cholera and Enteric Diseases, India – (Okayama University)
- ○ Tropical Disease Center, Airlangga University, Indonesia – (Kobe University)
- ● The University of Zambia, Zambia – (Hokkaido University)

RCC (Research Collaboration Center)
NIH (Bangkok, Thailand) - Osaka University

- **Viruses**
  - **HIV/AIDS, avian flu, dengue, hepatitis E & enteric viruses**
- **Bacteria**
  - **enteric & respiratory bacteria**
- **Bioinformatics**

Center for International Collaborative Research (Friendship Lab)
NIHE (Hanoi, Vietnam) - Nagasaki University

- **Zoonosis**
  eg. Avian flu, virus surveillance in bats
- **Insect borne infections**
  eg. Dengue, West Nile, JE
- **Food borne infections**
  eg. Viral gastroenteritis
- **Human to human infections**
  eg. SARS, TB

Japan-China Joint Research Laboratories on Emerging Infectious Diseases

Inst. Med. Sci. Univ. Tokyo —

CAS (Beijing)

Institute of Biophysics

Institute of Microbiology

CAAS (Harbin)

Harbin Veterinary Research Institute
National AI Reference Laboratory

- Avian Influenza (Harbin)
- HIV, Viral Hepatitis (Beijing)
- Structural Biology of Infection-Related Proteins (Beijing)

University of Zambia (Lusaka, Zambia)-Hokkaido University Research Center for Zoonosis Control

- **Ebola hemorrhagic fever**

  Surveillance, molecular pathogenesis

- **Influenza**

  Surveillance, diagnosis, molecular pathogenesis

- **Mycobacterium**

  Diagnosis technology

Other Joint Efforts

Thailand NIAH (Bangkok) – JP NIAH: Avian & swine flu

Vietnam Bach Mai HP (Hanoi) – IMCJ: AIDS, TB, flu

Indonesia Airlangga-U (Surabaya) – Kobe-U: Avian flu, Viral hepatitis

India NICED (Kolkata)– Okayama-U: Cholera, Bacterial diarrhea

NIAH Thailand

Bach Mai HP Vietnam

TDC Indonesia

NICED India

Creeds and Aims

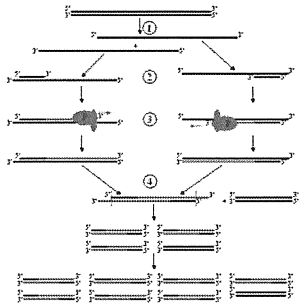
The bilateral joint efforts are based on equal partnership and love for public, and aim to contribute to security and safety of Japan and each counterpart by facilitating (1) *better understanding of infectious diseases of the regional and/or global impact,* (2) *technology innovation for their diagnosis, treatment and prevention,* and (3) *human resources development in the field*.

Attempts to Converge Modern Technologies on Rapid and Accurate Identification of the Causative Agents on an Occasion of EID Outbreak

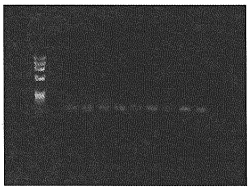
- Conventional Technologies: Staining, EM, Culture, Serology etc.
- Modern Technologies: Nucleotide Sequence (Molecular Biology)-based, combined with IT

PCR (polymerase chain reaction)

X20
95℃
65℃
72℃



Agarose gel electrophoresis

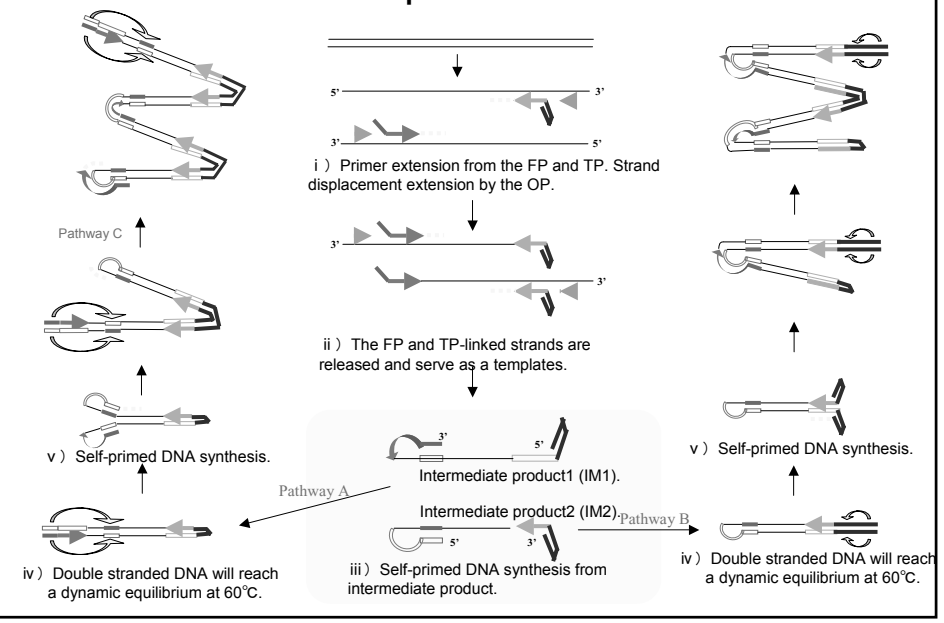


It needs a thermal cycler and multi-step procedure (PCR in a test tube followed by detection of the amplified products by gel electrophoresis.

Comparison of three methods for diagnosis

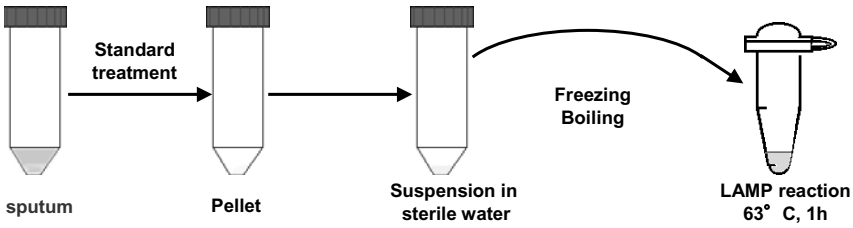
	PCR (Polymerase Chain Reaction)	LAMP (Loop-Mediated Isothermal Amplification)	SMAP (Smart Amplification Process)
Developed by	Roche Diagnostics, Co. Ltd.	Eiken Chem. Co. Ltd.	RIKEN and Dnaform Co. Ltd.
Amplification temperature	Thermal cycling (4℃～95℃)	Isothermal (65℃)	Isothermal (60℃)
Sensitivity	High	High	High
Cost for Equipments	High	Very Low	Low
Feature	Conventional method	Low cost Fast detection	Fastest detection High fidelity (useful for SNPs analysis)
Disadvantage	Time (1.5hr)	Difficult primer design	Difficult primer design

The whole procedure of LAMP & SMAP amplification



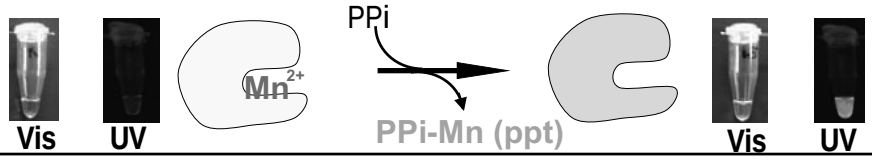
Detection of *M. tuberculosis* by LAMP

Standard procedure for TB-LAMP



LAMP reaction can be seen by naked eyes or under UV lamp with FDR

FDR: Fluorescent Detection Reagent

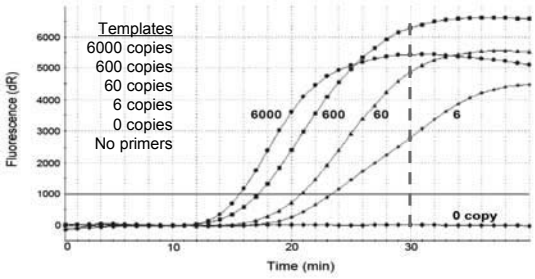


Detection of tubercle bacilli (TB) in sputum from Thailand by LAMP

Specimen ID	smear	culture (4-8 wks)	LAMP (60 min)
514826	-	-	-
514827	1+	+	+
514814	2+	+	+
514815	2+	+	+
514935	2+	+	+
514838	2+	-	-
514841	2+	+	+
514855	2+	+	+
514819	2+	+	+
514878	3+	+	+
515027	3+	NTM	-
514944	3+	+	+

Features of SMAP

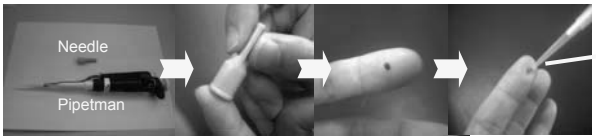
- Fastest detection within15-30 min
- Amplification = detection (No background)
- Sensitivity
- Low energy requirements (isothermal amplification)



Real-time detection by measuring fluorescence intensity of SYBR Green I

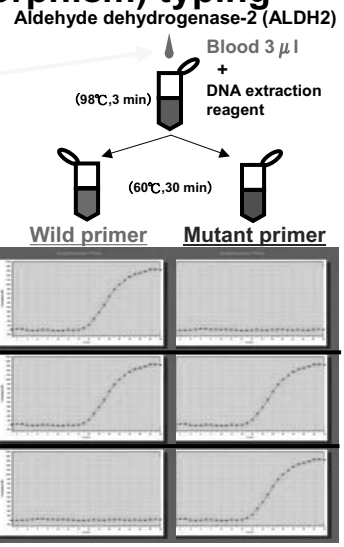
More compact (mobile) device is under developing

SNP (Single Nucleotide Polymorphism) typing



Genotype	ALDH2 Activity	Alcohol Sensitivity (flushing experience)	The rate classified by race of an appearance		
			Negroid	Caucasian	Mongoloid (Japanese)
Wild 2*1/2*1	High	Non-flusher	100%	100%	56%
Hetero 2*1/2*2	Low	Light flusher	0%	0%	40%
Mutant 2*2/2*2	Very Low	Flusher	0%	0%	4%

Aldehyde dehydrogenase-2 (ALDH2)



Aldehyde dehydrogenase 2 (ALDH2)

Genome : -ACACTGAAGTG- -ACACTAAAGTG-

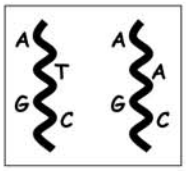
Amino acid : Glutamic acid Lysine

Enzyme activity : High Low

Y.Hayashizaki

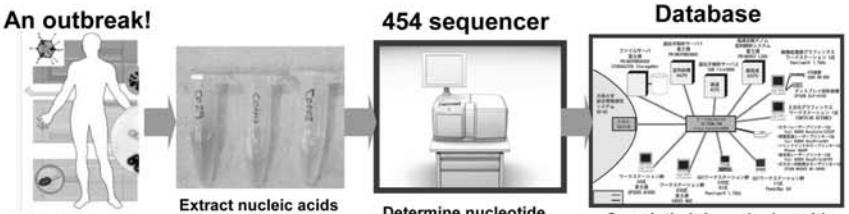
SMAP
to monitor mutations in avian flu H5N1

- Tamiflu resistance (NA gene)
  - H274Y and N294S
- Receptor (avian to human) change (HA ge
  - S223N, Q192R, G139R and N182 K
    (Increased affinity to human receptor)
- Human pathogenicity marker (PB2)
  - E627K
    (Cause severe symptom in human)



RAPID

Robotics-Assisted Pathogen Identification



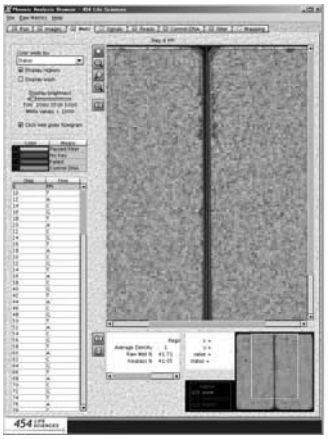
~1 Week

Question: Is it a known pathogen, unknown but related to some known one, or completely new one?

Identify the agent or narrow the candidates down

Answer:It is smallpox; completely unknown; related to human/ animal corona viruses but new.

Three steps in *RAPID*



(1) Sample preparation

The best way is under developing

(2) Sequence

Amplification and beads preparation

Applied to 454 sequencer

24hr

200,000 Read X ◯ (100b)

Follow the maker's instruction

(3) Homology search How to reduce the time?

100 base nucleotide sequence	acctagagacaaaatgttcctagtgcgcattatgtggcgcggcattatgttgaggggcag tcgtcagtaccattgcgccagcactgacggcctcacttgc

↓

Public DNA database

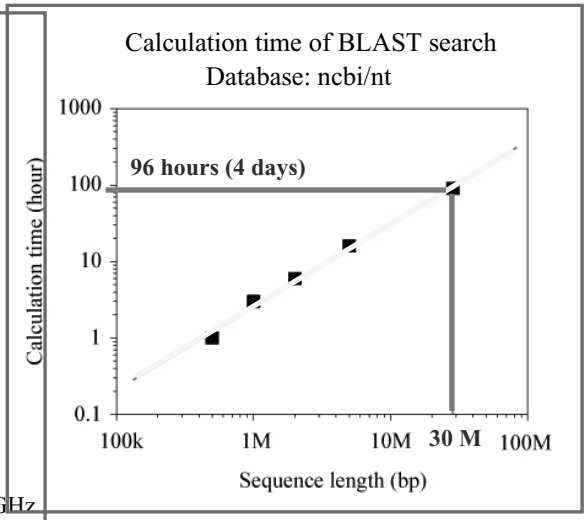
Sequences producing significant alignments:

(Click headers to sort columns)

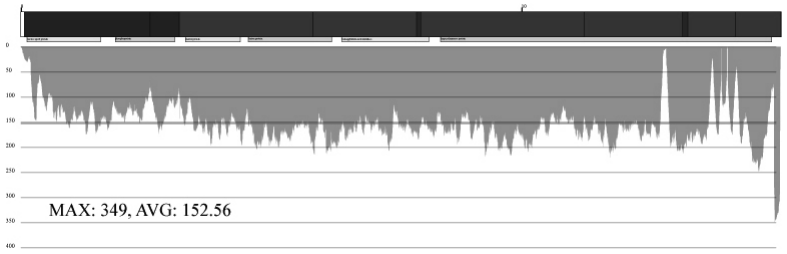
Accession	Description	Max score	Total score	Query coverage	E value	Max ident	Links
AB299800.1	Vibrio cholerae O1 DNA, Vibrio phage CTX, Vibrio phage fs2 regions, strain: Bgd 17	196	196	100%	9e-48	100%	
AB299799.1	Vibrio cholerae O139 DNA, Vibrio phage CTX, Vibrio phage fs2 regions, strain: AI 4450	163	163	100%	9e-38	94%	
AE003852.1	Vibrio cholerae O1 biovar eltor str. N16961 chromosome I, complete sequence	113	113	60%	9e-23	98%	
AY349614.1	Bacteriophage HybRS-Knphi att-RS1/VGJ junction region, complete sequence	113	113	60%	9e-23	98%	
AY242529.1	Vibrio cholerae phage VGJphi attL region integrated at chromosomal attRS site	113	113	60%	9e-23	98%	
AB002632.1	Vibrio cholerae filamentous bacteriophage fs-2 DNA, complete genome sequence	113	113	60%	9e-23	98%	G
CP000627.1	Vibrio cholerae O395 chromosome 2, complete genome	111	111	56%	3e-22	100%	
CP000626.1	Vibrio cholerae O395 chromosome 1, complete genome	111	111	56%	3e-22	100%	
AF238372.1	Filamentous phage CTXphi zona occludens toxin gene, partial cds	111	111	56%	3e-22	100%	
AY349175.1	Vibrio cholerae strain 97-73 hypothetical protein gene, partial cds;	106	106	56%	1e-20	98%	
AF511003.1	Vibrio phage CTX Zot (zot) gene, partial cds	106	106	56%	1e-20	98%	
AF510995.1	Vibrio phage CTX Zot (zot) gene, partial cds; and CtxA (ctxA) and CtxB (ctxB) genes, complete cds	106	106	56%	1e-20	98%	
AF510994.1	Vibrio phage CTX Zot (zot) gene, partial cds; and CtxA (ctxA) and CtxB (ctxB) genes, complete cds	106	106	56%	1e-20	98%	
DQ012295.1	Vibrio phage CTX CtxB (ctxB) gene, partial cds; RstR (rstR), RstA (rstA), and RstB (rstB) genes, complete cds; and Cep (cep) gene, partial cds	106	106	56%	1e-20	98%	

Data-processing System

Fujitsu PRIMERGY－L200
16 nodes, 32CPU Pentium III 1.2 GHz
Hi-per BLAST System
Installed in Yasunaga Lab.,
Genome Information Research Center



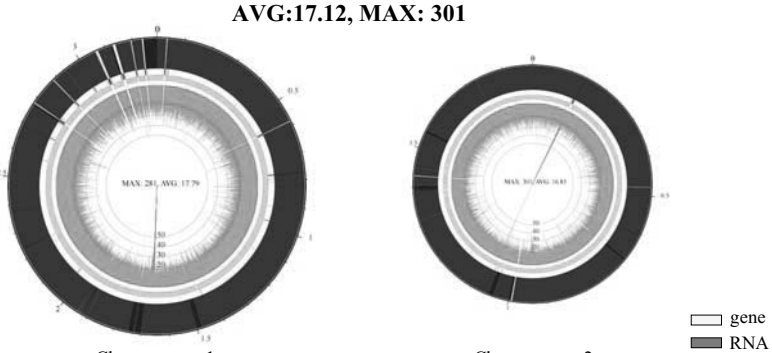
Newcastle Disease Virus



	Total read	Coverage
NDV	24,053	99.80%

Vibrio Parahaemolyticus

AVG:17.12, MAX: 301



Chromosome. 1 Chromosome. 2

	Total reads	Coverage
Chr. 1	581,831	98.00 %
Chr. 2	311,820	99.43 %
Total	893,651	98.52 %

454 system to identify unknown virus

NATURE Vol 447 3 May 2007

Rapid sequencer puts virus in the frame for deaths

The discovery of a virus that may have killed three transplant recipients in Australia could mark a dramatic acceleration in the speed at which new pathogens can be identified. But it raises concerns that the ease with which such suspects can now be found could lead to researchers overlooking the need to firmly establish them as the cause of the disease in question. Fingering the wrong microbe could lead to inappropriate treatment or divert attention

The three patients received organs from a single donor in Melbourne in December 2006. By January all three were dead. Ian Lipkin of Columbia University's Mailman School of Public Health in New York, who specializes in identifying new pathogens, heard about the case and collaborated with the Australian researchers who

Transplanted organs can

for thousands of telltale signs of known pathogens without success, Lipkin, who sits on the advisory board of 454 Life Sciences in Branford, Connecticut, decided to use the company's technology to sequence genes from samples that had been filtered to enrich their non-human DNA component.

144,000 fragments of sequence later, a homemade algorithm in Lipkin's lab had pulled out 14 gene fragments that looked viral. Preliminary, unpublished analyses suggest they come from a new member of the family Arenaviridae. Although this sort of sequencing has been used to identify viruses in the past, the 454 technology cuts down on time and effort, says Anthony Fauci, director of the US National Institute of Allergy and Infectious Diseases, which funded part of Lipkin's work. Lipkin estimates that the technique could be used to process samples in a matter of days.

But simply finding a virus is not enough, cautions microbiologist David Wang of Washington University in St Louis. Establishing that the virus actually caused the deaths is also critical, and is a lot harder. At present, the virus has been found in tissue from all three patients, and not in tissue from 60 controls. The virus's closest relative seems to be the lymphocytic choriomeningitis virus, which is believed to have killed organ-transplant patients in the past. But the team does not know whether the virus was also present in the donor. Lipkin says donor tissue samples have not been supplied to him by his Australian collaborators.

The guilt-by-association approach to pathogens can be misleading, warns microbiologist David Relman of Stanford University. Viruses do not necessarily behave in the same way as their closest known relatives. And the very fact that these new techniques work with raw sequence, rather than entities that could be grown and studied in the lab, makes follow-up experiments more challenging.

"It's not hard to find somebody you can implicate," says Relman, in police-procedural mode. "What's really hard is to nail the conviction." ■

Heidi Ledford

13

RAPID: New DNA sequencing technology (454 life sciences)

- **Features**
  - **20Mb sequencing within 24 hr**
  - **No need of specific primer nor probe**
  - **No need of pathogen containment facility**
- **Problems to be solved**
  - **Elimination of DNA/RNA from human materials**
  - **High cost (machine; appx.$1 million, running cost; $8300 per run)**
  - **Speed up information processing**

New technologies for diagnosis

- Simple, inexpensive and quick
  - ***LAMP***
- Useful to monitor point mutations
  - ***SMAP***
- Useful to identify unknown pathogens
  - ***RAPID***

SUMMARY

1. Recombinant DNA technology (P. Berg, 1972) → Nucleotide sequencing (viral genomes in 1980s, bacteria genomes in 1990s) → A large body of database has become available.

2. *PCR* **(K. M. Mullis, 1986) based on known sequences is becoming a routine technology to detect pathogens in both developing and developed countries.**

3. PCR-based concept was developed into more sophisticated, yet inexpensive technologies such as *LAMP* **and** *SMAP***.**

4. Early in 80s, at least several months were required to decide an entire viral genome sequence of e.g. only 15 kb, because all procedures were manual and because of the lack of software that would help reconstitute the fragments of sequences into the whole genome. However, it is now possible within hours by robotic *RAPID***. Even bacterial genomes with millions of bases can now be sequenced rapidly by** *RAPID***.**

Who could predict such rapid progress in BT!

SUMMARY - continued

5. Novel new, revolutionary technologies will further come onstage that will deserve introduction to cope with infectious diseases. We therefore have always to be as close to the advance of BT as well as IT as possible.

6. Those inexpensive technologies such as *LAMP* and *SMAP* can be introduced into developing countries, and those expensive system such as *RAPID* should be set up in a developed country so that it will be shared with many other countries, although some (*SMAP* and *RAPID*) need to be verified for their feasibility.

7. Human resources (specialists) development is a crucial issue to converge technologies available currently and in the near future on the fights against infectious diseases..

Thank you very much.

NECTEC
a member of NSTDA

Emerging Technologies
&
Potential ICT Infrastructure for EID Research Collaboration

Chalermpol Charnsripinyo

Technology Roadmap Workshop:
Converging Technologies to Combat Emerging Infectious Diseases (E
22-24 May 2007
Toshi Center Hotel, Tokyo, Japan

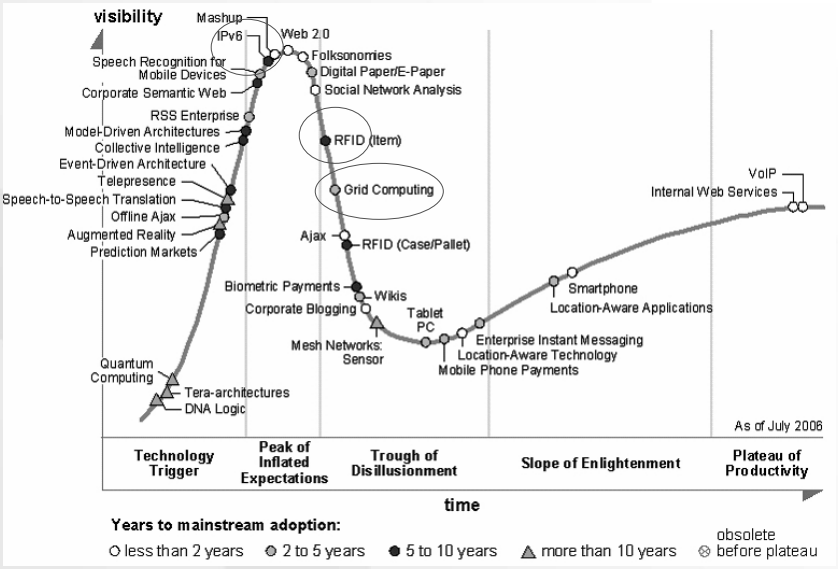
A Driving Force for National Science and Technology Capability

Outline

- Emerging Technologies
- ICT Infrastructure for Research Collaborations
- Examples and Projects
- Concluding Remarks

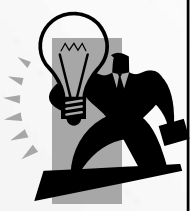
A Driving Force for National Science and Technology Capability

Gartner's 2006 Emerging Technology Hype Cycle

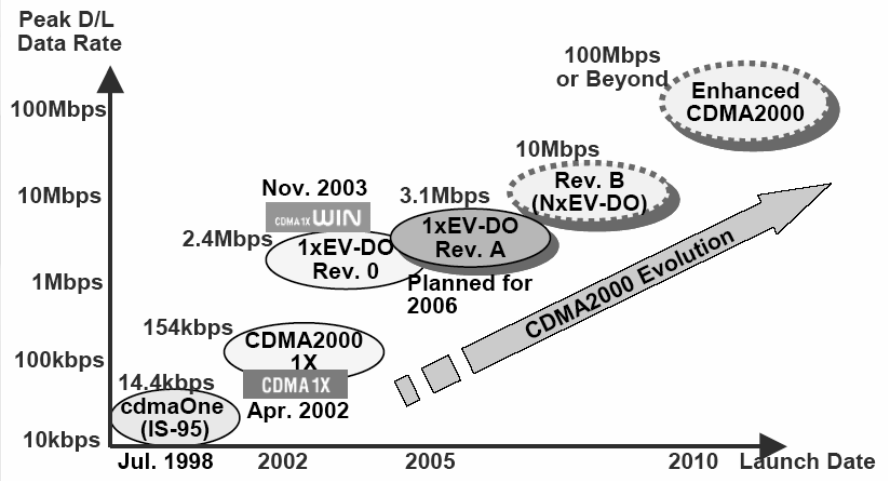


Source: http://www.gartner.com/it/page.jsp?id=495475

Emerging Technology: Wireless Networks



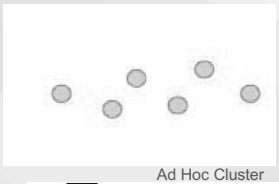
Mobile Phone System Evolution



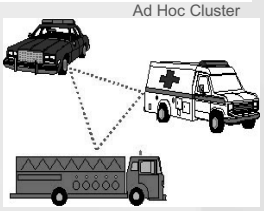
Source: ITU-T workshop "NGN and its Transport Networks", April 2006

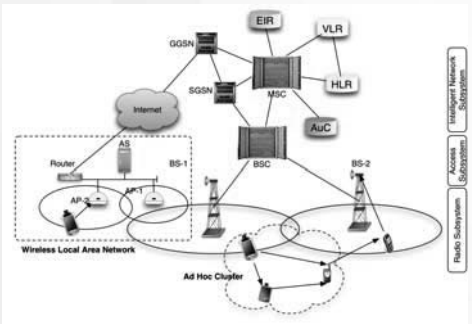
Wireless Ad Hoc Network

- A LAN or other small networks with wireless connections, in which some of the network devices are part of the network only for the duration of a communication session (in the case of mobile or portable devices), while in some close proximity to the rest of the network.
- Useful when infrastructure not available, impractical, or expensive
  - Home networking, Emergency services, Disaster recovery, Military applications



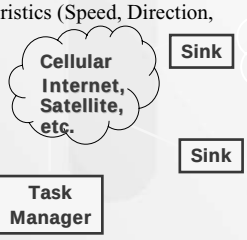
Ad Hoc Cluster





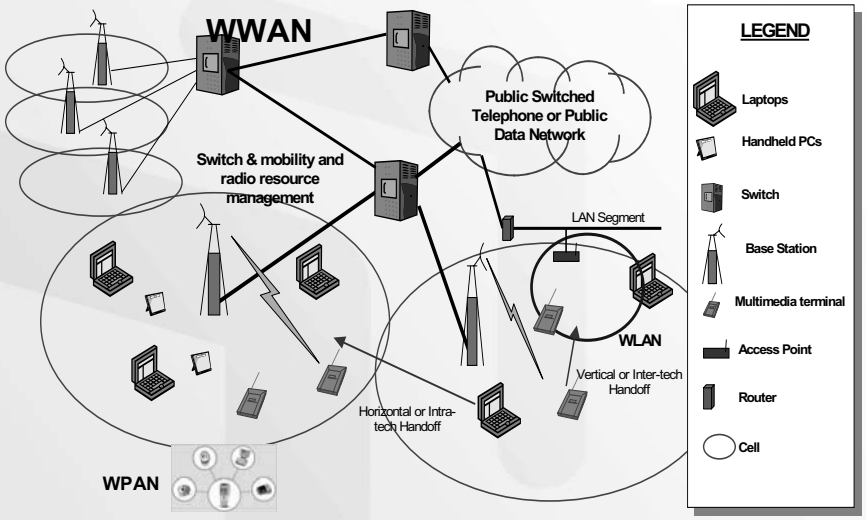
SENSOR NETWORKS

- Specialized wireless networks to gather data from a specific system – usually no mobility of sensor nodes
  - APPLICATIONS
    Military, Environmental, Health, Home, Space Exploration, Chemical Processing, Disaster Relief….
  - SENSOR TYPES:
    Seismic, Low Sampling Rate Magnetic, Thermal, Visual, Infrared, Acoustic, Radar…
  - SENSOR TASKS:
    Temperature, Humidity, Vehicular Movement, Lightning Condition, Pressure, Soil Makeup, Noise Levels, Presence or Absence of Certain Types of Objects, Current Characteristics (Speed, Direction, Size) of an Object ….



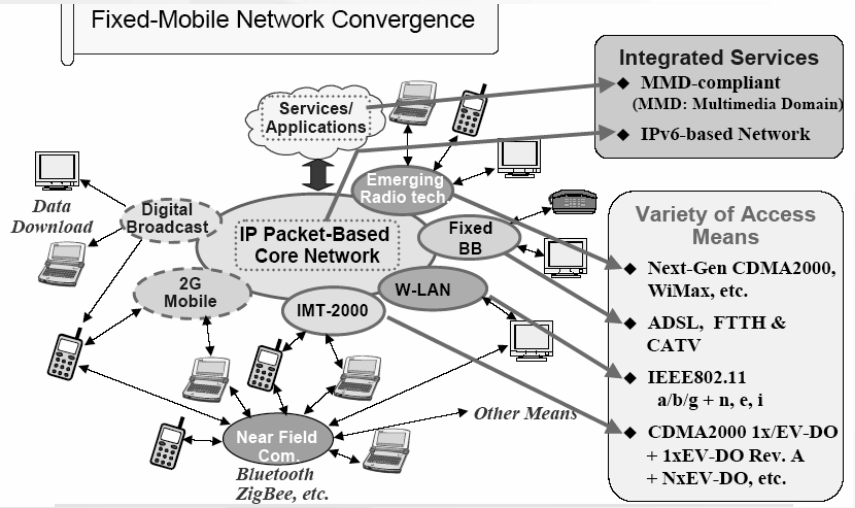
A Driving Force for National Science and Technology Capability

Example of Future Wireless Networks



A Driving Force for National Science and Technology Capability

Example: KDDI's "Ultra-3G" Vision



Source: ITU-T workshop "NGN and its Transport Networks", April 2006

Emerging Technology: IPv6

- IPv6 is the Internet Protocol Version 6 designed by IETF to replace current IP (IPv4)

- **IPv6 Advantages**
  - ➢Much larger address space (128 bits)
  - ➢Trust network: real IP address access
  - ➢More efficient header format
  - ➢Improved routing
  - ➢Enhanced security and QoS
  - ➢Improved support for mobile IP and mobile computing devices
  - ➢Support Multicast and Anycast

- **IPv6 deployment issues**
  - ➢Transition takes time.
  - ➢Mechanisms for solving IPv4 address problem are used
    - ▪Network Address Translation (NAT)
      - –Internet becomes InterNAT!
      - –Not for IPSec, QoS
    - ▪Dynamic Host Configuration Protocol (DHCP).
  - ➢No Killer Application yet

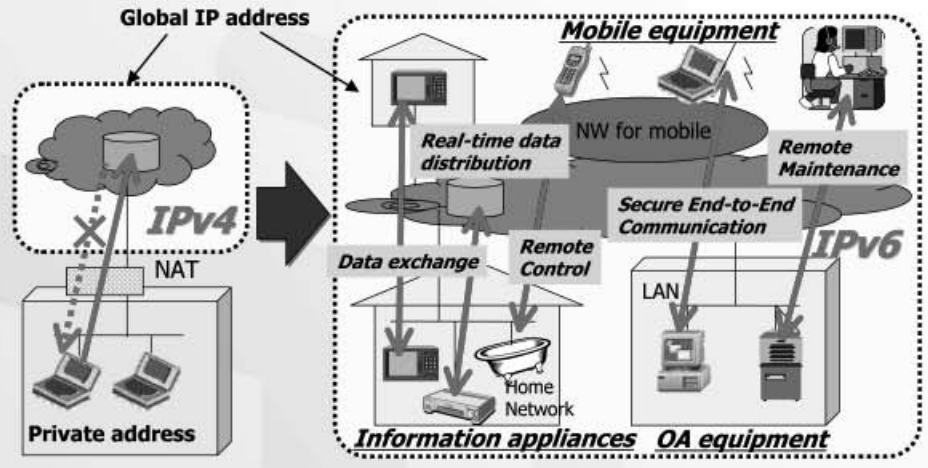
Global IPv6 Deployment

http://www.sixxs.net/tools/grh/dfp/

Pos	Country	V	A	VP	Pos	Country	V	A	VP	Pos	Country
1	United States	107	371	6.54%	38	Hong Kong	5	10	0.31%	75	Macao
2	Germany	75	123	4.58%	39	Brazil	3	10	0.18%	76	Saudi A
3	Japan	72	108	4.40%	40	Slovakia	5	8	0.31%	77	Mauriti
4	United Kingdom (Great Britain)	40	87	2.44%	41	Philippines	5	7	0.31%	78	Kenia
5	Netherlands, The	32	63	1.96%	42	Iran	1	7	0.06%	79	Qatar
6	France	15	47	0.92%	43	Luxembourg	1	7	0.06%	80	Nether
7	Italy	24	45	1.47%	44	Singapore	2	7	0.12%	81	Paragu
8	Korea	13	43	0.79%	45	Turkey	1	6	0.06%	82	Tunisia
9	Switzerland	20	42	1.22%	46	Peru	0	5	0.00%	83	Angola
10	Sweden	14	34	0.86%	47	Bulgaria	2	5	0.12%	84	Baham
11	Poland	17	32	1.04%	48	Israel	2	5	0.12%	85	Papua
12	Taiwan	16	30	0.98%	49	Romania	1	5	0.06%	86	Andorr
13	China	15	28	0.92%	50	Egypt	1	4	0.06%	87	Nigeria
14	Canada	9	28	0.55%	51	Pakistan	2	4	0.12%	88	Latvia
15	Spain	14	27	0.86%	52	Colombia	0	4	0.00%	89	Vatican
16	Austria	13	26	0.79%	53	Dominican Republic	1	4	0.06%	90	Puerto
17	Australia	8	23	0.49%	54	Chile	3	4	0.18%	91	Iceland
18	Czech Republic	12	20	0.73%	55	Asian Pacific	0	4	0.00%	92	Malawi
19	Mexico	6	19	0.37%	56	Slovenia	3	4	0.18%	93	Oman
20	Finland	12	18	0.73%	57	Uruguay	3	4	0.18%	94	Senega
21	Norway	7	17	0.43%	58	Bangladesh	0	4	0.00%	95	Sri Lan
22	Indonesia	7	16	0.43%	59	Cuba	2	3	0.12%	96	Camero
23	Portugal	6	16	0.37%	60	Panama	1	3	0.06%	97	Sudan
24	Ireland	7	15	0.43%	61	Costa Rica	1	3	0.06%	98	Trinida
25	Thailand	6	15	0.37%	62	Vietnam	1	3	0.06%	99	United
26	Europe	10	14	0.61%	63	Malta	2	3	0.12%	100	Monaco
27	South Africa	6	14	0.37%	64	Greece	1	3	0.06%	101	Bermud
28	Denmark	6	13	0.37%	65	Croatia	2	3	0.12%	102	Bahrain
29	Argentina	4	13	0.24%	66	Serbia	0	3	0.00%	103	Republi

A Driving Force for National Science and Technology Capability

New Opportunities created by IPv6



IPv4 : one-way communication

- due to NAT, the business model is only client & server.

IPv6: two-way communication

- two-way communications between information appliance and mobile equipment
- New internet business models will be created

Source: NTT Communications

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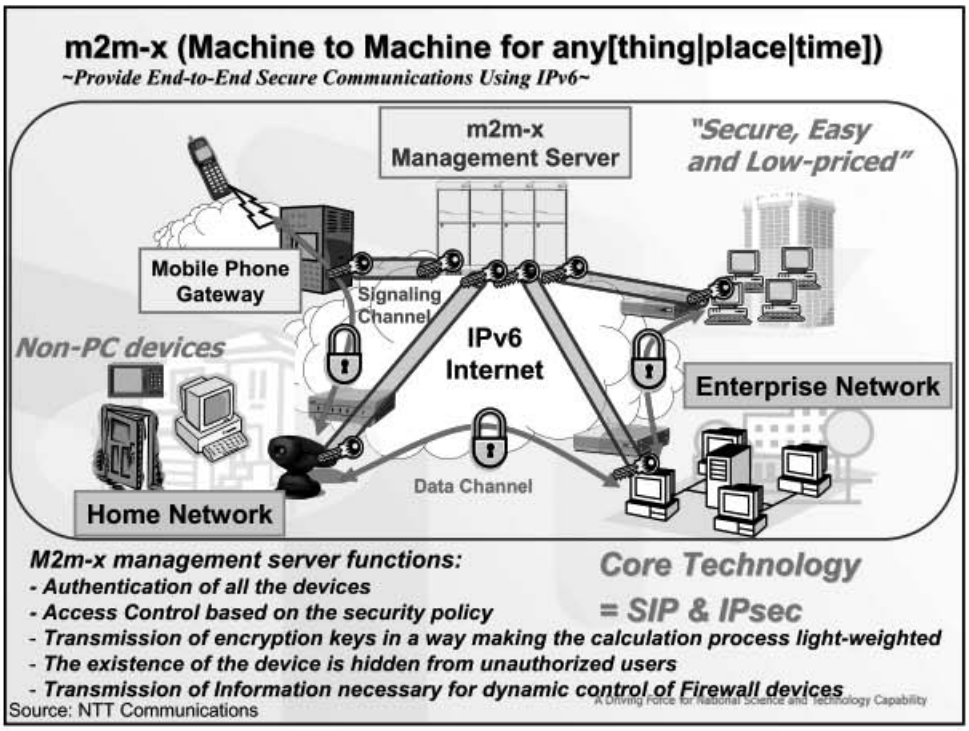
m2m-x (Machine to Machine for any[thing|place|time])
~Provide End-to-End Secure Communications Using IPv6~
m2m-x Management Server
"Secure, Easy and Low-priced"
Mobile Phone Gateway
Signaling Channel
IPv6 Internet
Non-PC devices
Enterprise Network
Data Channel
Home Network
M2m-x management server functions:
- Authentication of all the devices
- Access Control based on the security policy
- Transmission of encryption keys in a way making the calculation process light-weighted
- The existence of the device is hidden from unauthorized users
- Transmission of Information necessary for dynamic control of Firewall devices
Core Technology
= SIP & IPsec
Source: NTT Communications
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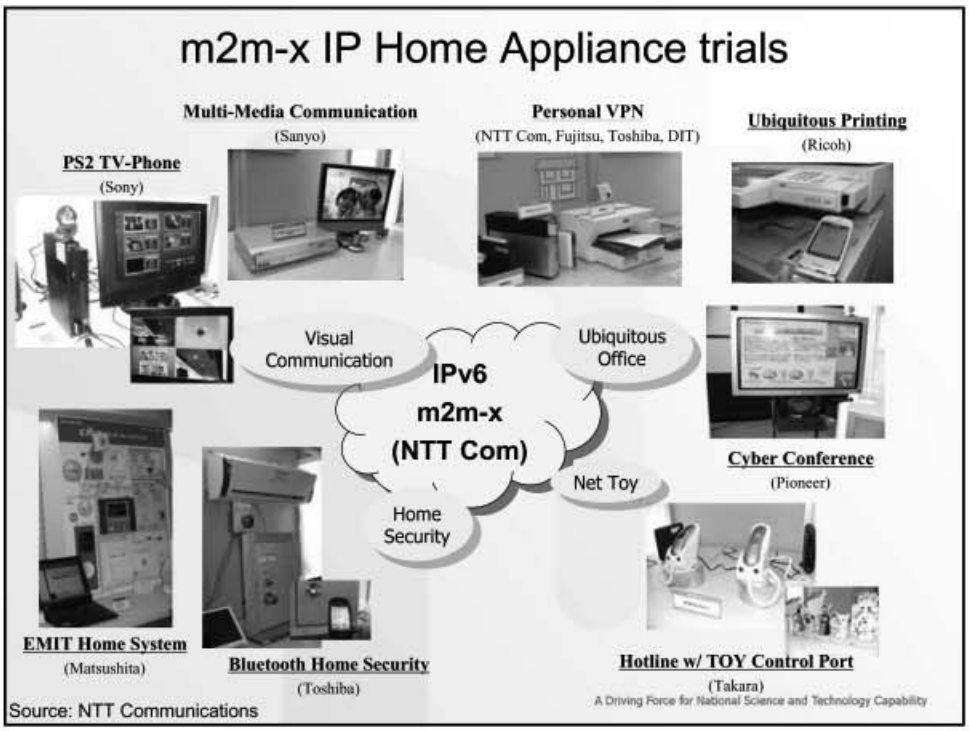
m2m-x IP Home Appliance trials
Multi-Media Communication
(Sanyo)
Personal VPN
(NTT Com, Fujitsu, Toshiba, DIT)
Ubiquitous Printing
(Ricoh)
PS2 TV-Phone
(Sony)
Visual Communication
IPv6
m2m-x
(NTT Com)
Ubiquitous Office
Net Toy
Home Security
Cyber Conference
(Pioneer)
EMIT Home System
(Matsushita)
Bluetooth Home Security
(Toshiba)
Hotline w/ TOY Control Port
(Takara)
Source: NTT Communications
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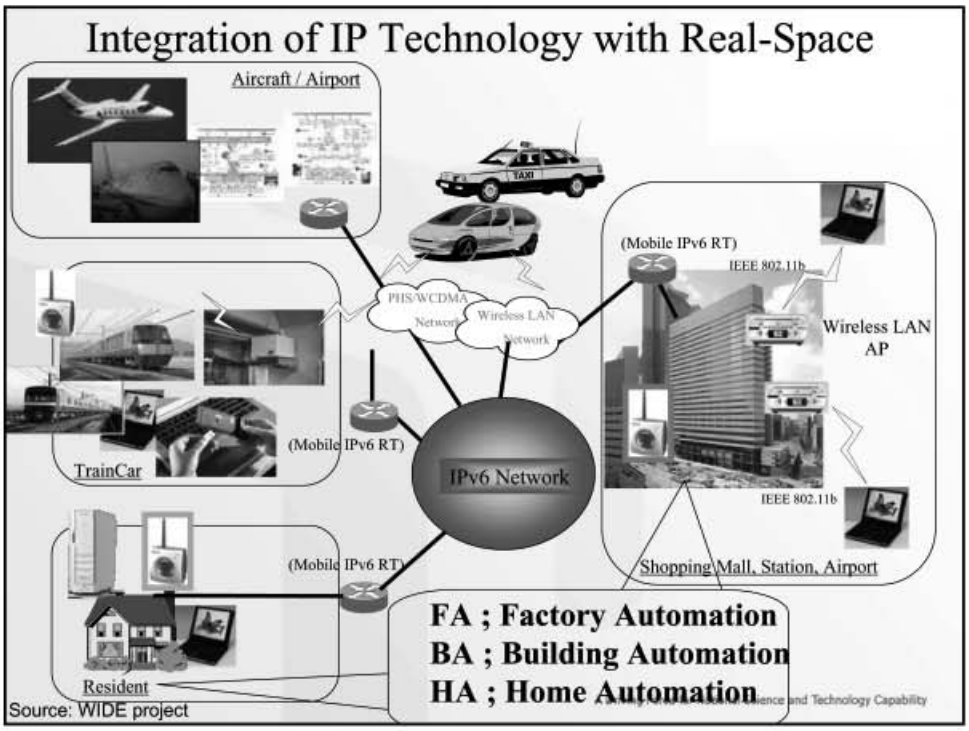
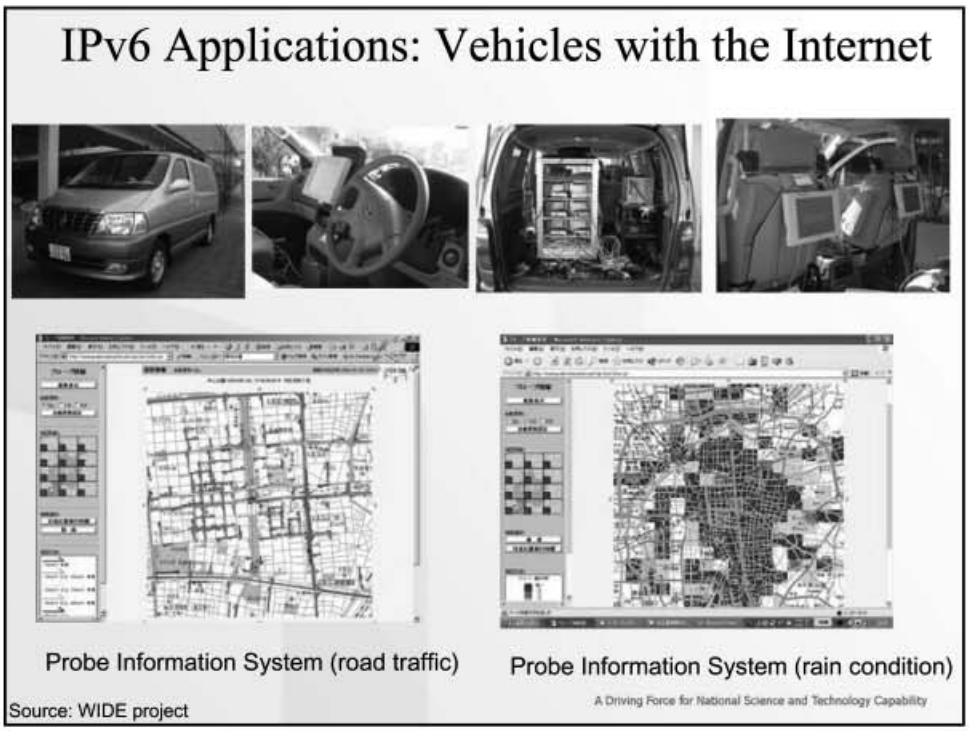

Integration of IP Technology with Real-Space
Aircraft / Airport
TAXI
(Mobile IPv6 RT)
IEEE 802.11b
PHS/WCDMA Network
Wireless LAN Network
Wireless LAN AP
TrainCar
(Mobile IPv6 RT)
IPv6 Network
IEEE 802.11b
(Mobile IPv6 RT)
Shopping Mall, Station, Airport
Resident
FA ; Factory Automation
BA ; Building Automation
HA ; Home Automation
Source: WIDE project


IPv6 Applications: Vehicles with the Internet
Probe Information System (road traffic)
Probe Information System (rain condition)
A Driving Force for National Science and Technology Capability
Source: WIDE project

IPv6 Applications: Monitoring and Surveillance services

IPv6 Network Camera

Source: WIDE project

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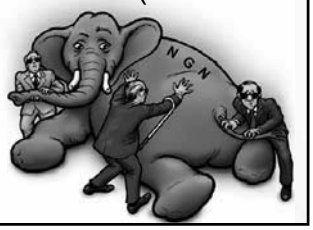
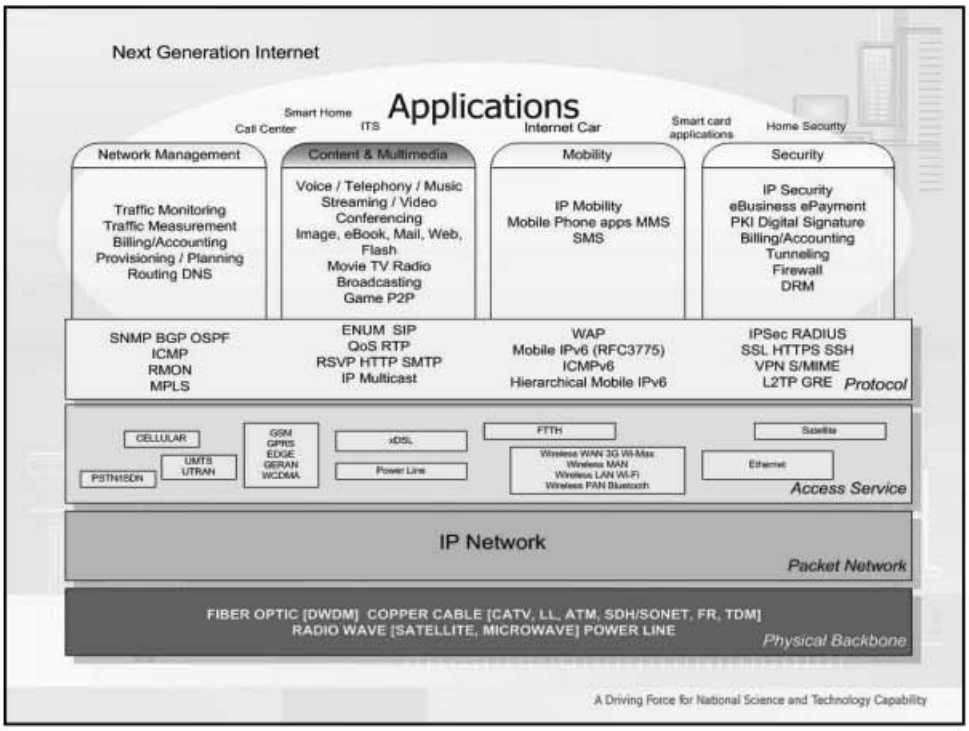
Next Generation Network

- Next generation networking (NGN) is a broad term to describe some key architectural evolutions in telecommunication core and access networks that will be deployed over the next 5-10 years.
- The general idea behind NGN: one network transports all information and services (voice, data, and all types of media) by encapsulating these into packets, like it is on the Internet.
- NGN are commonly built around Internet Protocol ("all-IP" is sometimes used).



Source: en.wikipedia.org

A Driving F



Emerging Technology: The Grid

- **Definition 1998:** Ian Foster and Carl Kesselman: *The Grid: Blueprint for a New Computing Infrastructure*

  "A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities."

- **Definition 2002:** Ian Foster, ANL:*What is the Grid? A Three-Point Checklist*

  "A Grid is a system that coordinates resources that are not subject to centralized control using standard, open, general-purpose protocols and interfaces to deliver nontrivial qualities of service."

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Building Grid Systems

- Different Grid systems
  - Computing Grid, Storage Grid, Information Grid, Access Grid
- Globus Toolkit: an open source software toolkit used for building grids.
  - Software services and libraries for
    - Resource monitoring, discovery, and management
    - Security
    - File management
- PyGlobus: An interface to the Globus toolkit using the Python scripting language

  By Lawrence Berkeley National Laboratory,

  http://www-itg.lbl.gov/gtg/projects/pyGlobus/

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Computing Grid

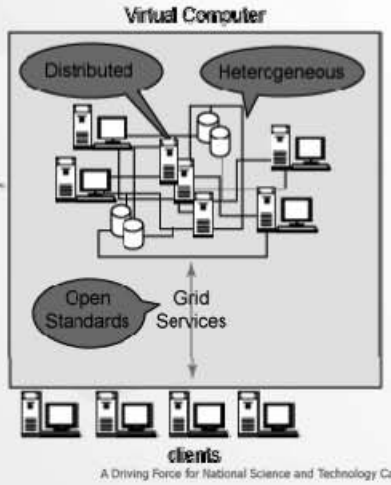
- Making use of resources of large numbers of disparate computers across administrative domains

Distributed computing over a network: WAN, LAN, MAN, Internet, Wi-fi

Heterogeneous resources: processing power, application services, operating system services, CPU, memory, storage, I/O.

Using open standards: ANSI, W3C, OGSA.

Beyond multiple organizations.



Source: www.ibm.com

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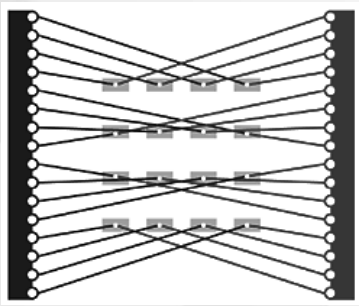
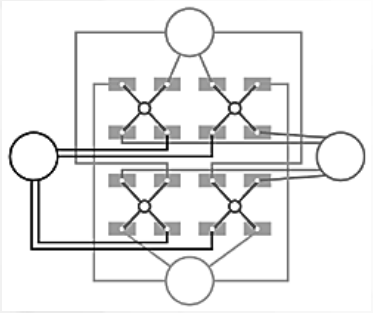
Storage Grid

- Applying grid topology to a storage network provides several benefits
  - Reliability, Performance, Scalability
- Grid-based storage has grid attributes associated with it



Conventional 16-node storage configuration



16-node grid storage configuration

Source: www.computerworld.com, www.networkworld.com

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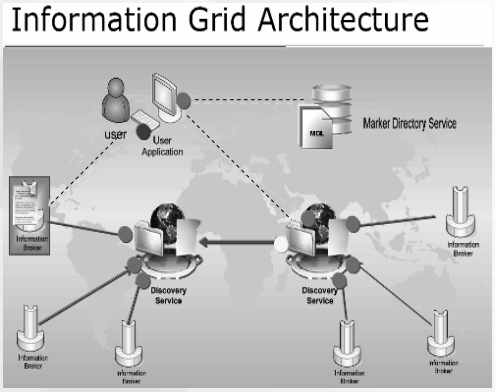
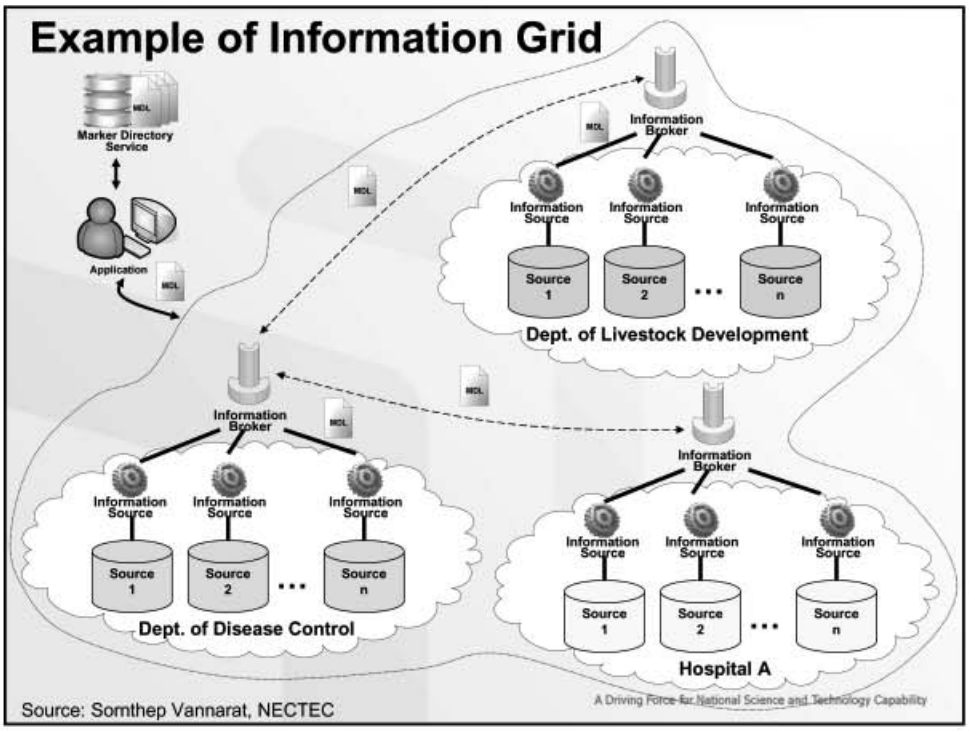
Information Grid

- The structure that allows end users and applications to share information, no matter where it is stored



A Driving Force for National Science and Technology Capability



Access Grid

- Support large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials and training
  - Consists of multimedia display, presentation and interaction environments
  - Interfaces to grid middleware
  - Interfaces to visualization environments

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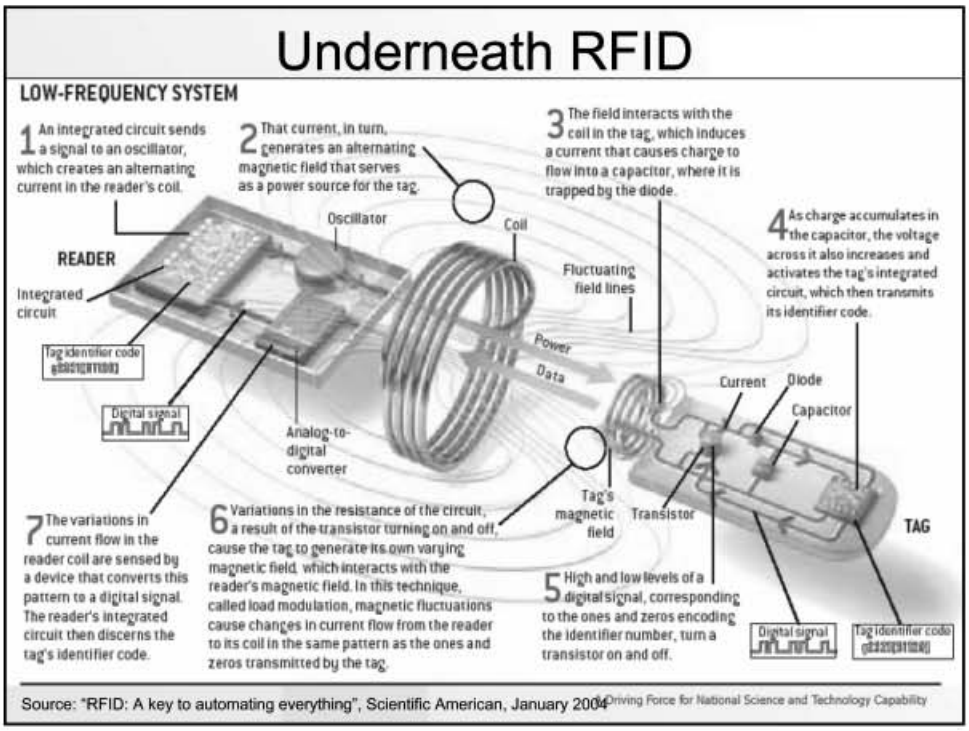
Emerging Technology: RFID

- RFID (Radio-frequency identification) refers to technologies that use radio waves to automatically identify and track individual items.

Source: "Ubiquitous Network Societies: The case of radio frequency identification", ITU workshop on Ubiquitous Network Societies, ITU Document UNS/04

How does RFID Work?

- An RFID system consists of
  - A transponder to carry data (e.g. a tag), which is located on the object to be identified
  - An interrogator (or reader) to read the transmitted data
- In an RFID system, RFID tags are "interrogated" by an RFID reader that generates a radio frequency signal to communicate with the tags. The reader also has a receiver that captures a reply signal from the tags, and decodes that signal. The reply signal from the tags reflects the tag's data content.
- RFID frequencies could be
  - Low frequency (125 kHz)
  - High frequency (13.56 MHz)
  - Ultra high frequency (800-960 MHz)


Underneath RFID
LOW-FREQUENCY SYSTEM
1 An integrated circuit sends a signal to an oscillator, which creates an alternating current in the reader's coil.
2 That current, in turn, generates an alternating magnetic field that serves as a power source for the tag.
3 The field interacts with the coil in the tag, which induces a current that causes charge to flow into a capacitor, where it is trapped by the diode.
4 As charge accumulates in the capacitor, the voltage across it also increases and activates the tag's integrated circuit, which then transmits its identifier code.
READER
Integrated circuit
Tag identifier code
Digital signal
Oscillator
Coil
Analog-to-digital converter
Fluctuating field lines
Power
Data
Current
Diode
Capacitor
Tag's magnetic field
Transistor
TAG
7 The variations in current flow in the reader coil are sensed by a device that converts this pattern to a digital signal. The reader's integrated circuit then discerns the tag's identifier code.
6 Variations in the resistance of the circuit, a result of the transistor turning on and off, cause the tag to generate its own varying magnetic field, which interacts with the reader's magnetic field. In this technique, called load modulation, magnetic fluctuations cause changes in current flow from the reader to its coil in the same pattern as the ones and zeros transmitted by the tag.
5 High and low levels of a digital signal, corresponding to the ones and zeros encoding the identifier number, turn a transistor on and off.
Digital signal
Tag identifier code
Source: "RFID: A key to automating everything", Scientific American, January 2004
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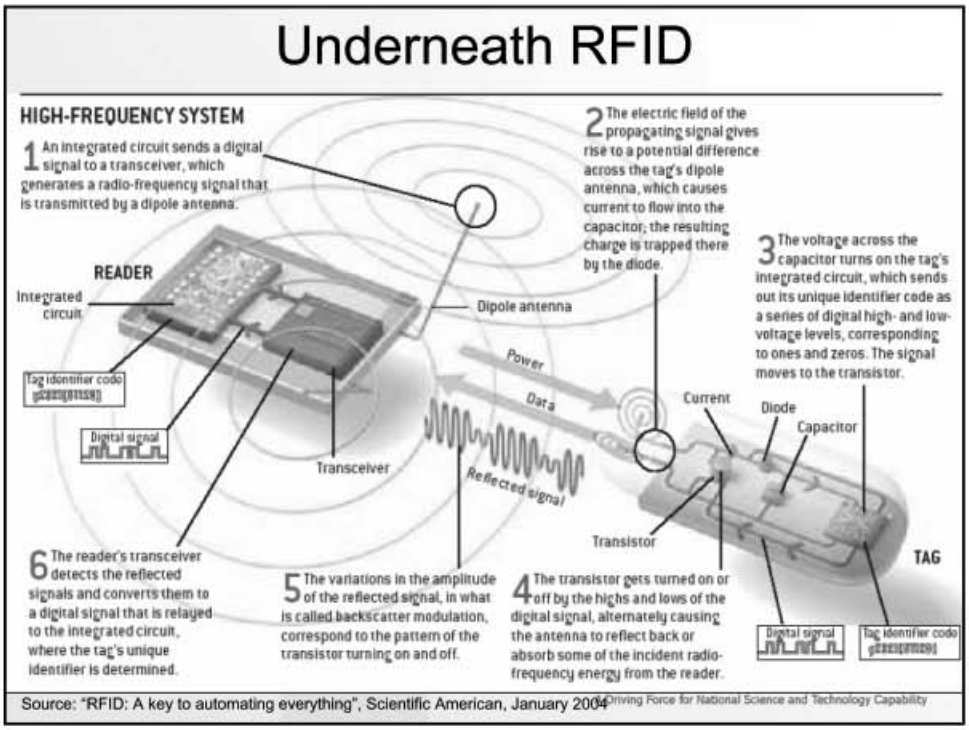
Underneath RFID
HIGH-FREQUENCY SYSTEM
1 An integrated circuit sends a digital signal to a transceiver, which generates a radio-frequency signal that is transmitted by a dipole antenna.
2 The electric field of the propagating signal gives rise to a potential difference across the tag's dipole antenna, which causes current to flow into the capacitor; the resulting charge is trapped there by the diode.
3 The voltage across the capacitor turns on the tag's integrated circuit, which sends out its unique identifier code as a series of digital high- and low-voltage levels, corresponding to ones and zeros. The signal moves to the transistor.
READER
Integrated circuit
Tag identifier code
Digital signal
Dipole antenna
Transceiver
Power
Data
Reflected signal
Current
Diode
Capacitor
Transistor
TAG
6 The reader's transceiver detects the reflected signals and converts them to a digital signal that is relayed to the integrated circuit, where the tag's unique identifier is determined.
5 The variations in the amplitude of the reflected signal, in what is called backscatter modulation, correspond to the pattern of the transistor turning on and off.
4 The transistor gets turned on or off by the highs and lows of the digital signal, alternately causing the antenna to reflect back or absorb some of the incident radio-frequency energy from the reader.
Digital signal
Tag identifier code
Source: "RFID: A key to automating everything", Scientific American, January 2004
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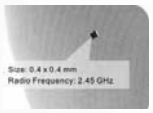
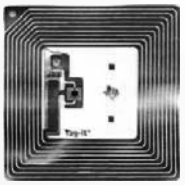
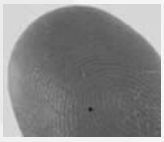
RFID Tag

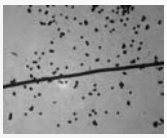
- RFID Tag Types
  - Passive tags: no power source of their own, operate within a short distance (typically < 3 m.)
  - Semi-passive tags: rely on a battery built into the tag to achieve better performance (communication range)
  - Active tags: with their own power source, can actively transmit and processing data over considerable distances (> 100 m.)







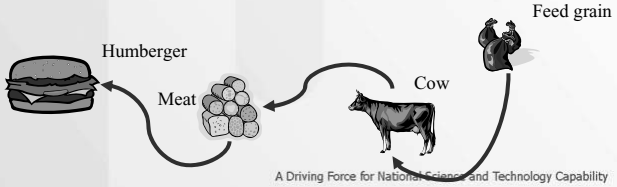
Hitachi mu-chip tiny RFID tag



Powder RFID chips next to the human hair

Examples of RFID Applications

- **Transport and logistics**:
  toll management, tracking of goods
- **Security and access control**
  tracking people (students etc.), control access to restricted areas
- **Supply chain management**: item tagging, theft-prevention
- **Medical and pharmaceutical applications**: identification and location of staff and patients, asset tracking, counterfeit protection for drugs
- **Manufacturing and processing:** streamlining assembly line processes
- **Agriculture:** tracking of animals, quality control
- **Public sector:** passports, driver's licenses, counterfeit protection for bank notes, library systems



RFID: Opportunities and Constraints

Opportunities

- **Analysts:** tremendous market-growth
- **Problem:** estimates vs. guesstimates (remarkable differences in market volume, growth rates)
- **Frost & Sullivan:** 11.7 billion USD (2010)
  Research and Markets: 3.8 billion USD (2011)
  IDTechEx: 26.90 billion USD (2015)

Constraints

- **Pricing:** (5-cent-tag)
- **Standards landscape**
- **Security and privacy issues:** consumers, policy makers, researchers

Source: "RFID: Opportunities for mobile telecommunication services", ITU-T Lighthouse

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ICT Infrastructure for Research Collaborations:

Research and Education Networks (RENs)

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Examples of National Research and Education Networks Around the World

Europe-Middle East

Austria (ACOnet)
Belgium (BELNET)
Croatia (CARNet)
Czech Rep. (CESNET)
Cyprus (CYNET)
Denmark (Forskningsnettet)
Estonia (EENet)
Finland (Funet)
France (Renater)
Germany (G-WIN)
Greece (GRNET)
Hungary (HUNGARNET)
Iceland (RHnet)
Ireland (HEAnet)
Israel (IUCC)
Italy (GARR)
Latvia (LATNET)
Lithuania (LITNET)
Luxembourg (RESTENA)
Malta (Univ. Malta)
Netherlands (SURFnet)
Norway (UNINETT)
Poland (POL34)
Portugal (RCTS2)
Qatar (Qatar FN)
Romania (RoEduNet)
Russia (RBnet)
Slovakia (SANET)
Slovenia (ARNES)
Spain (RedIRIS)
Sweden (SUNET)
Switzerland (SWITCH)
United Kingdom (JANET)
Turkey (ULAKBYM)
*CERN

Asia-Pacific

Australia (AARNET)
China (CERNET, CSTNET, NSFCNET)
Hong Kong (HARNET)
Indonesia
Japan (SINET, WIDE, IMNET, JGN2)
Korea (KOREN, KREONET2)
Philippines (PREGINET)
Malaysia (MYREN)
Singapore (SingAREN)
Taiwan (TANet2, ASNet)
Thailand (ThaiREN, UNINET, ThaiSarn)
Vietnam (VINAREN)

Americas

Argentina (RETINA)
Brazil (RNP2/ANSP)
Canada (CA*net)
Chile (REUNA)
Mexico (Red-CUDI)
United States (Abilene)
Venezuela (REACCIUN-2)

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Global Lambda Integrated Facility for Research and Education Networks

World Map – August 2005

Visualization courtesy of Bob Patterson, NCSA/University of Illinois at Urbana-Champaign.
Data compilation by Maxine Brown, University of Illinois at Chicago. Earth texture from NASA.

www.glif.is

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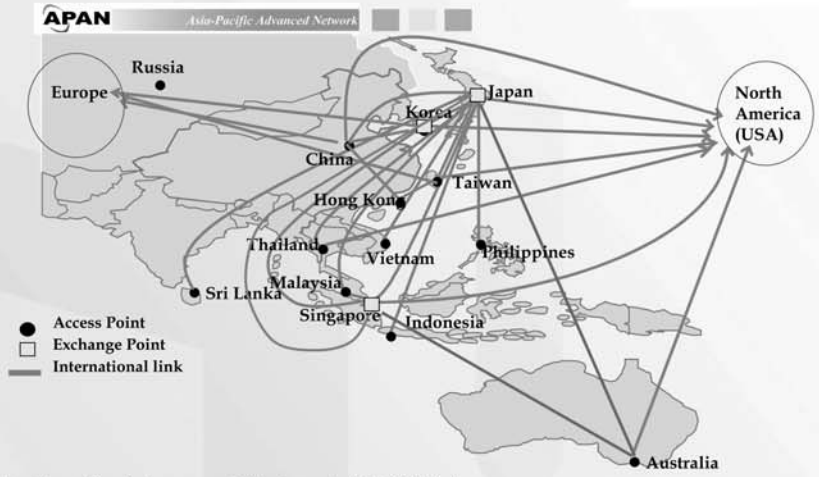
Asia Pacific Advanced Network (APAN)



Asia Pacific Advanced Network (APAN) is a non-profit international consortium established in June 1997.

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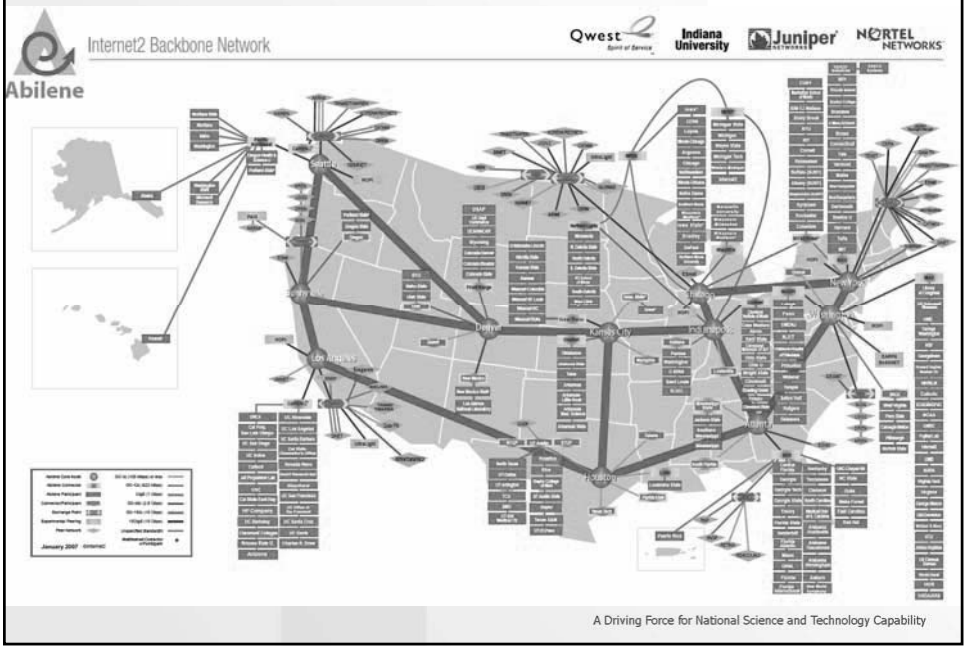
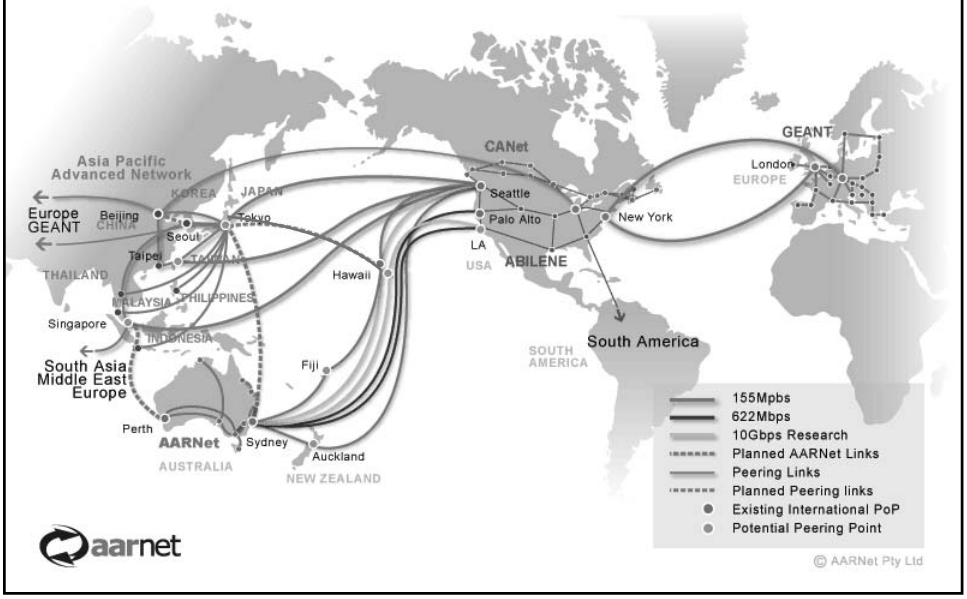
INTERNET2

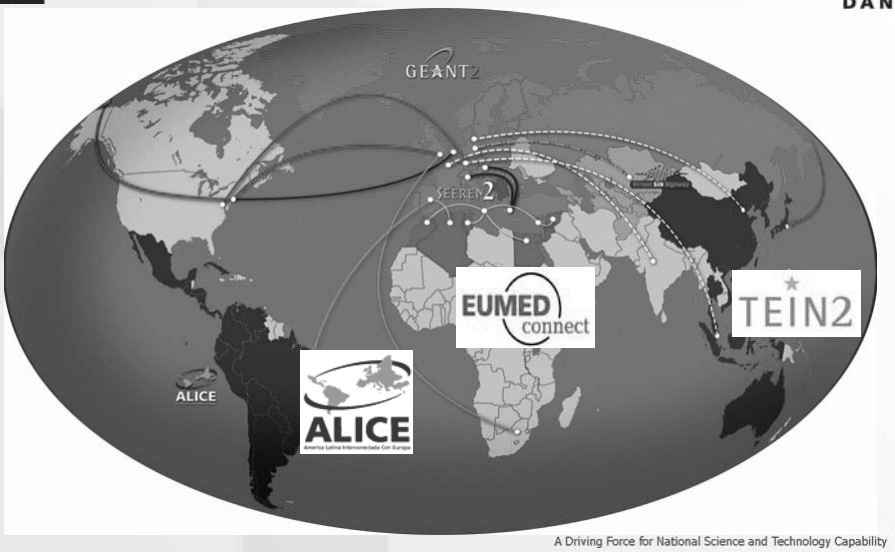


AARNet's International Connections



International Research Networking

GÉANT2 Global Connectivity



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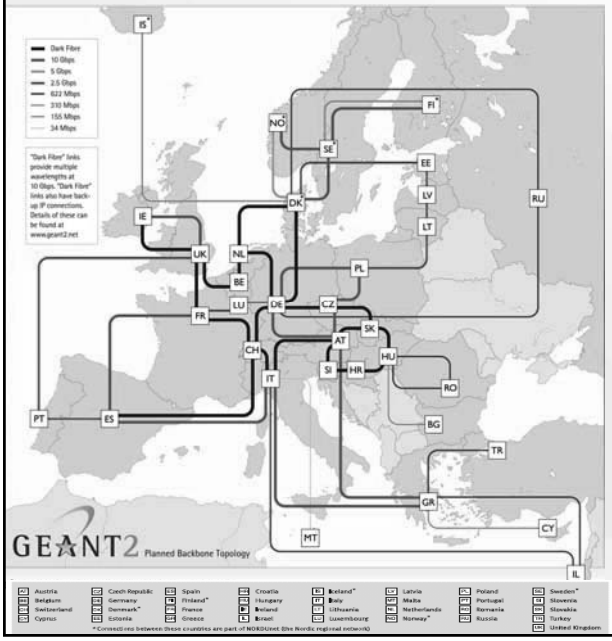
GÉANT2

International Research Networking

- **Interconnection network for European NRENs (32 countries)**
- **+3500 universities and research sites**



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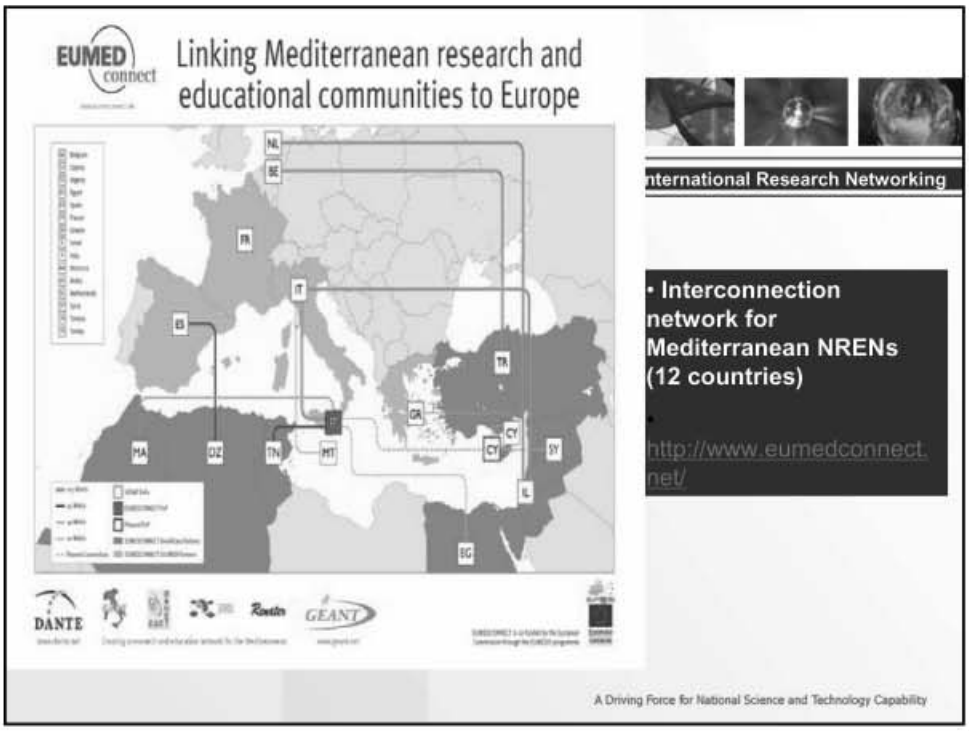
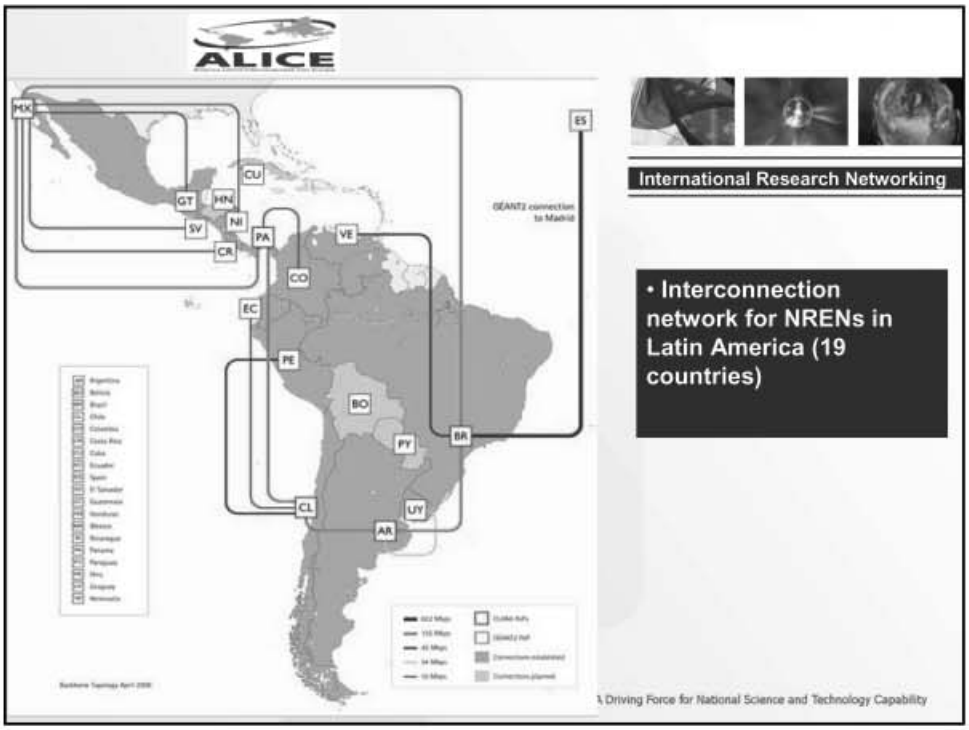

EUMED connect
Linking Mediterranean research and educational communities to Europe
NL
BE
FR
IT
ES
TR
GR
CY
MA
DZ
TN
MT
SY
IL
BG
DANTE
GEANT
International Research Networking
• Interconnection network for Mediterranean NRENs (12 countries)
http://www.eumedconnect.net/
A Driving Force for National Science and Technology Capability


ALICE
MX
ES
CU
GT
HN
SV
NI
CR
PA
VE
CO
EC
PE
BO
PY
BR
CL
UY
AR
GEANT2 connection to Madrid
International Research Networking
• Interconnection network for NRENs in Latin America (19 countries)
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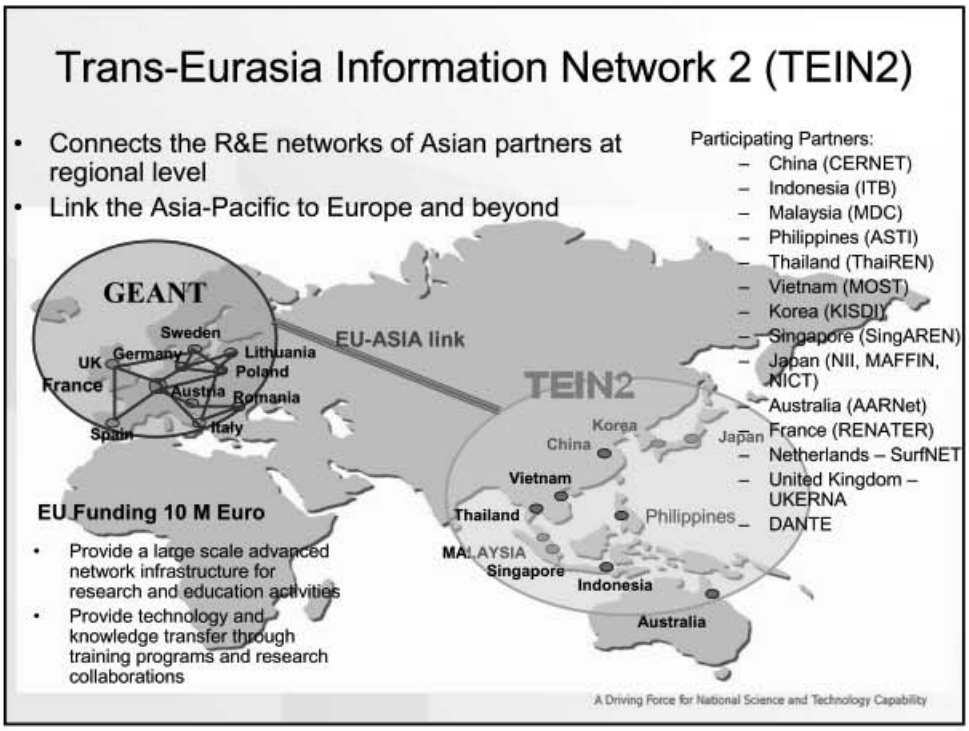
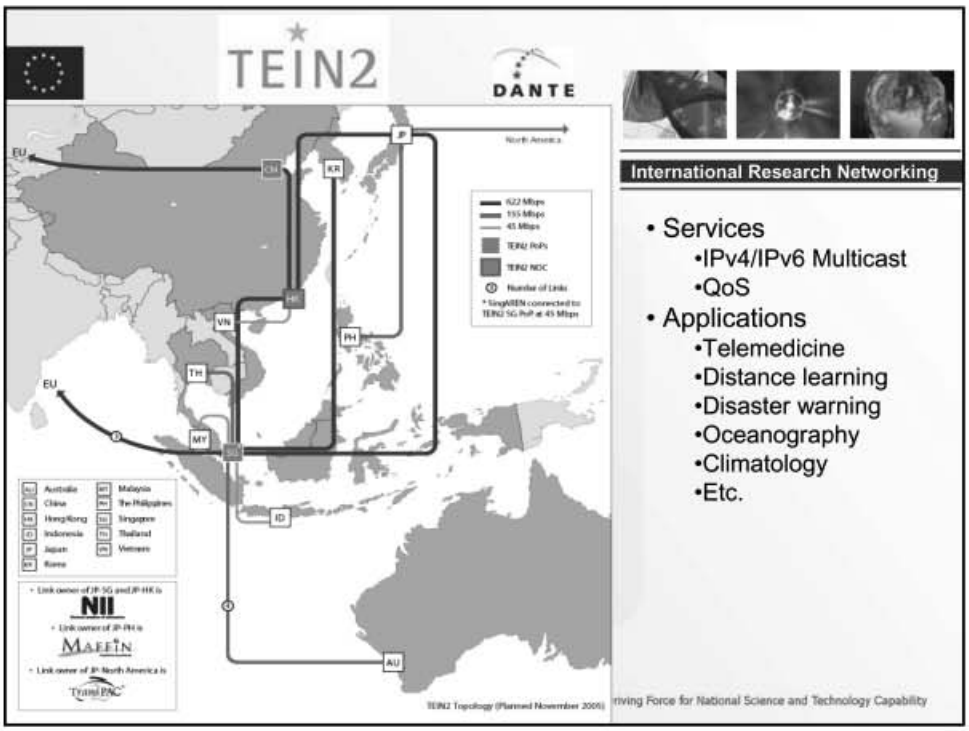
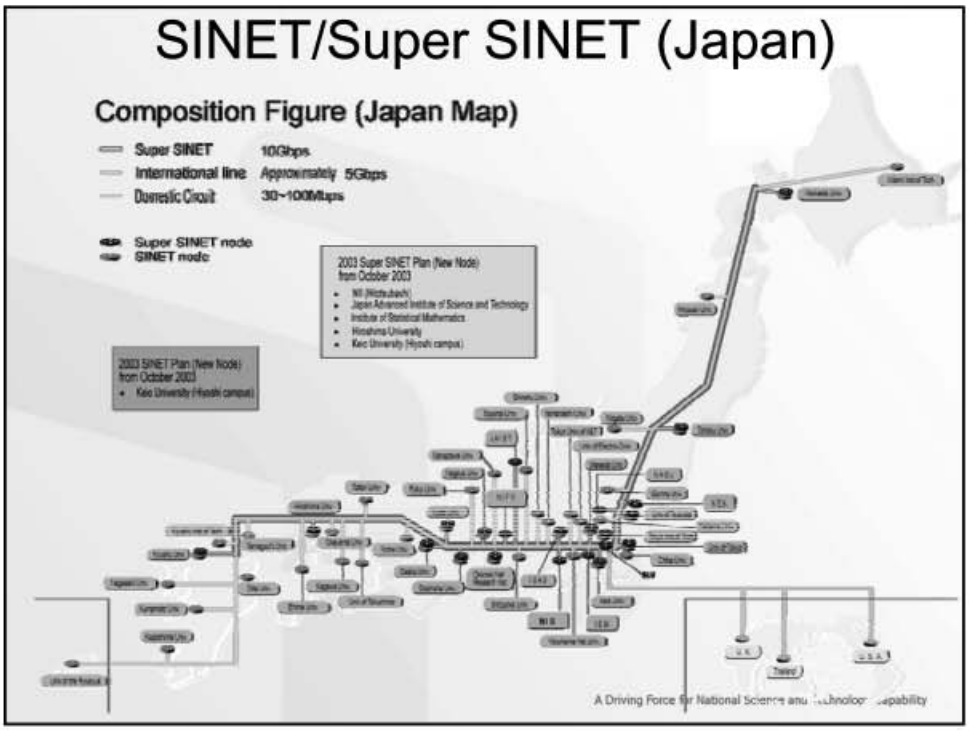
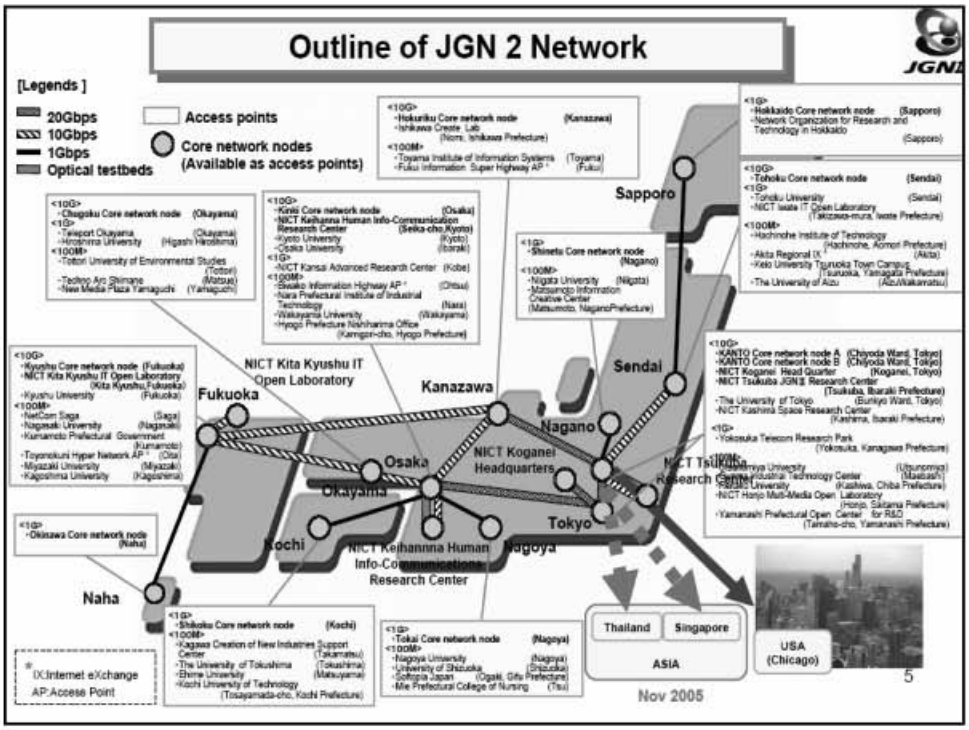
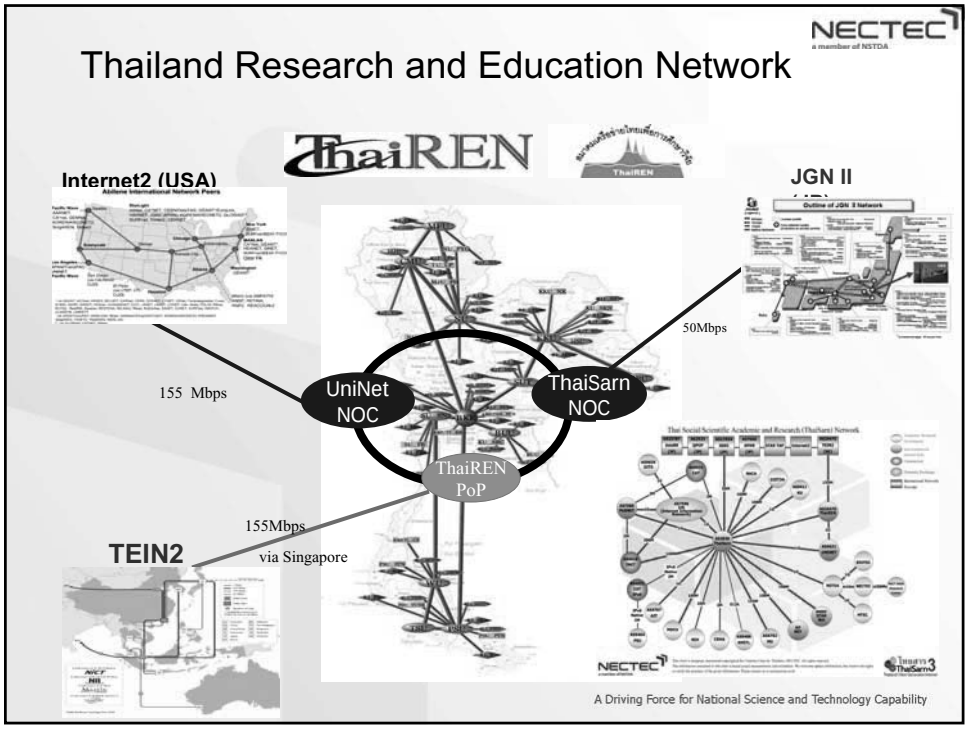
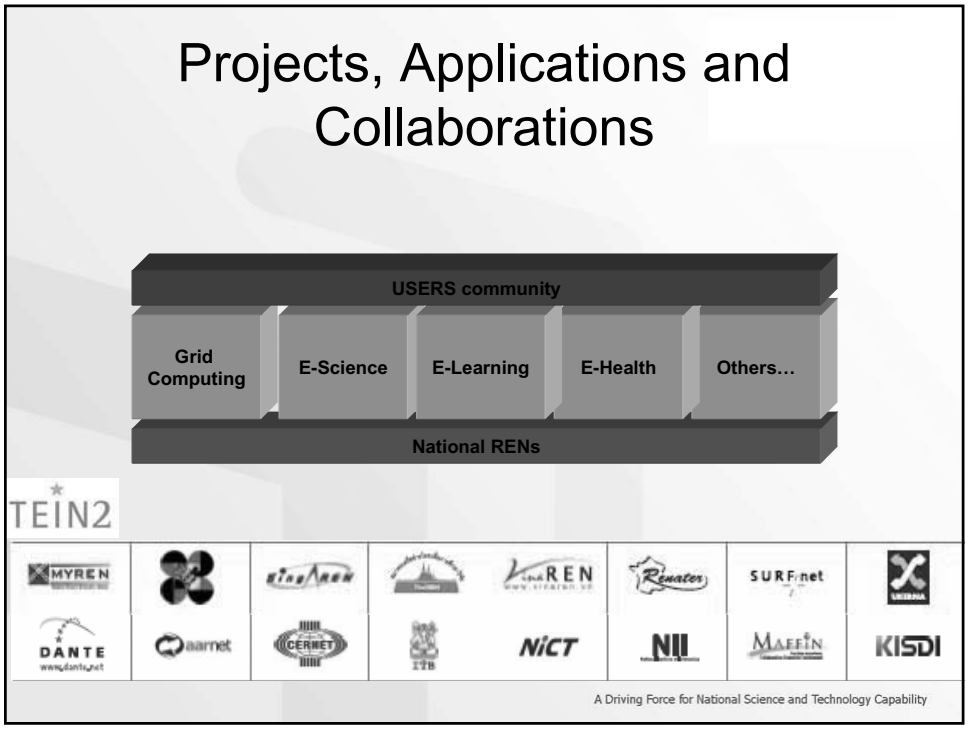

Trans-Eurasia Information Network 2 (TEIN2)
• Connects the R&E networks of Asian partners at regional level
• Link the Asia-Pacific to Europe and beyond
Participating Partners:
– China (CERNET)
– Indonesia (ITB)
– Malaysia (MDC)
– Philippines (ASTI)
– Thailand (ThaiREN)
– Vietnam (MOST)
– Korea (KISDI)
– Singapore (SingAREN)
– Japan (NII, MAFFIN, NICT)
– Australia (AARNet)
– France (RENATER)
– Netherlands – SurfNET
– United Kingdom – UKERNA
– DANTE
GEANT
Sweden
Germany
Lithuania
UK
Poland
France
Austria
Romania
Spain
Italy
EU-ASIA link
TEIN2
Korea
China
Japan
Vietnam
Thailand
Philippines
MALAYSIA
Singapore
Indonesia
Australia
EU Funding 10 M Euro
• Provide a large scale advanced network infrastructure for research and education activities
• Provide technology and knowledge transfer through training programs and research collaborations
A Driving Force for National Science and Technology Capability


TEIN2
DANTE
International Research Networking
• Services
•IPv4/IPv6 Multicast
•QoS
• Applications
•Telemedicine
•Distance learning
•Disaster warning
•Oceanography
•Climatology
•Etc.
NII
MAFFIN
TransPAC
A Driving Force for National Science and Technology Capability


SINET/Super SINET (Japan)
Composition Figure (Japan Map)
Super SINET 10Gbps
International line Approximately 5Gbps
Domestic Circuit 30~100Mbps
Super SINET node
SINET node
2003 Super SINET Plan (New Node) from October 2003
NII (Hitotsubashi)
Japan Advanced Institute of Science and Technology
Institute of Statistical Mathematics
Hiroshima University
Keio University (Hiyoshi campus)
2003 SINET Plan (New Node) from October 2003
Keio University (Hiyoshi campus)
A Driving Force for National Science and Technology Capability


Outline of JGN 2 Network
JGNII
[Legends]
20Gbps
10Gbps
1Gbps
Optical testbeds
Access points
Core network nodes (Available as access points)
Sapporo
Sendai
Kanazawa
Nagano
Fukuoka
NICT Kita Kyushu IT Open Laboratory
NICT Koganei Headquarters
Osaka
Okayama
Tokyo
Kochi
Nagoya
Naha
NICT Keihannna Human Info-Communications Research Center
Thailand
Singapore
ASIA
USA (Chicago)
IX:Internet eXchange
AP:Access Point
Nov 2005
5


NECTEC
a member of NSTDA
Thailand Research and Education Network
ThaiREN
ThaiREN
Internet2 (USA)
JGN II
50Mbps
155 Mbps
UniNet
NOC
ThaiSarn
NOC
ThaiREN
PoP
155Mbps
via Singapore
TEIN2
NECTEC
A Driving Force for National Science and Technology Capability

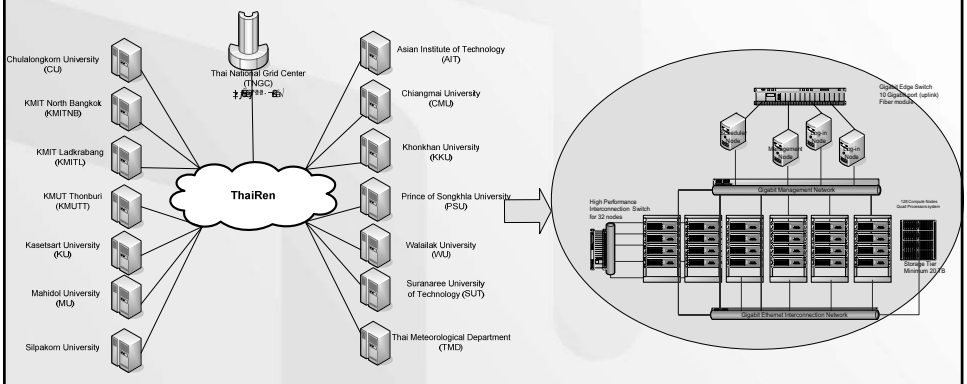

Projects, Applications and Collaborations
USERS community
Grid Computing
E-Science
E-Learning
E-Health
Others…
National RENs
TEIN2
MYREN
SURFnet
DANTE
aarnet
CERNET
NiCT
NII
KISDI
A Driving Force for National Science and Technology Capability

Examples of Projects and Applications on ThaiGrid

A Driving Force for National Science and Technology Capability

Thai National Grid Project

- A national project under Ministry of Information and Communication Technology
- Goal
  - Building the next generation advanced computing infrastructure
  - Stimulating the adoption of grid technology to support research, education, and industry
  - Building up man power for future generation IT industry

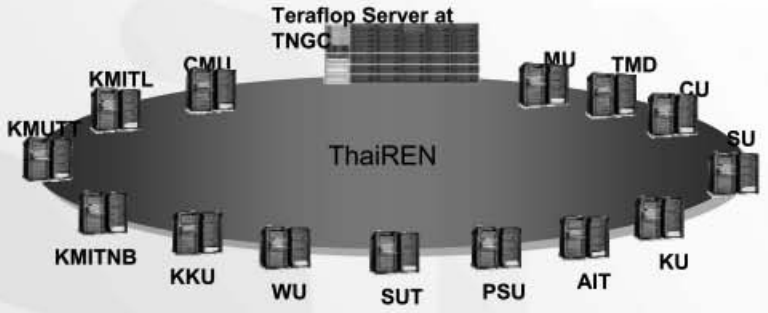


Teraflop Grid Server

[Source: Thai National Grid Project http://www.thaigrid.or.th]

A Driving Force for National Science and Technology Capability

ThaiGrid Computing Infrastructure



- First Phase: 80 dual processor nodes (160 CPU) has been installed in 14 founding institutes (IBM X series)
- TNGC has two IBM X3550 cluster (Araya, Sunyata) for POF application testing
- TNGC will also be equipped with a teraflop supercomputer
  - 200 nodes dual processors dual core XEON EMT64 (800 Core) , Gigabit Ethernet, Infiniband (partially)
  - HP DL360G5

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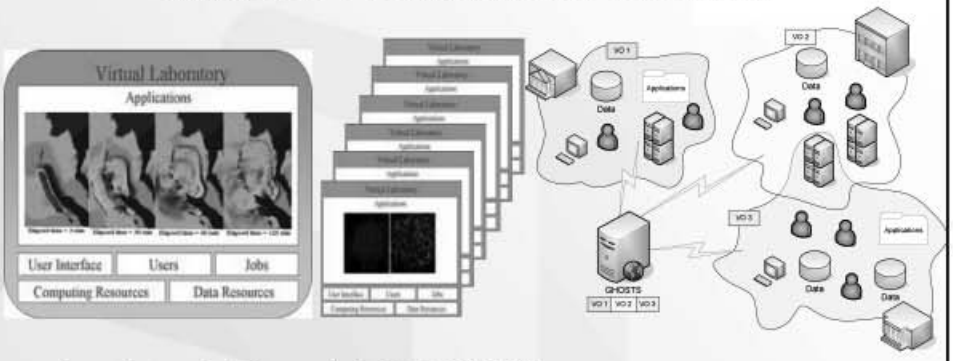
Virtual Research Center



- Investigator: Dr. Tiranee Achalakul, KMUTT
- Project to explored the use of Grid technology to build an advanced collaboration environment for researchers
  - Resources sharing
  - Collaborative environment over grid and advanced network
  - Funded by Thai National Grid Project

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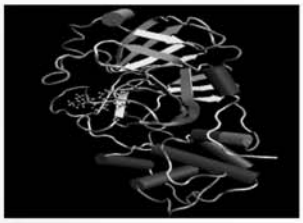
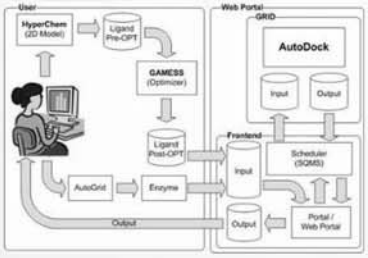
ThaiGrid Drug Discovery Infrastructure

- Partners:
  - Dr. Chak Saengma, KU
  - Somsak Sriprayoonsakul, TNGC
  - IBM Thailand
- Challenges
  - From over 10000 active compounds available from Thai medicinal plants database, find a smallest set of compounds that has a potential to be used as a drug
  - Very compute intensive. Several month of computing time
- Solution: Use grid to increase computing power to 10-100 times
  - Distributed screening process to hundred of hosts on the Grid
- Benefit
  - Speeding up time to results
  - Allow scientists to spend more time analyzing results





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TNGC

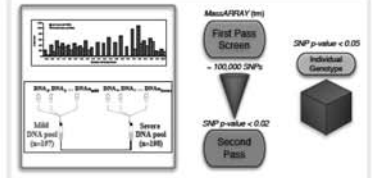
Gene Mapping Study for Severity Expression in β-Thalassemia Patients

Total number of thalassemic patients (per year)

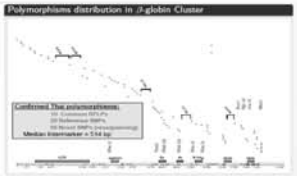
Disease	Couple at Risk	Birth	Living Patient
Homo β-Thal	2,500	625	6,250
β-Thal/Hb E	13,000	3,250	97,500
Hb Bart's Hydrops	5,000	1,250	0
Hb H Disease	28,000	7,000	420,000
Total	48,500	12,125	523,750

...to perform a genome-wide search by the association approach using gene-based SNPs to identify the severity modifiers in β-Thalassemia disease...

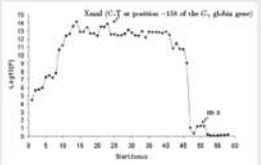
Regionally matched pooled DNA Construction



Polymorphisms distribution in β-globin Cluster



Sliding window of 3 SNPs to check the association effect



- 39 SNPs spanning the LCR and G_γ-globin genes are **strongly** associated with disease severity
- The strongest association is XmnI G_γ-globin

Sissades Tongsima, Ph.D.
National Center for Genetic Engineering and Biotechnology

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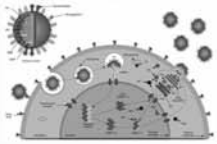
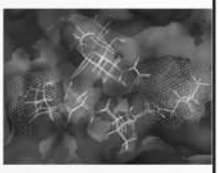
In-silico Mutagenesis of H5N1 Hemagglutinin





Principle Investigator

CHAK SANGMA, Cheminformatics Research Unit, Chemistry Department, Faculty of Science, Kasetsart University, THAILAND

Problem

Up to now, HA of H5 prefers avian receptor to human receptor but mutated HA found. Can mutation on HA cause the pandemic outbreak?

Objective

Structure and binding affinity prediction of mutated HA by molecular dynamic simulation using

Benefit

- Need for H5 mutation monitoring and provide a high throughput prediction

Challenges

Estimated 240 selected mutations on 24 residues. Estimated computing time: one month per mutant (AMBER9 on 8 nodes cluster) Or 60 months for 240 mutations (32 nodes)

Reference: 1.Sangma C., Nunrium P., Hannongbua S. (2006) J. Theor. and Comp. Chem. 5, 1–16.

Sponsor

- *The National Science and Technology Development Agency (NSTDA)*
- *The National Center for Genetic Engineering and Biotechnology*
- *The Thailand Research Fund*
- *Kasetsart University Research and Development Institute*

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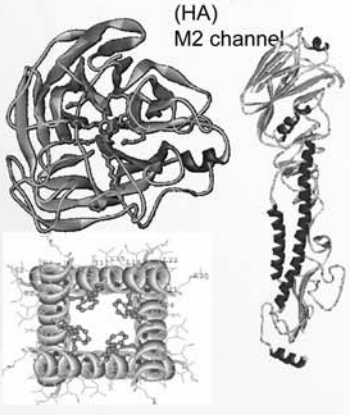
CCUC: Biomolecular modeling and simulations

- Computer-aided molecular modeling on Influenza virus H5N1 and HIV-1 enzymes.
  - To study the structural properties of the enzyme.
  - To explore the dynamical behavior of the enzyme as well as the inhibitors/drugs.
  - To investigate the interaction between enzyme and inhibitor.

.....Understand basic properties of known drug-target interaction.....

.....design new compounds which fit better to the catalytic site of both Wild and Mutant types.....

Bird Flu
Neuraminidase (NA)
Hemaglutinin (HA)
M2 channel



Put your material in and we'll serve the calculation

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PSU Genomics and Bioinformatics Research

Automatic Synchronization and Distribution of Biological Databases and Software over Low-Bandwidth Networks among Developing Countries

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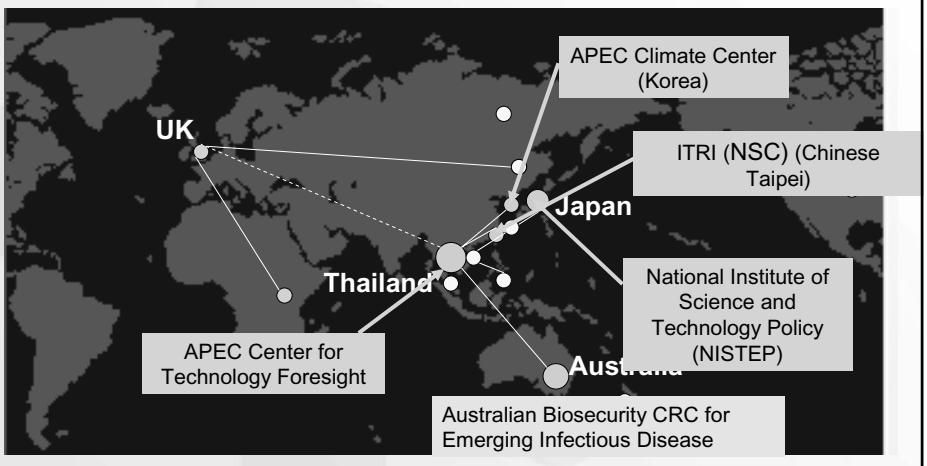
EID Collaborations

○ Current collaborators ○ Co-sponsors ○ Non-APEC network



Collaborators could use existing ICT infrastructure

As of February 2007

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Example of EID Research Collaboration: RCC-ERI

Research Institute for Microbial Diseases, Osaka University

National Institute of Health, Thailand

National Institute of Animal Health, Thailand

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List of EID Projects using ICT and Emerging Technologies

BioSense	**is a syndromic surveillance system that aggregates syndromic data from a variety of electronic sources to improve early detection of possible disease outbreaks, bioterrorism threats, or other urgent public health threats. The data are collected and analyzed by The US Centers for Disease Control and Prevention (CDC). Data sources include patient encounters from the Department of Defense's medical treatment facilities in the United States, the Department of Veterans Affairs' medical facilities, national clinical laboratory test orders, and more than 10,000 over-the-counter retailers nationwide**
Electronic Laboratory Exchange Network (eLEXNET)	**is a Web-based system for real-time sharing of food safety laboratory data among federal, state, and local agencies. As of July 2004, there were 113 laboratories representing 50 states that are part of the eLEXNET system.**
A geographic information system	**is a system that can be used to identify spatial clustering of abnormal health events as the data are collected. This can assist public health officials in identifying affected areas.**
Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)	**is a syndromic surveillance system operated by DOD that is used in the early detection of infectious disease outbreaks and it provides epidemiological tools for improved investigation. The system collects data from hospitals and clinics on a daily basis. Epidemiologists can track, in near real-time. ESSENCE analyses by using historical data for baseline comparisons and analytic methods such as a geographic information system.**
Epidemic Information Exchange (Epi-X)	**is a secure, Web-based communication system that CDC uses to share information relevant to disease outbreaks with state and local public health officials and with other federal officials. Epi-X users can post questions and reports, query CDC, and receive feedback on ongoing infectious disease control efforts. As of 2004, over 1,200 public health officials had used the system.**

List of EID Projects using ICT and Emerging Technologies

Foodborne Disease Active Surveillance Network (FoodNet)	**is a surveillance system that is a collaborative effort among CDC, USDA, and FDA.. FoodNet is used to detect cases or outbreaks of foodborne disease, identify their source, recognize trends, and respond tooutbreaks., So FoodNet is intended to provide more accurate estimates of the occurrence of foodborne diseases than are otherwise available.**
Global Outbreak Alert and Response Network (GOARN)	**GOARN electronically links WHO member countries to investigation of, and response to, disease outbreaks of international importance. GOARN issues real-time outbreak alerts and gathers global disease information from a number of sources, including media reports, ministries of health, laboratories, academic institutes, and WHO offices in various countries.**
Global Public Health Intelligence Network (GPHIN)	**is an Internet-based application that searches and translates in French and English more than 950 news feeds and discussion groups around the world in the media and on the Internet for information onpossible outbreaks of infectious diseases. In 2004, translation capabilities will be expanded from French and English to also include Arabic, Chinese, Russian, and Spanish.**
Health Alert Network(HAN)	**is an early warning and response system that is designed to ensure that state and local health departments as well as other federal agencies and departments have timely access to emerging health information.**
Infectious Diseases Society of America Emerging Infections Network (IDSA-EIN)	**is a network of over 900 infectious disease practitioners to enhances communications and health education among its members, collaborates in research projects, and provides assistance during outbreak investigations.**
Laboratory Response Network (LRN)	**is an integrated network of public health and clinical laboratories run by CDC to test specimens and develop diagnostic tests for identifying infectious diseases and biological or chemical agents.**
PulseNet	**PulseNet is a national network of public health laboratories that perform DNA "fingerprinting" on bacteria that may be foodborne. The network idenifies and labels each "fingerprint" pattern and permits rapid comparison of these patterns through an electronic database at CDC. This network is intended to provide an early warning system for outbreaks of foodborne disease.**

Concluding Remarks

- Emerging Technologies and ICT Infrastructure are important. They should be wisely used and applied to efficiently combat Emerging Infectious Diseases.

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Thank you
Question?
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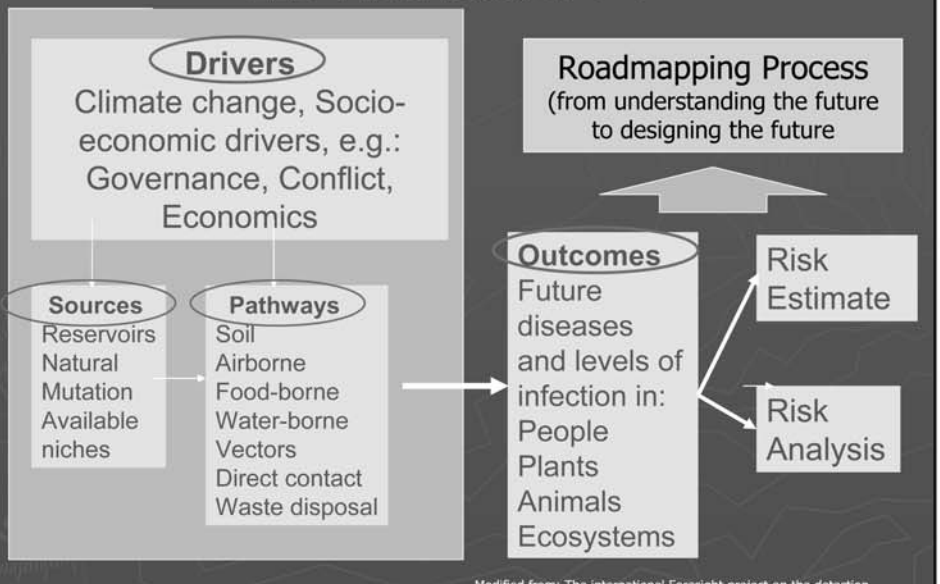
Recap from the Scenario Workshop

Nares Damrongchai
APEC Center for Technology Foresight

EID Risk model ++



Modified from: The international Foresight project on the detection, identification and monitoring of infectious diseases, UK (2006)

‘drivers’

- … are the positive (or negative) driving factors that increase the risk of emerging infectious diseases
- They are the reason why we always have new diseases.
- Most drivers could be identified by analysing trends: the pathways of events that are driven by the drivers, that can go into any direction
- For some drivers it is not possible to de… …om trends (no trends), and for some we don’t k… w its impact whether large or small, positive negative --> impact unknown

?

Emerging infectious diseases scenario workshop

Scenario Workshop Day 2

- Work in groups to create future scenarios of the Asia-Pacific
- Focal issue: how converging technologies are used to combat emerging infectious diseases?

Scenario Workshop Day 3: Assessment of scenario coherence

- Assessment of the coherence of the scenario is carried out by critical examination of its logic, identification of key events or turning points, and linkages with the greatest weakness.

Scenario Workshop Day 3: Assessment of implications of scenarios for strategic planning

- Implications are examined by returning to the focal issue. What emerges as the consequences under each scenario? What vulnerabilities have been revealed? What kind of strategies might be robust under all scenarios?
- Scenario helps us to
  - identify clear and logical outcome
  - take the stakeholders to a new level of thinking
  - raise new issues for future action.

Key Drivers for Emerging Infectious Diseases

Social
- Health concern for everyone
- Increasing population
- Urbanization
- Gap of Knowledge Sharing

Technological
- Complexity of transportation
- Nanotechnology
- Genetic modification
- Event Tracking

Economical
- Free Trade Agreement
- Sufficient economy
- Rich poor gap

Environmental
- Climate change
- Vector patterns changes
- Land use change
- Wild life – Changes of wild life consumption But pet trades will increase

Political
- Terrorism
- Patent in developed countries, incubate for developing countries
- Wrong policy

These are the foreseeable trends!

Key Drivers for Emerging Infectious Diseases

Uncertainties
- Massive Natural disasters such as massive volcanoes, earthquakes, etc.
- Global securities (man-made disasters, alien species/ breakthrough tech.)
- Local/Global panic
- Urbanization: increase, Economic crisis
- Gap of Knowledge sharing
- Unpredicted/unplanned technologies

The Four Scenarios

- **Group 1 "Malaria in Miami 2017"**
- **Group 2 "20,000 People Now Confirmed Dead from Mystery Disease"**
- **Group 3 "The Mysterious Achaean Virus"**
- **Group 4 "Emerging Rainforest Syndrome (RFS)"**

NOT CLEARED FOR OPEN PUBLICATION

Technological Approaches Can Enter Throughout the EID Lifecycle

EID Decision Model

- Severity estimation
- Timeliness and efficacy of intervention

Adapted from: Dr. Richard Silberglitt, RAND Corporation (2007)

The 3 Domains of Technology Application

Ubiquitous Computing

- Field tests networked
- Data collection (real time)
- Data mining
- Mobile phone tracking
- Data sharing
- Modelling
- Bioinformatics
- Network info system countries sign up for info sharing

The 3 Domains of Technology Application

Treatment

- Drug design
- Delivery vaccine
- Vaccine development
- Personalised medicine advance in pharmaceutics
- Nanodelivery of drugs
- Molecular medicine, Cell-based vaccine development advance in genetic engineering of virus and antiviral material
- Conventional Drug Discovery

The 3 Domains of Technology Application

Diagnosis

- Micro/Nano array molecular
- Implantable diagnostics
- Simple thermographical scanner
- Genotyping characterization
- Advance in micro-fluidic device
- Advance in genetic sequencing
- Advance in lab on a chip

Strategic Technology Roadmapping

Service-Layer Integrated Comprehensive Roadmapping

Converging Technology to Combat Emerging Infectious Diseases (EID): Technology Roadmap Workshop
22-24 May 2007
Toshi Center Hotel, Tokyo, Japan

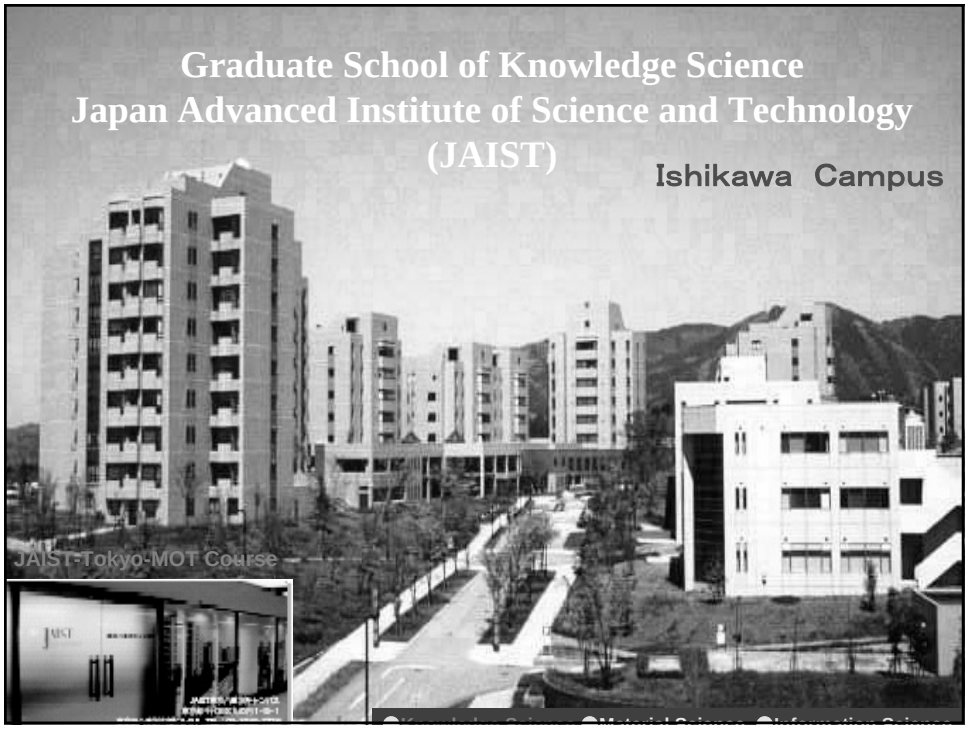
Prof. Akio Kameoka

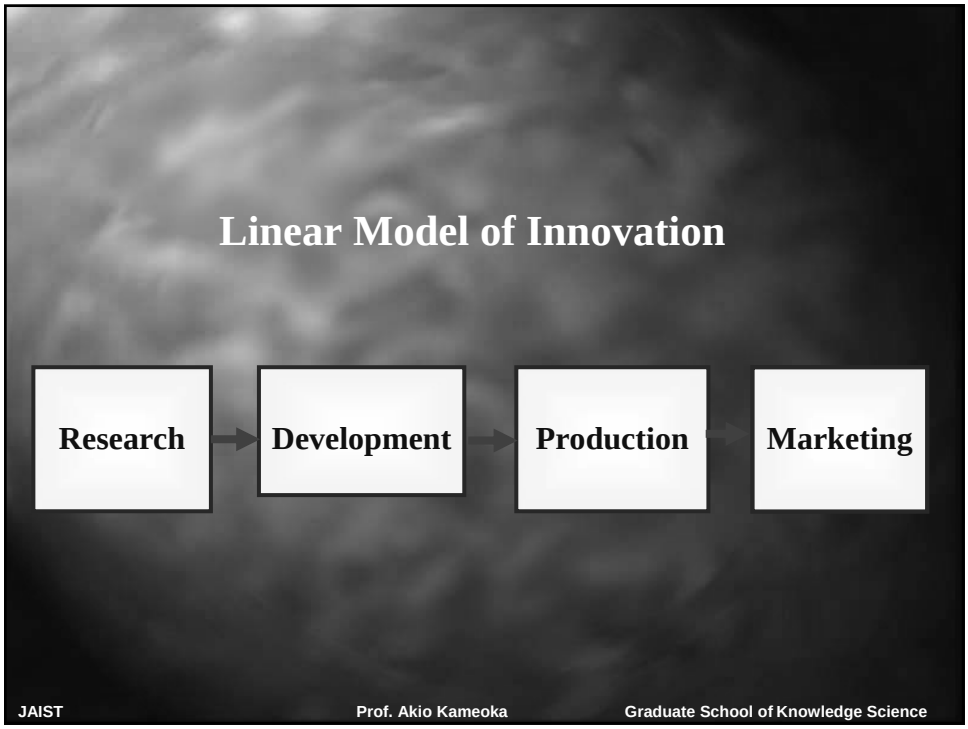
JAIST-Tokyo-MOT Course,
Graduate School of Knowledge Science,
Japan Advanced Institute of Science and Technology (JAIST)

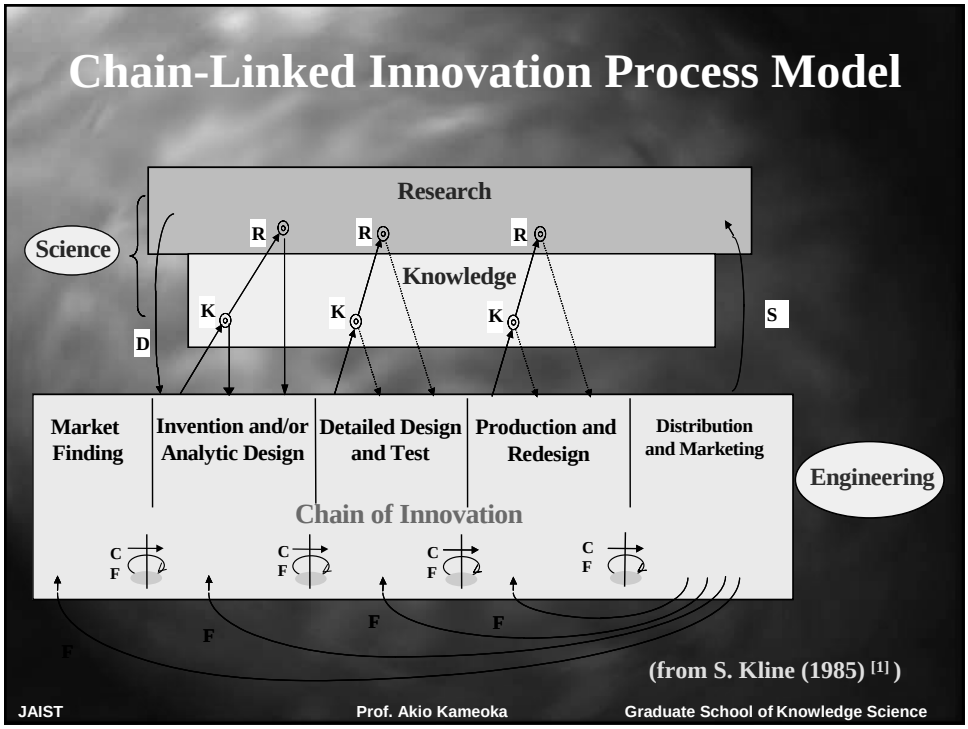
TOPICS

1. Next-Generation Innovation Model
2. Strategic Roadmapping
3. Service Innovation and Service Science
4. Service Layer Integrated Strategic Roadmapping
5. Strategic MOT Goal: Just-in-Time Innovation
6. Techno-producer
7. Industry-Academy Collaborations through Communications with Roadmaps

Final remarks : Symbiotic Competitiveness


Graduate School of Knowledge Science
Japan Advanced Institute of Science and Technology
(JAIST)
Ishikawa Campus
JAIST-Tokyo-MOT Course


Linear Model of Innovation
Research
Development
Production
Marketing
JAIST
Prof. Akio Kameoka
Graduate School of Knowledge Science


Chain-Linked Innovation Process Model
Research
Science
Knowledge
R
K
D
S
Market Finding
Invention and/or Analytic Design
Detailed Design and Test
Production and Redesign
Distribution and Marketing
Engineering
Chain of Innovation
C F
F
(from S. Kline (1985) [1])
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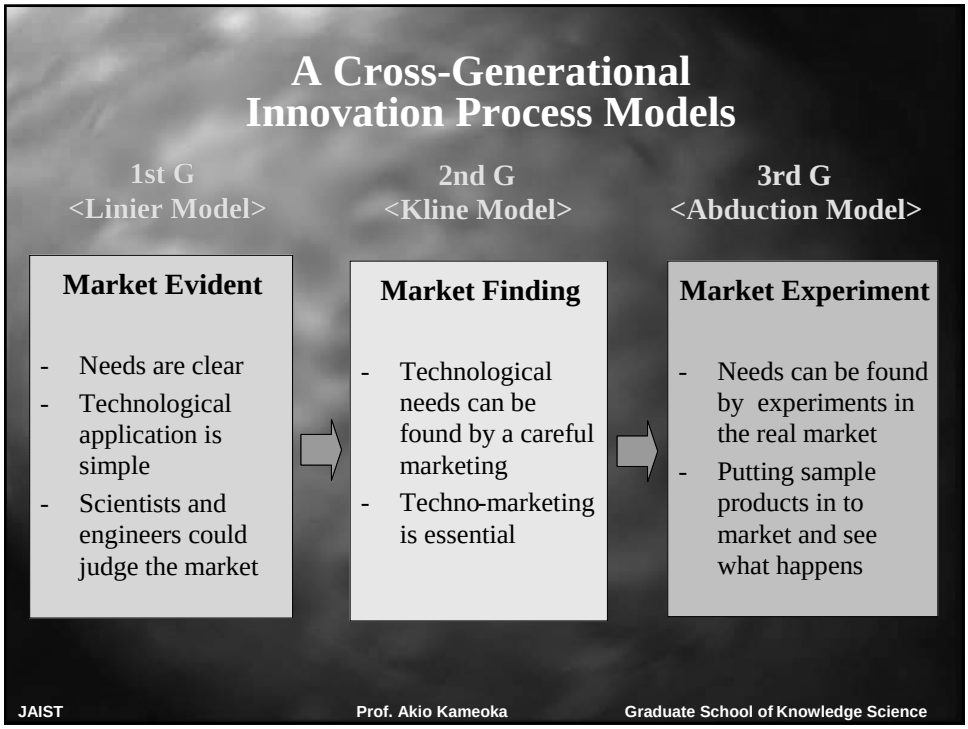
A Cross-Generational Innovation Process Models
1st G <Linier Model>
2nd G <Kline Model>
3rd G <Abduction Model>
Market Evident
- Needs are clear
- Technological application is simple
- Scientists and engineers could judge the market
Market Finding
- Technological needs can be found by a careful marketing
- Techno-marketing is essential
Market Experiment
- Needs can be found by experiments in the real market
- Putting sample products in to market and see what happens
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Graduate School of Knowledge Science

Next-Generation Innovation Model

4th Generation
<Market Creation Model>

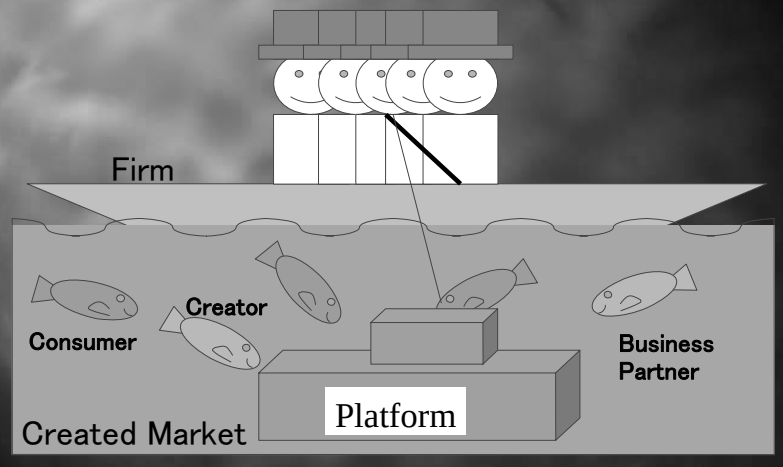
Market Creation

- **Users and producers interactively creates new products**
- **Produce what users really want by participating into the initial planning**
- **Experience values are obtained through participation**

Coordinator
Concept Creator
Techno -producer
Creative Platform
"Ba"

JAIST Prof. Akio Kameoka Graduate School of Knowledge Science

Metaphor of the Market Creation Model



Ito & Kameoka, IEEE EMS IEMC2001 (October, 2001, Albany, NY)

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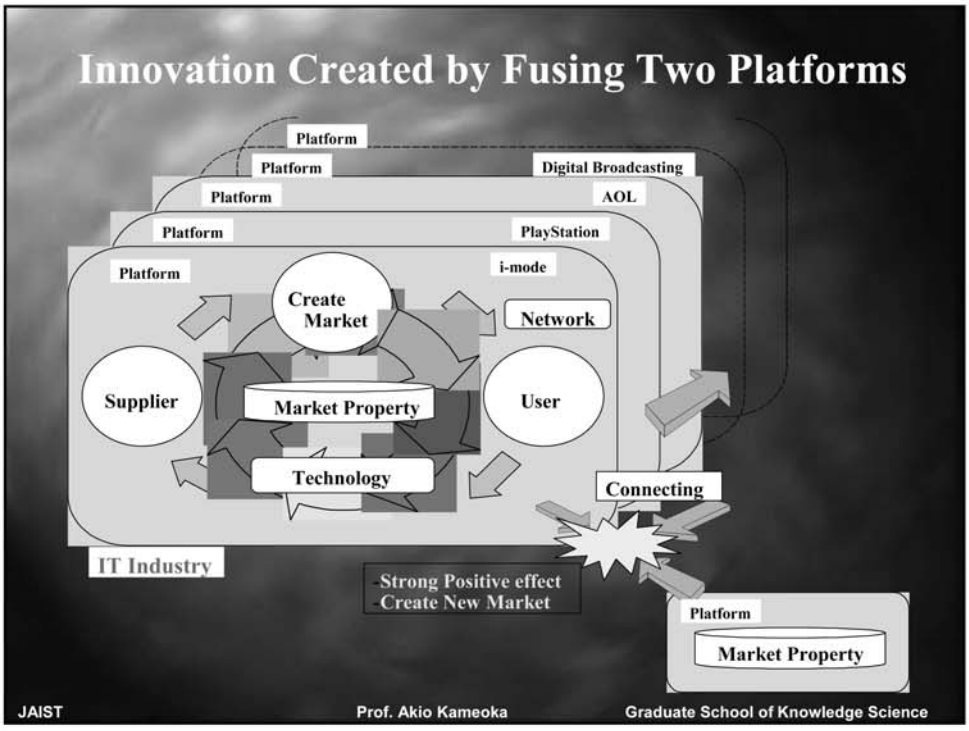
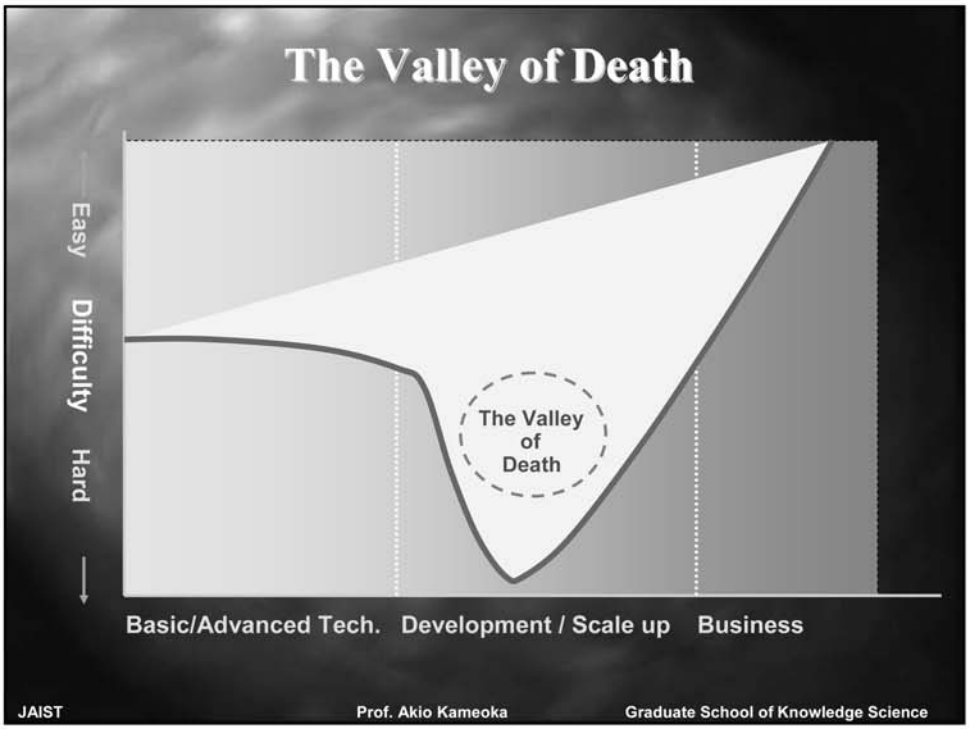

Innovation Created by Fusing Two Platforms
Platform
Platform
Digital Broadcasting
Platform
AOL
Platform
PlayStation
Platform
i-mode
Create Market
Network
Supplier
Market Property
User
Technology
Connecting
IT Industry
-Strong Positive effect
-Create New Market
Platform
Market Property
JAIST
Prof. Akio Kameoka
Graduate School of Knowledge Science


The Valley of Death
Easy
Difficulty
Hard
The Valley of Death
Basic/Advanced Tech.
Development / Scale up
Business
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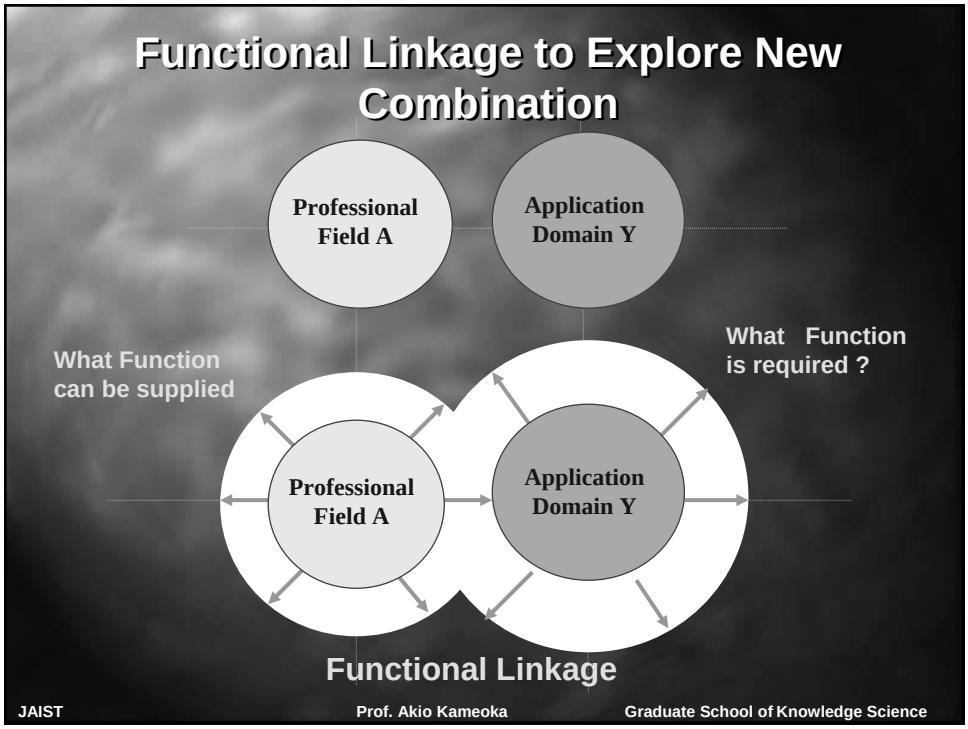
Functional Linkage to Explore New Combination
Professional Field A
Application Domain Y
What Function can be supplied
What Function is required ?
Professional Field A
Application Domain Y
Functional Linkage
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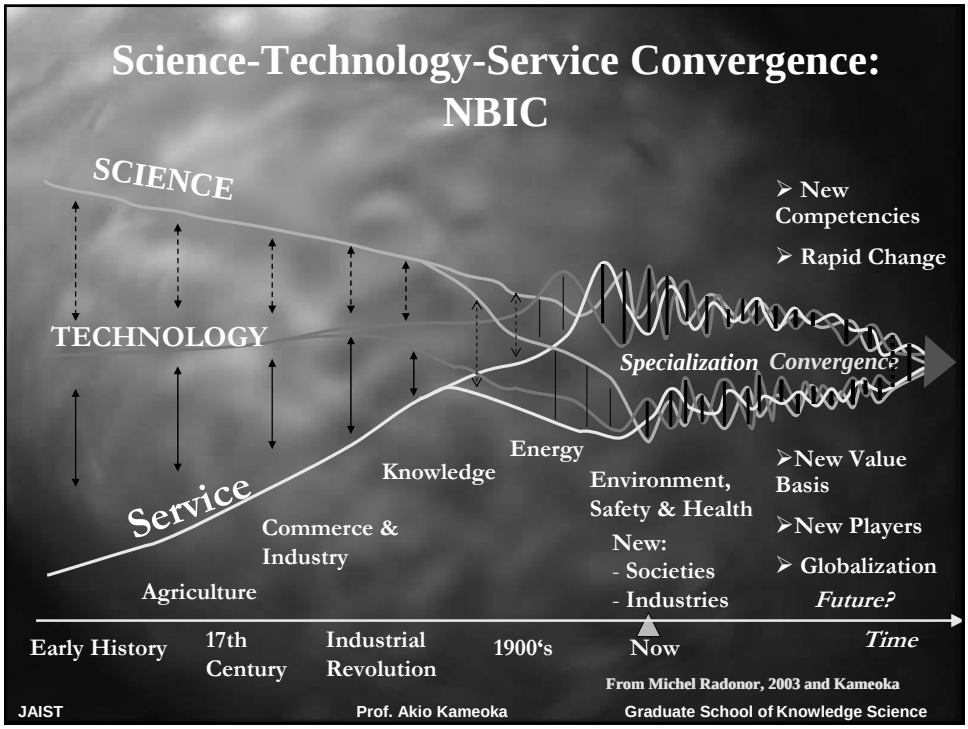
Science-Technology-Service Convergence: NBIC
SCIENCE
TECHNOLOGY
Service
Agriculture
Commerce & Industry
Knowledge
Energy
Environment, Safety & Health
New:
- Societies
- Industries
Specialization
Convergence
➢ New Competencies
➢ Rapid Change
➢New Value Basis
➢New Players
➢ Globalization
Future?
Early History
17th Century
Industrial Revolution
1900's
Now
Time
From Michel Radonor, 2003 and Kameoka
JAIST
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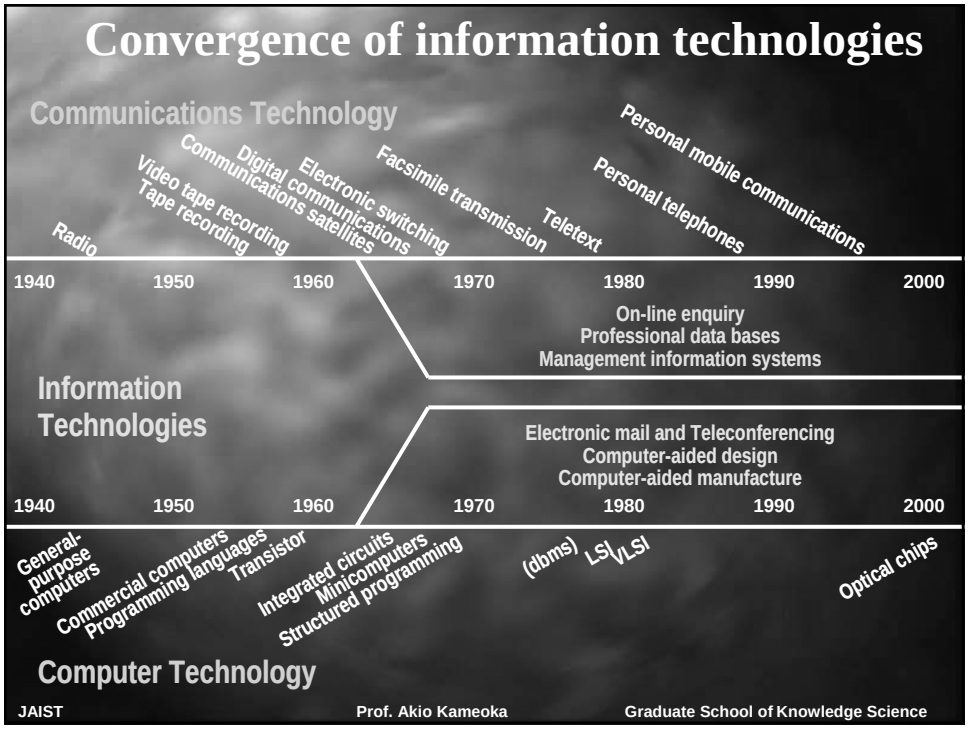
Convergence of information technologies
Communications Technology
Radio
Tape recording
Video tape recording
Communications satellites
Digital communications
Electronic switching
Facsimile transmission
Teletext
Personal telephones
Personal mobile communications
1940
1950
1960
1970
1980
1990
2000
On-line enquiry
Professional data bases
Management information systems
Information Technologies
Electronic mail and Teleconferencing
Computer-aided design
Computer-aided manufacture
1940
1950
1960
1970
1980
1990
2000
General-purpose computers
Commercial computers
Programming languages
Transistor
Integrated circuits
Minicomputers
Structured programming
(dbms)
LSI
VLSI
Optical chips
Computer Technology
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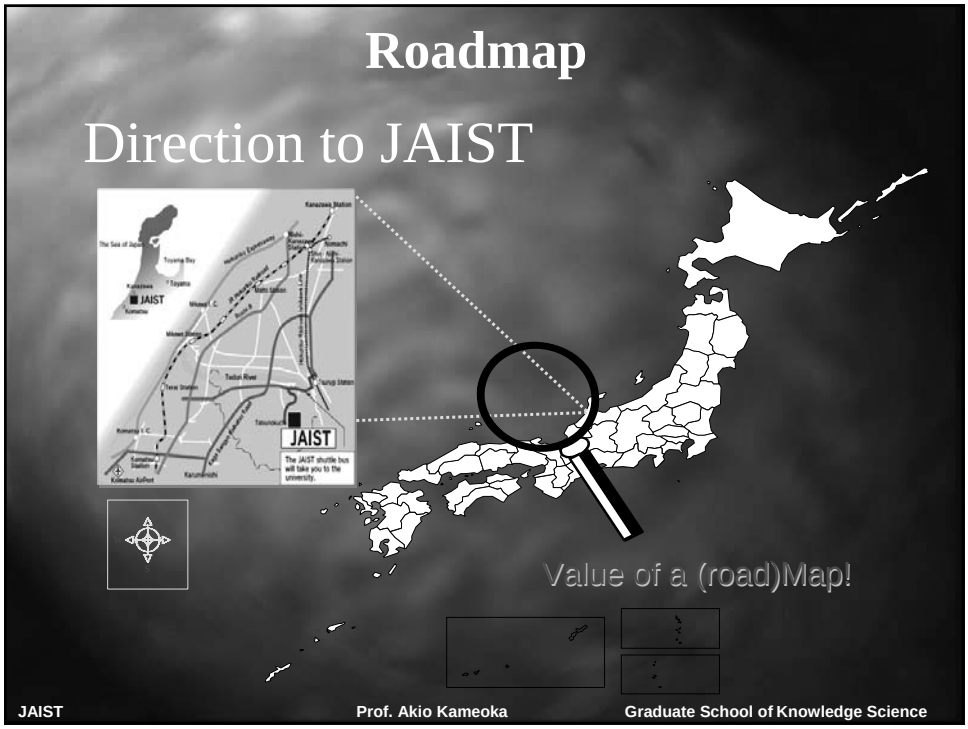
Roadmap
Direction to JAIST
JAIST
JAIST
Value of a (road)Map!
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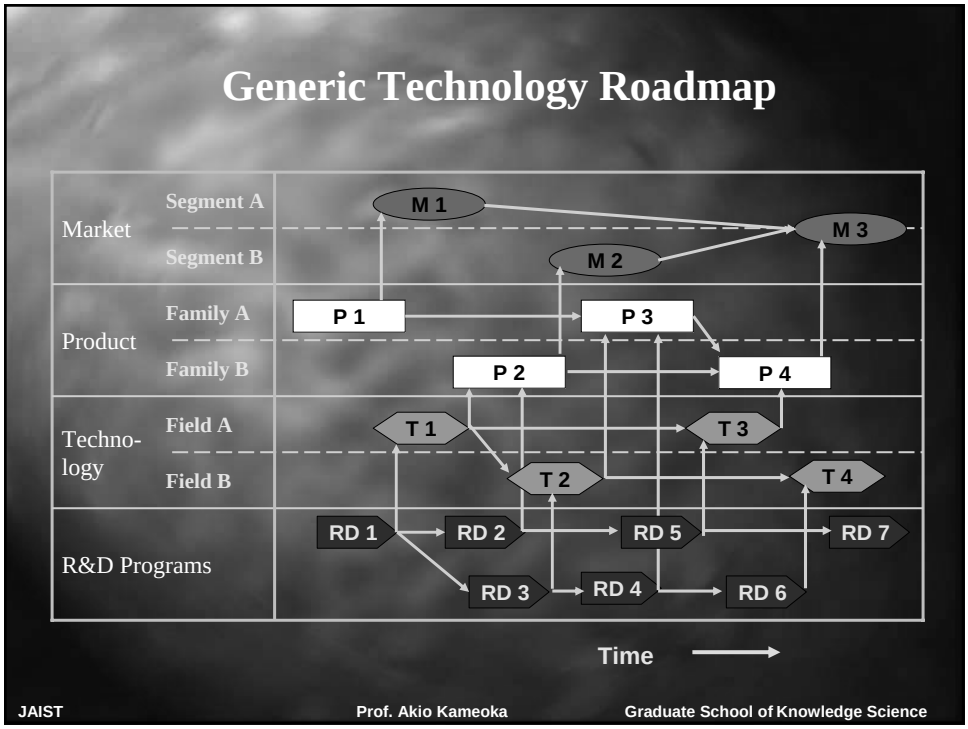
Generic Technology Roadmap
Market
Segment A
Segment B
Product
Family A
Family B
Techno-logy
Field A
Field B
R&D Programs
M 1
M 2
M 3
P 1
P 2
P 3
P 4
T 1
T 2
T 3
T 4
RD 1
RD 2
RD 3
RD 4
RD 5
RD 6
RD 7
Time
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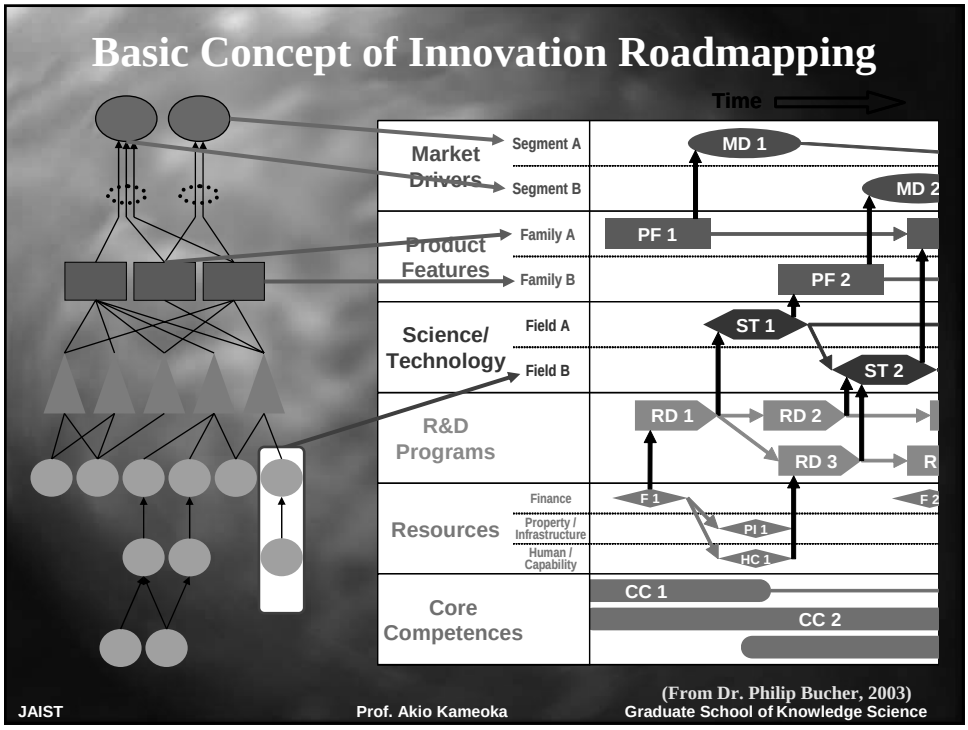
Basic Concept of Innovation Roadmapping
Time
Market Drivers
Segment A
Segment B
Product Features
Family A
Family B
Science/ Technology
Field A
Field B
R&D Programs
Resources
Finance
Property / Infrastructure
Human / Capability
Core Competences
MD 1
MD 2
PF 1
PF 2
ST 1
ST 2
RD 1
RD 2
RD 3
F 1
PI 1
HC 1
CC 1
CC 2
(From Dr. Philip Bucher, 2003)
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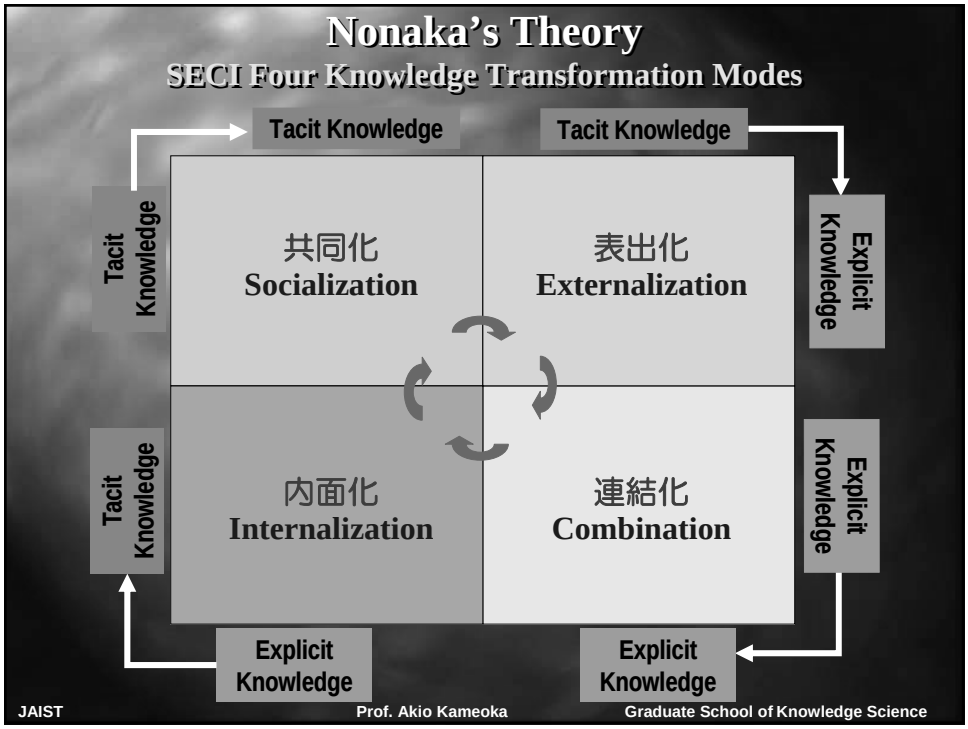
Nonaka's Theory
SECI Four Knowledge Transformation Modes
Tacit Knowledge
Tacit Knowledge
Tacit Knowledge
Explicit Knowledge
共同化
Socialization
表出化
Externalization
内面化
Internalization
連結化
Combination
Tacit Knowledge
Explicit Knowledge
Explicit Knowledge
Explicit Knowledge
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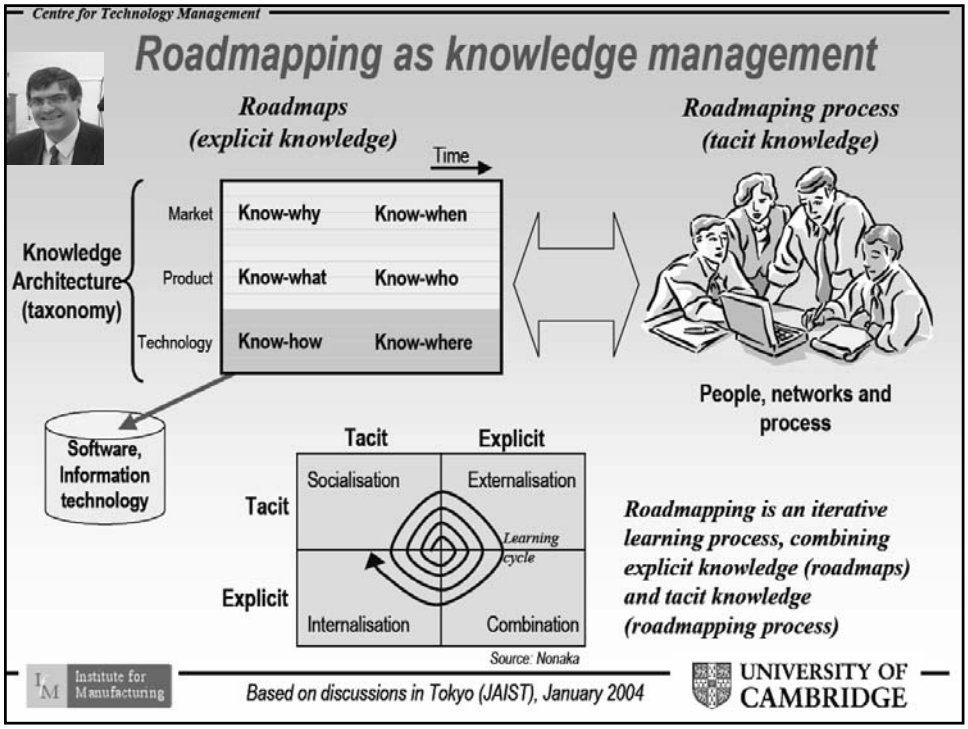
Centre for Technology Management
Roadmapping as knowledge management
Roadmaps
(explicit knowledge)
Roadmaping process
(tacit knowledge)
Time
Market
Know-why
Know-when
Product
Know-what
Know-who
Technology
Know-how
Know-where
Knowledge Architecture (taxonomy)
People, networks and process
Software, Information technology
Tacit
Explicit
Socialisation
Externalisation
Internalisation
Combination
Learning cycle
Roadmapping is an iterative learning process, combining explicit knowledge (roadmaps) and tacit knowledge (roadmapping process)
Source: Nonaka
Institute for Manufacturing
Based on discussions in Tokyo (JAIST), January 2004
UNIVERSITY OF CAMBRIDGE

What is "Service" ? : A Definition -

"a supporting activity to help an individual or organization to achieve its objective"

- Physical supporting functions,
- Psychological supporting functions,
- Intellectual supporting functions,
- Spiritual supporting functions, as well as
- Technological Product supporting functions, and Others.

"Product" only provides a function to achieve "Service"

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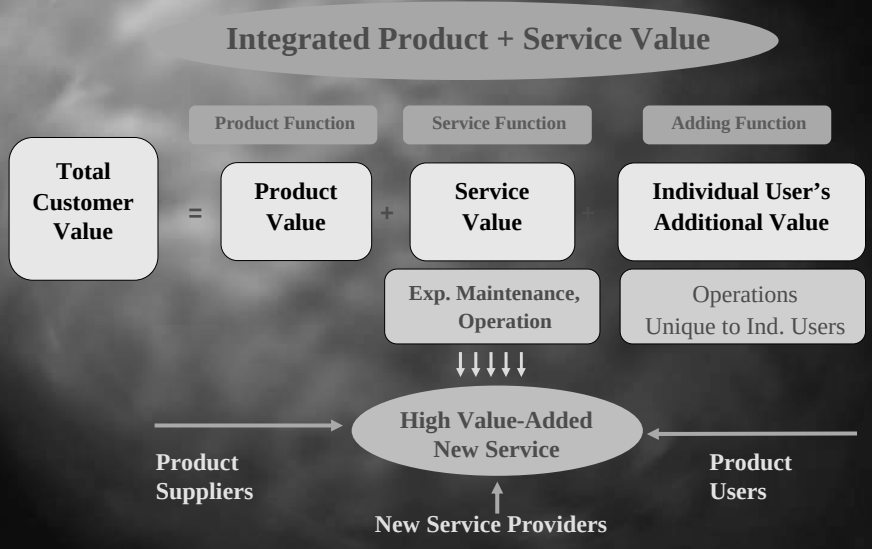
Total Customer Value



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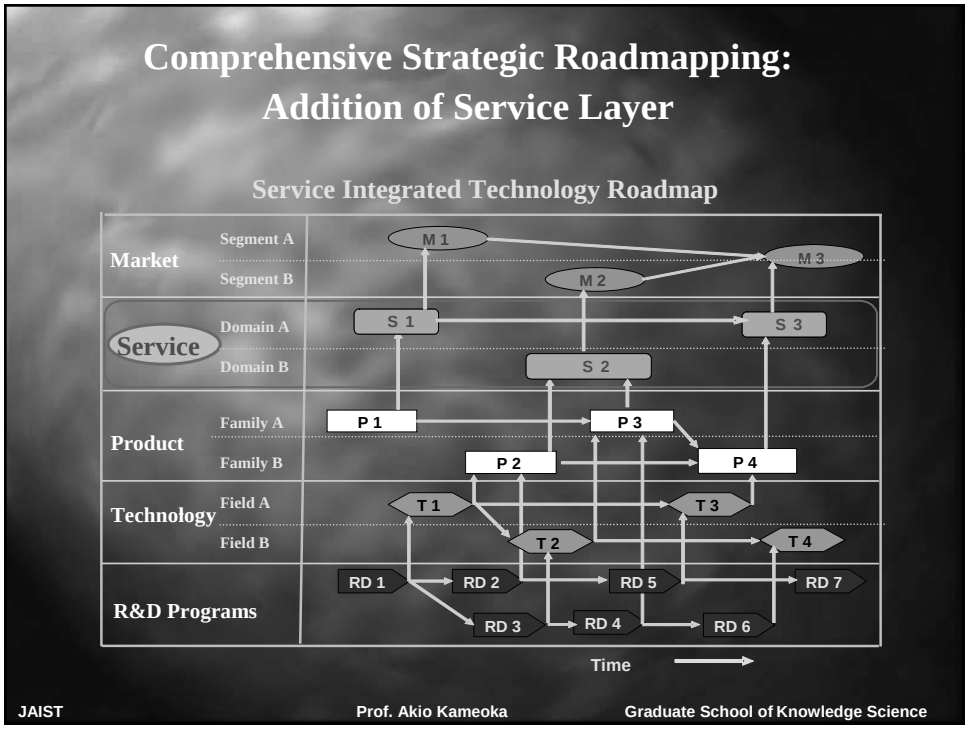
Comprehensive Strategic Roadmapping:
Addition of Service Layer
Service Integrated Technology Roadmap
Market
Segment A
Segment B
Service
Domain A
Domain B
Product
Family A
Family B
Technology
Field A
Field B
R&D Programs
M 1
M 2
M 3
S 1
S 2
S 3
P 1
P 2
P 3
P 4
T 1
T 2
T 3
T 4
RD 1
RD 2
RD 3
RD 4
RD 5
RD 6
RD 7
Time
JAIST
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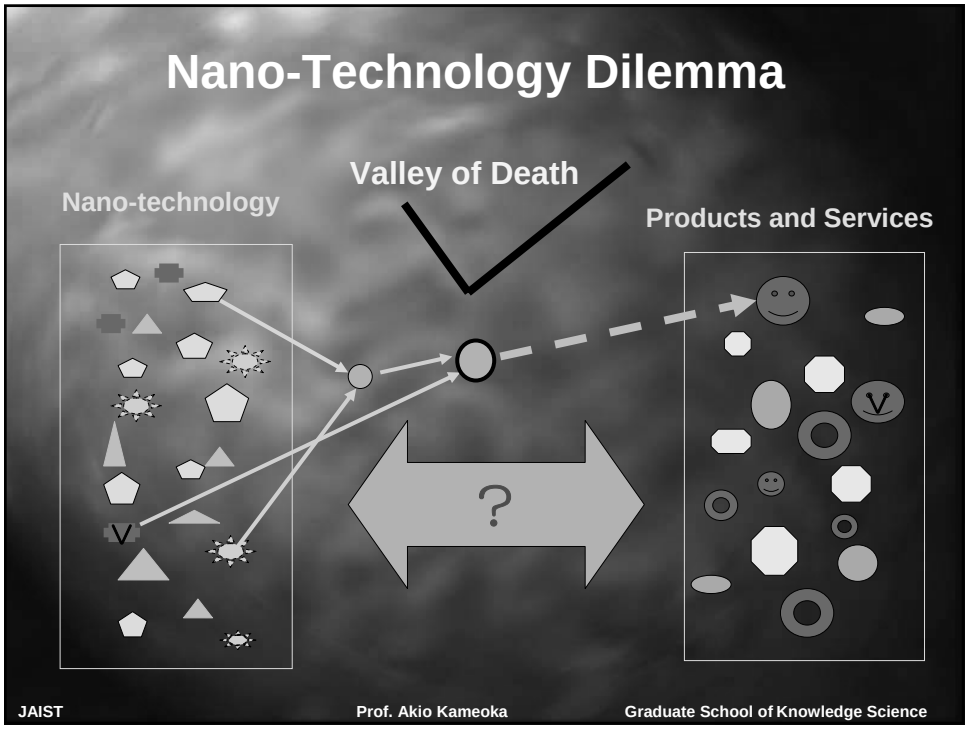
Nano-Technology Dilemma
Valley of Death
Nano-technology
Products and Services
?
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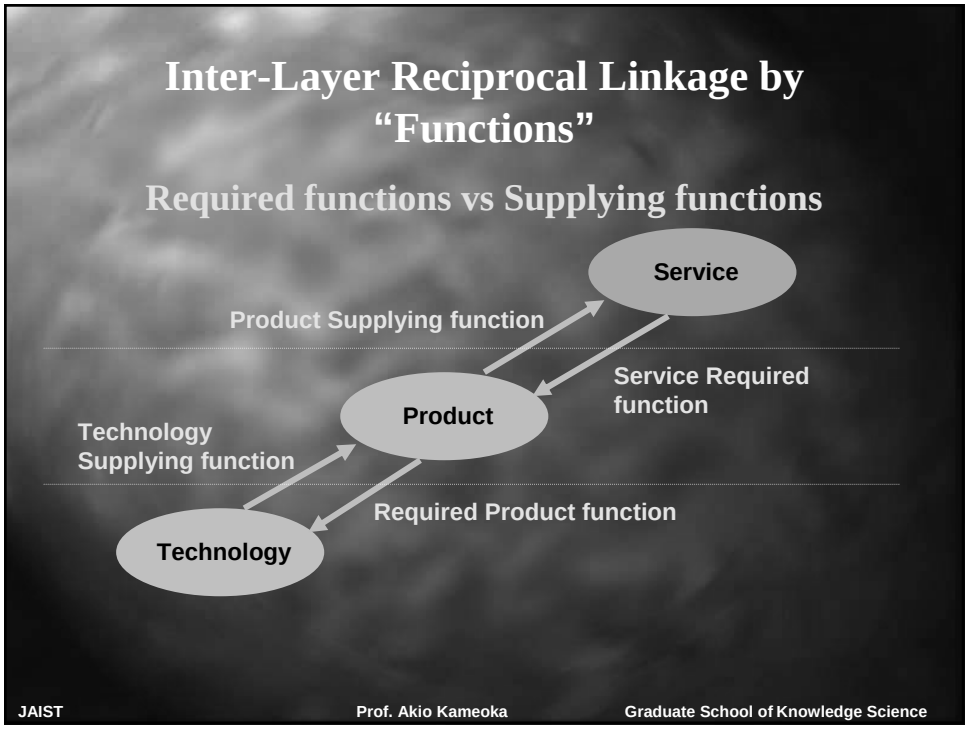
Inter-Layer Reciprocal Linkage by "Functions"
Required functions vs Supplying functions
Service
Product Supplying function
Service Required function
Product
Technology Supplying function
Required Product function
Technology
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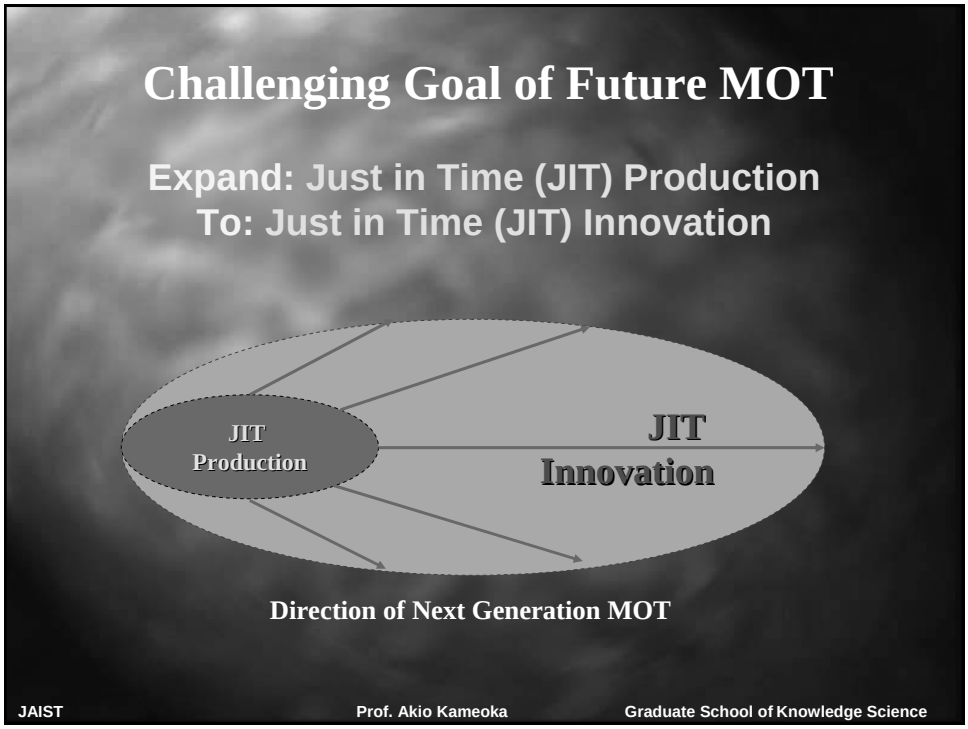
Challenging Goal of Future MOT
Expand: Just in Time (JIT) Production
To: Just in Time (JIT) Innovation
JIT Production
JIT Innovation
Direction of Next Generation MOT
JAIST
Prof. Akio Kameoka
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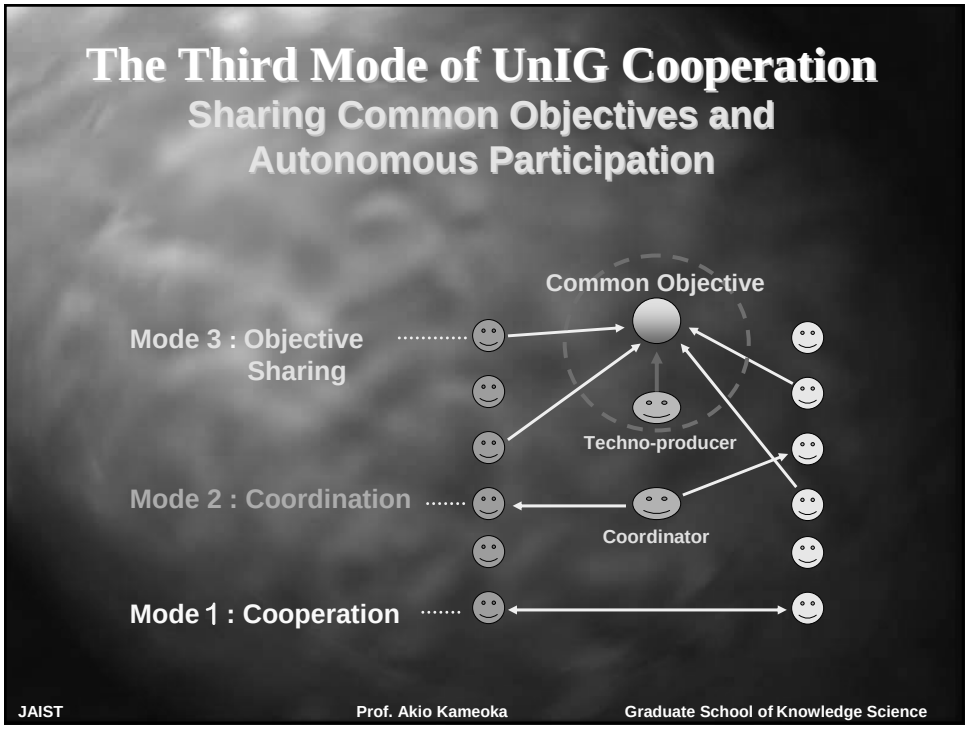
The Third Mode of UnIG Cooperation
Sharing Common Objectives and Autonomous Participation
Common Objective
Mode 3 : Objective Sharing
Techno-producer
Mode 2 : Coordination
Coordinator
Mode 1 : Cooperation
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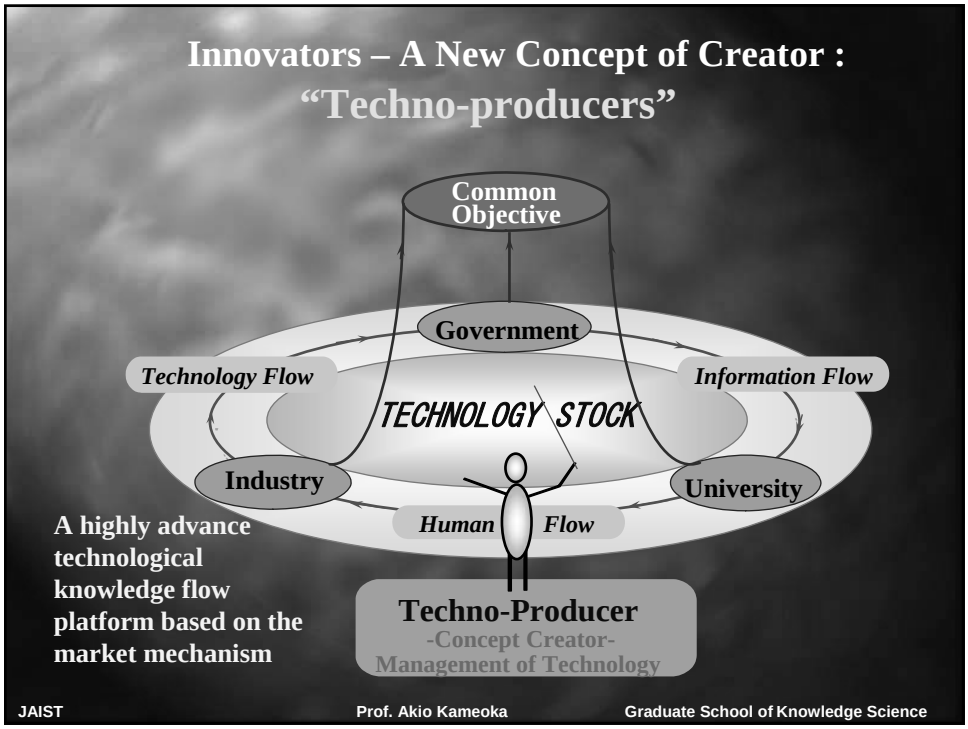
Innovators – A New Concept of Creator :
"Techno-producers"
Common Objective
Government
Technology Flow
Information Flow
TECHNOLOGY STOCK
Industry
University
Human Flow
A highly advance technological knowledge flow platform based on the market mechanism
Techno-Producer
-Concept Creator-
Management of Technology
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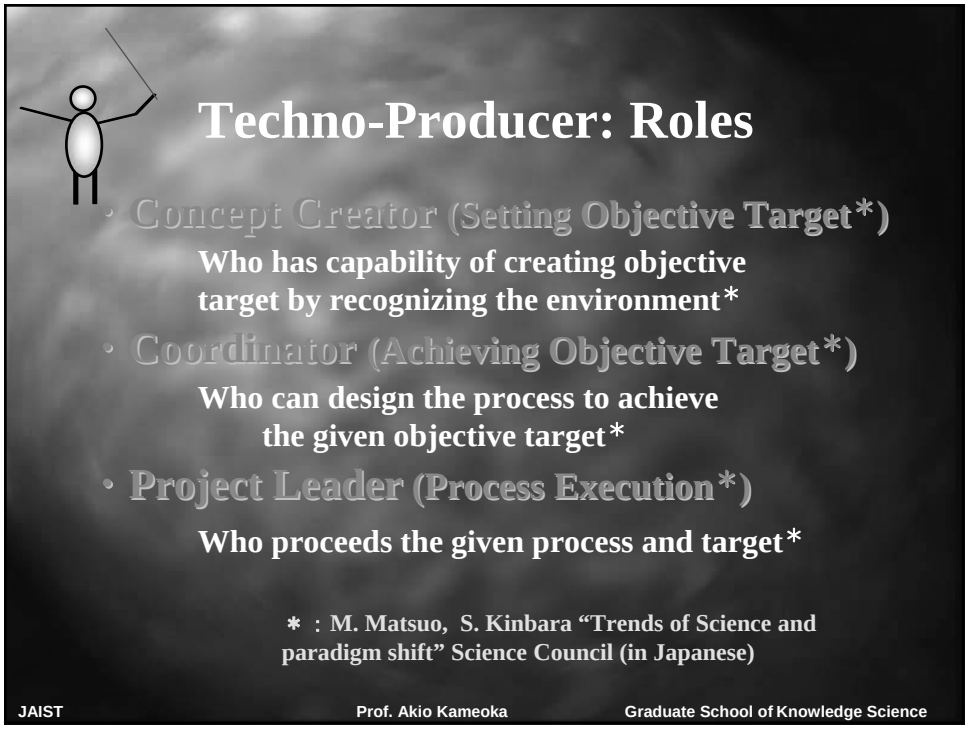
Techno-Producer: Roles
• Concept Creator (Setting Objective Target*)
Who has capability of creating objective target by recognizing the environment*
• Coordinator (Achieving Objective Target*)
Who can design the process to achieve the given objective target*
• Project Leader (Process Execution*)
Who proceeds the given process and target*
* : M. Matsuo, S. Kinbara "Trends of Science and paradigm shift" Science Council (in Japanese)
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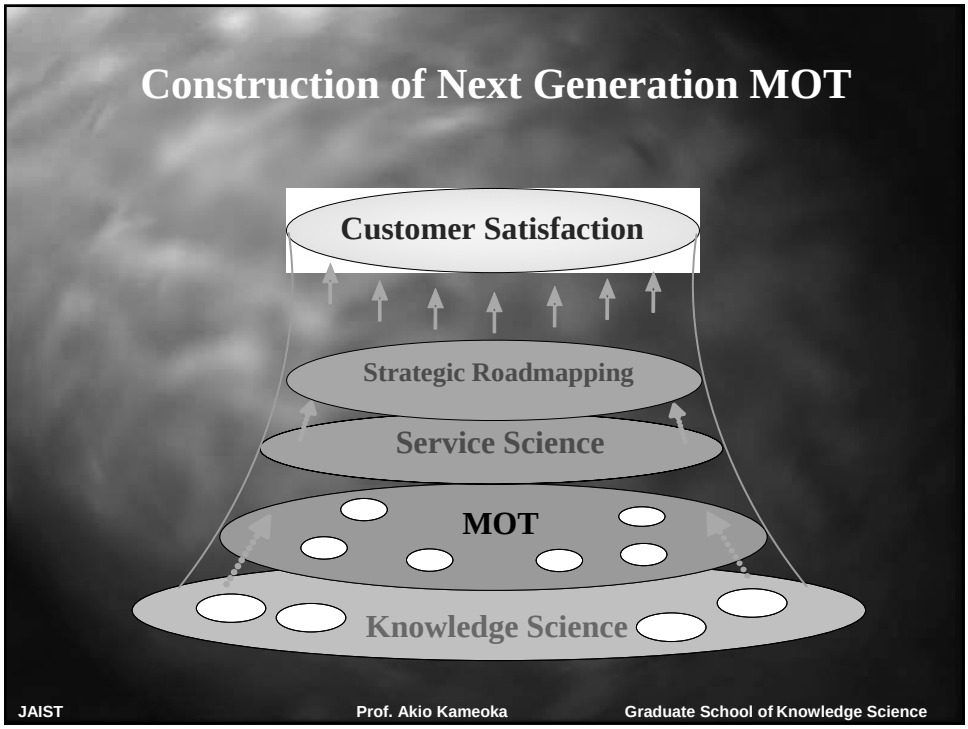
Construction of Next Generation MOT
Customer Satisfaction
Strategic Roadmapping
Service Science
MOT
Knowledge Science
JAIST
Prof. Akio Kameoka
Graduate School of Knowledge Science

National Innovation System, promoted by Government in Japan

By METI and NEDO

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Concluding Remarks (1)

1. Next generation MOT moves its focus to 4th Generation market creation model, for creating higher value by service innovations based on integrating more sophisticated service functions to the conventional products and systems.

2. This approach provides a scheme for the newly emerging "service science" expected to support service innovations and derives practical methodology to integrate new services to the strategic technology roadmap/roadmappinng by introducing a new independent layer of services between the market and products layers.

Concluding Remarks (2)

3. Here, the concept of "service" is widely defined as "a supporting activity to help an individual or organization to achieve its objective".

4. Accordingly, it includes physical supporting functions, psychological supporting functions, intellectual supporting functions, spiritual supporting functions, as well as technological supporting functions provided through products.

5. Valuating products and systems with their added services improves customer satisfaction and the total customer value should be considered as the summation of the products/system value, added services value, and individually user added value.

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Concluding Remarks (3)

6. As for a new methodology for managing the service integrated technology/products innovation, this paper proposes a service-integrated technology roadmap/ roadmapping, which involves a new concept of functions, "requiring functions" and "supplying functions" to fill the gaps between the market and service layers, as well as the service and products layers.

7. Industry-Academy Collaborations through Effective Communications with Roadmaps and Roadmapping

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Symbiotic Competitiveness by Roadmapping for the 21st Century

What is "Competitiveness"? Dr. Hiroshi INOSE

- **The word 'compete' derives from Latin word 'competere'. The prefix 'com' means 'together', and 'petere' means 'pursue'. Consequently, 'competere' means to 'pursue together'.**
- **But, what is to pursue ? The answer is "human ideals".**
- **When people pursue ideals, they help each other and strive together. In correcting each errors and compensating each other's weakness, and in acknowledging each other's insight and strength, they see the true competitiveness.**
- **Competitiveness, thus, should come from the power for self-discipline and not from the motivation to be superior by commanding power, tricks, or fraud tactics, because its purpose is to pursue human ideals.**

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Thank you for your attention

JAIST Prof. Akio Kameoka Graduate School of Knowledge Science

EID Technology Roadmap Workshop
22-24 May 2007, Tokyo Japan

Strategic Technology Roadmapping

Case Study :

Converging Technology based on Optical Molecular Imaging Technology to attack the Cancer Desieses

Prof. Shotaro Kohtsuki

Graduate School of Technology Management
Ritsumeikan University

Optical Molecular Imaging Technology

- *Total concept of Optical Molecular Imaging Process*

- Detection and identification of unknown cancer cell in an internal organ by optical molecular emission
- High performance observation of transferring cancer parts from its original site to another part of the body
- High sensitive analysis and visualization of the cancer diseases
- Medical treatment by use of the optical molecular imaging process

Optical Molecular Imaging Technology

- *key drivers:*

  / Quality of Life
  / To make sure the Human Life in safety and security
  / To allay the anxieties of the personal health

- *Needs or wants:*

  / Detection of the cancer diseases in early stage
  - Suitable treatment to the traditional cancer molecules
  - Accurate diagnosis of a new type of cancer disease
  - Accurate evaluation of a spread stage of cancer focus
  / Appropriate therapy without physical pain and damage
  / Cancer disease prevention, etc.

Optical Molecular Imaging Technology

- *Function:*

  / High performance observation of transferring cancer focus from its original site to another part of the body
  / Detailed data analysis and visualization of the locus of cancer focus
  / Diagnostic imaging using the optical molecular imaging data
  / Medical treatment by use of the optical molecular imaging process
  / Diagnostic data accumulation and data transfer
  / Establishment of evaluation methods using the optical molecular imaging to the cancer disease variation

RITS

Optical Molecular Imaging Technology

Technology : Optical Molecular Imaging

/ Development of bio-marker
- molecular fluorescence, molecular luminescence

/ Introduction of a bio-marker to the target molecules in a part of cancer focus

/ Development of traceable system of cancer molecule

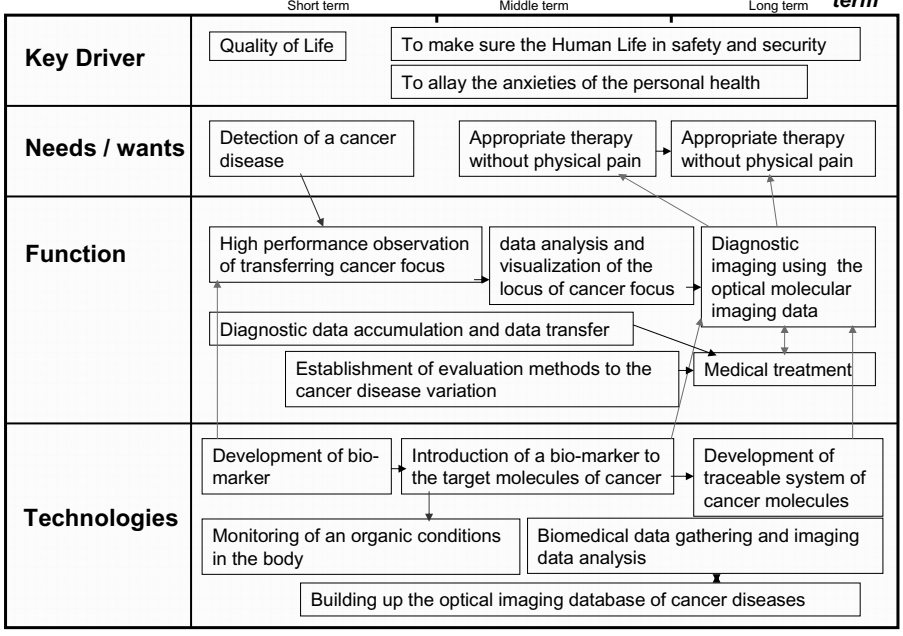
/ Monitoring of an organic conditions in the body

/ Biomedical data gathering and imaging data analysis

/ Building up the optical imaging database of cancer diseases

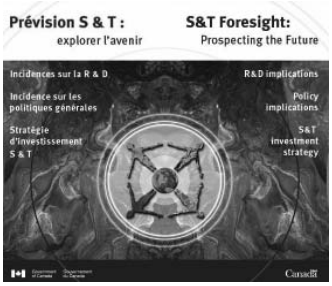
Strategic Technology Road mapping of Optical Molecular Imaging Technology to Cancer Research

RITS



The Convergence Questions…

Which prospective nano-bio-info and bio-nano-info convergent technology applications do industry and government need to pursue to ensure that Canada prospers in the future global economy; what are the prospective areas of application, products and impacts; how should these be stewarded; and what steps should be taken to accelerate their development?



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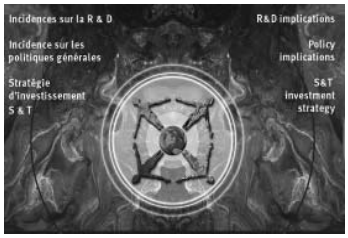
Key Activities 2007

The Foresight will engage a diverse group of experts to:

- ***Explore a range of applications involving emerging and converging technologies in the nano-bio-info and bio-nano-info innovation space;***
- ***Examine the potential implications of these technologies for various sectors (energy- environment, agriculture-bio-products, health and life sciences, public safety and national security);***
- ***Stimulate the development and/or refinement of future-oriented, innovative product and services strategies in participating organizations;***
- ***Influence priority-setting for provincial and federal investments***
- ***Provide insight to government with regard to converging technologies in order to be able to be appropriately prepared for these technologies (improved planning, regulatory environment, regulatory science, HR needs)***



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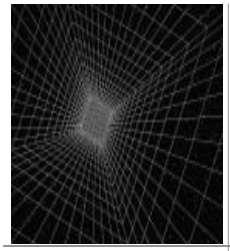
Why Are Converging Technologies Important For Canada?

- Technologies and markets of the future: *be involved*, or be overtaken;
- Canada has evolved good research and knowledge- technology strengths in both nano and bio which *should now be capitalized upon* through a focused approach to commercialization;
- Convergence identifies a space where *new means of coordination are required* – existing structures, budgets and expertise domains may be insufficient to the task;
- Moving from "hewers of wood and drawers of water" up the knowledge value chain requires *examining assets in a new context*;
- Risk mitigation and social weal: *avoiding technology "miscasts"* , early design of ethical and social benefits;
- Essential tools for *dealing with tough problems* Canada will face: energy, climate change, health, security.



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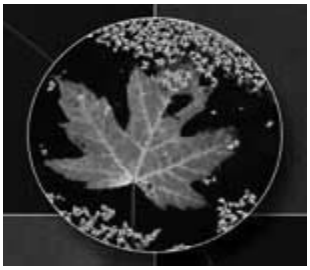
Focus on Key National Sectors

The PACT Research Team identified 12 technologies for detailed consideration by the Expert Panel in each of three application areas:

- *Energy and the Environment*
- *Water, Food, and Bioproducts*
- *Health and Life Sciences*
- *Public Safety and Security*

(will be examined in Stage Two)



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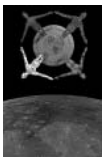
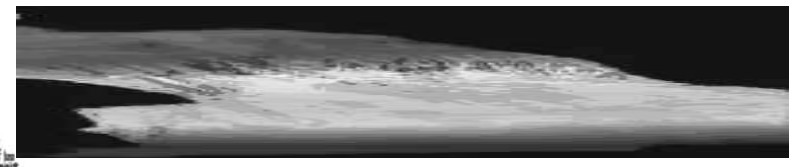
CT Applications-Sub Sectors

- *Nano-bio pharma-drug design, delivery*
- *Bio-computation, nano-imaging*
- *Bio-nano materials for health*
- *Bio-nano devices, arrays, diagnostics*
- *Bio-nano-genetic medicine*
- *Energy production and distribution*
- *Energy end use and device efficiencies*
- *Environmental stewardship + toxicology*
- *Environmental monitoring + sensing*
- *Bio-remediation, toxic removal*
- *Bio-fuels, bioenergy systems optimization*
- *Industrial bio-products*
- *Synthetic, bioengineered foods*
- *Bioterrorism and vaccines*
- *Food processing and packaging*
- *Food freshness and preservation*
- *Human Surveillance, smart "dust"*
- *All hazards detection, critical infrastructure monitoring, protection*
- *Climatic events warning and prediction*
- *Soldier capabilities and performance*





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Research Methodology…

Each technology/application area was evaluated by each member on three relevant dimensions:

- *Commercial Potential*
- *Technical Feasibility*
- *Public Policy Issues*

The midpoint of each team's evaluation are shown in the following 3 diagrams…

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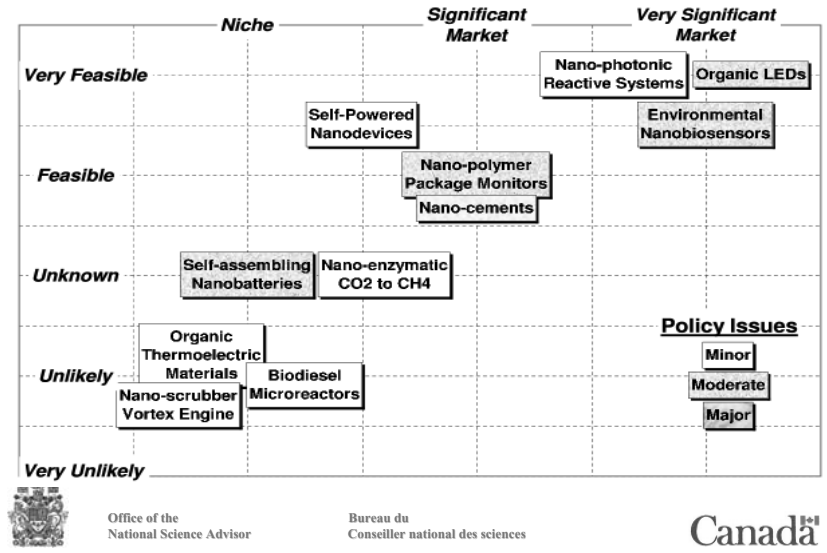
Convergent Technologies for Energy and the Environment 2020



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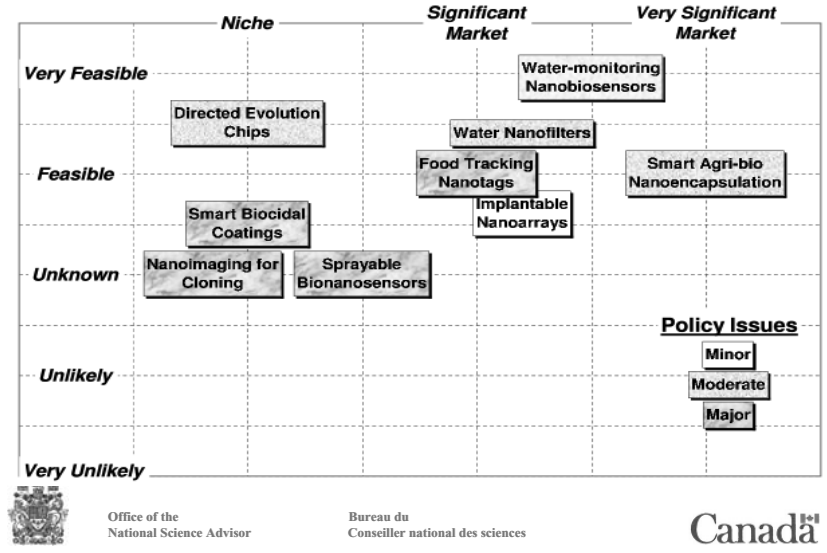
Convergent Technologies for Water, Food, and Bioproducts 2020



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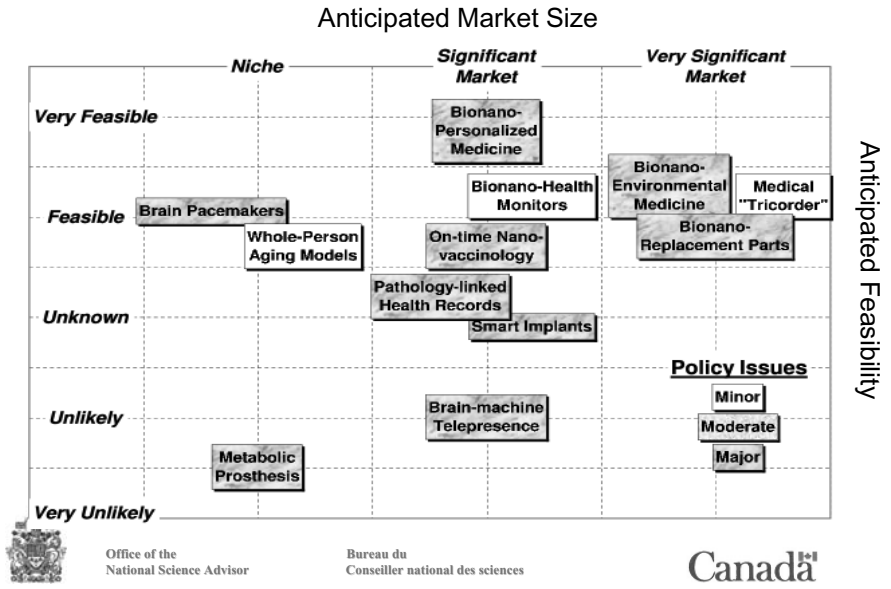
Convergent Technologies for Health and Life Sciences 2020



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Research Methodology…

The most technically feasible technologies were then re-evaluated by the group with an eye to what plausible role Canada could play in their development out to 2020.

Each of these technologies were evaluated as to their expected uptake in Canada, either by the public, the private market, or by relevant government agencies.

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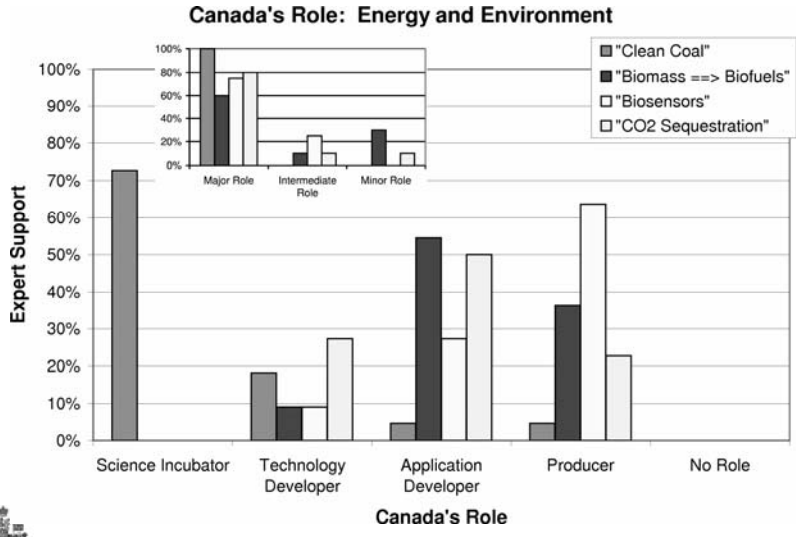
Canada's Role in Energy and the Environment 2020



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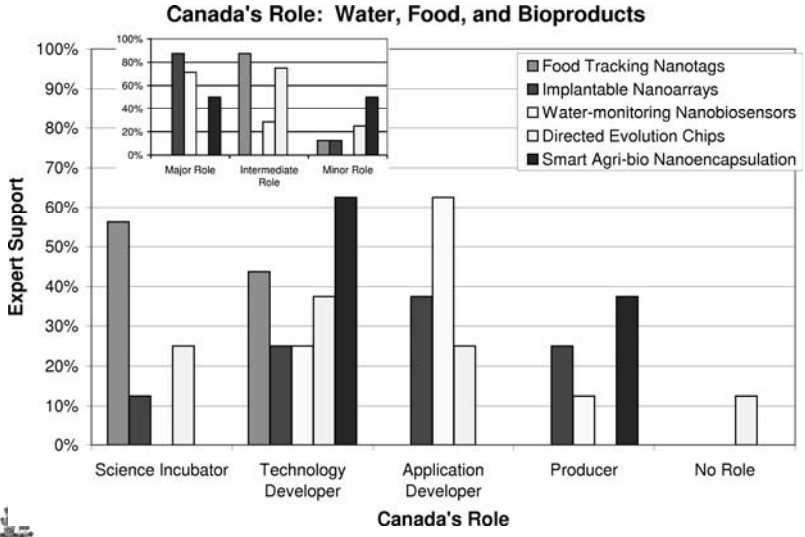
Canada's Role in Food, Water, and Bioproducts 2020



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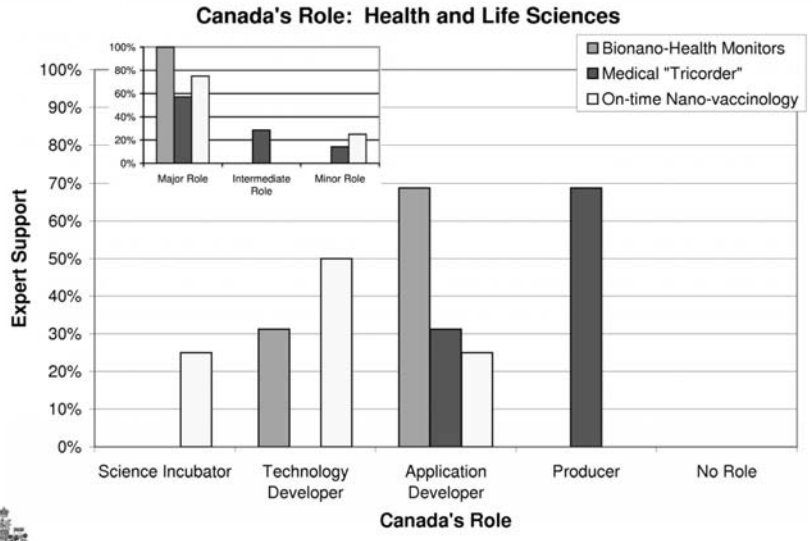
Canada's Role in Health and Life Sciences 2020



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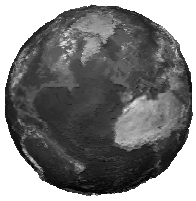
Top Converging Technologies For Canada ?



1. **"Clean Coal" technologies (science incubator)**
2. **Bio-nano-health Monitors (application developer)**
3. **Implantable Nanoarrays for Livestock (application developer)**
4. **"CO_2 Sequestration" technologies (application developer)**
5. **Environmental nanobiosensors (producer/application developer)**
6. **On-time Nano-vaccinology (technology developer)**
7. **"Biomass → Biofuels" technologies (application developer)**
8. **Medical "Tricorder" (producer)**
9. **Smart Agri-bio Nanoencapsulation (tech. developer)**
10. **Food-tracking Nanotags (science incubator)**
11. **Directed Evolution Chips (technology developer)**

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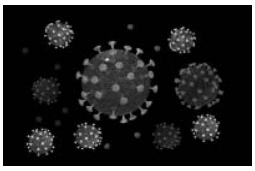
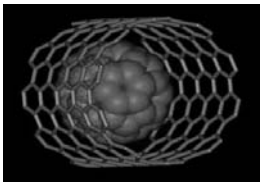
A Partnership Approach

- **S&T Advisory Board Chaired by Dr. Arthur Carty and Dr. Ted Sargent**
- **A multi-partner, collaborative project with federal, provincial, industry and academia;**
- **Project development and foresight design by ONSA and Lead Sponsors;**
- **Lead delivery agent is the Centre for Innovation Studies – THECIS, based in Calgary;**
- **Includes shared events, strategy discussions with stakeholders, and aligned & contributed studies sponsored by individual organizations;**
- **Linkages with similar foresight work in Europe, Asia and the US; OECD, APEC, TFRUNT**
- **Outcomes to be applied to development of a Canadian nanotechnology strategy when policy authorities are ready and receptive**





Office of the National Science Advisor

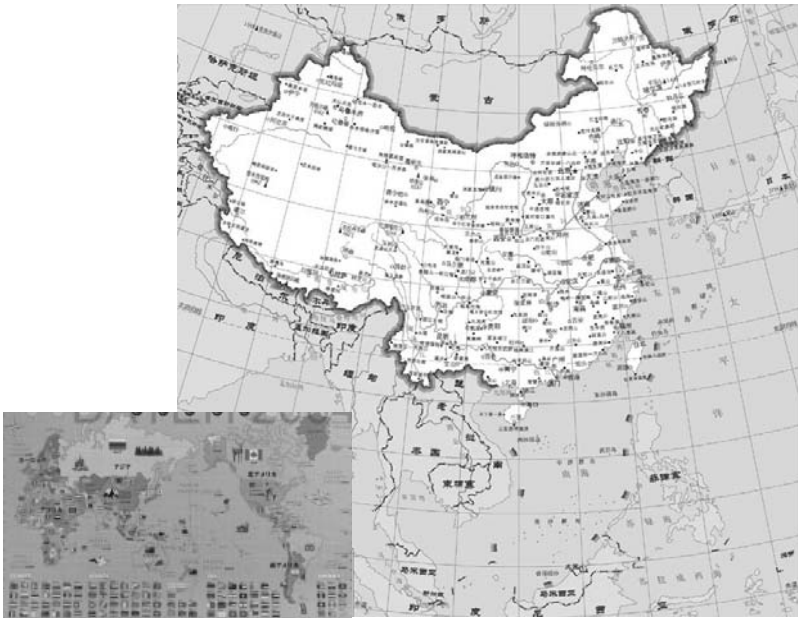
Bureau du Conseiller national des sciences

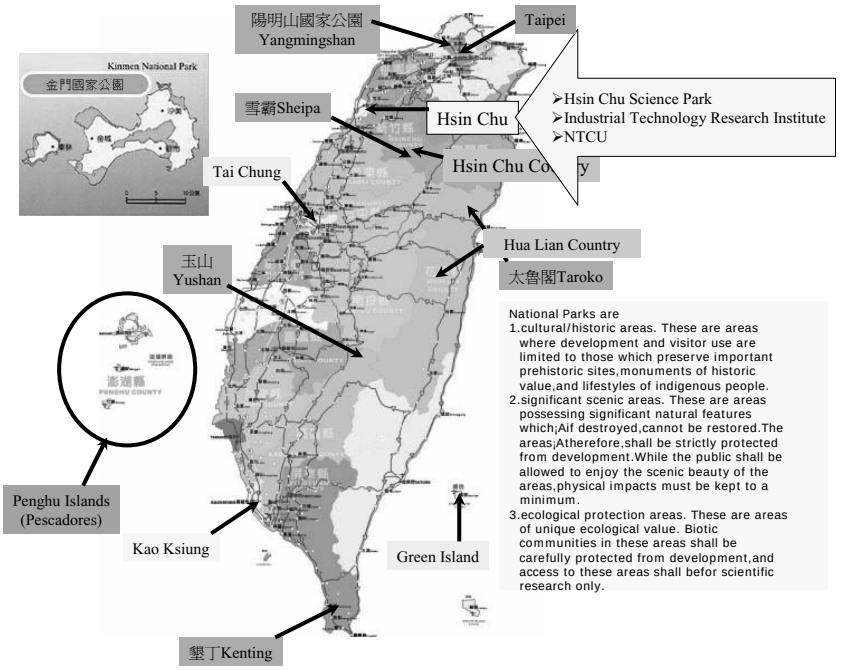
Canada

Welcome to the 2nd technology roadmapping workshop in Taipei

October 2007

Speaker : Yi-You Huang, Professor
Institute of Biomedical Engineering,
National Taiwan University,
Director, Dept. Biomedical Eng
National Taiwan University Hospital





Taipei is not only the capital of Taiwan, but a very adventurous place. Taipei has a wide variety of attraction places, many temples, night markets, hang outs, shopping and it has a very convenient way of transportation, which is the MRT (Mass Rapid Transit System).

Kenting is located at the tip of Taiwan. It is a very nice place to go for vacations in summer time. One can enjoy the sun, as well as the beach.

TaiDong is famous for its night market. TaiDong is a small quiet city, but once the night market starts, it is a place full of people and life.

Taichung is the third largest metropolitan area in Taiwan. It is a center of culture and education. Taichung is an attractive city due to its commercial district, abundant cultural activities, and the warmth of its residents.

Festivals

-Lunar New Year (Jan or Feb)
-Lantern Festival (Feb)
-Dragon Boat Festival (June)
-A Carnival for Ghosts (August)
-Mid-Autumn Festival (Sep)

Taipei Lantern Festival

Taipei 101 Building

Taipei 101 Building

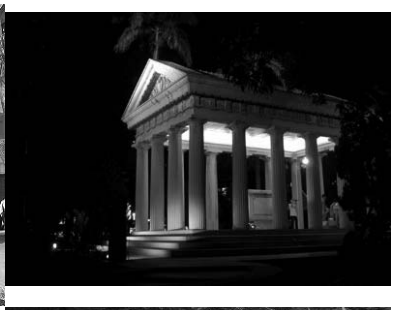
- 澎湖桶盤嶼
- 澎湖是由64個小島所組成的，但大多的島嶼都沒有住人，所以無人島上的海底生態很豐富，澎湖縣花是天人菊－澎湖有著菊島的美稱。產業以漁、農、礦等產業爲主。漁業是澎湖最重要之產業，農產以花生、瓜類爲主，礦產則以文石爲主，澎湖和義大利同爲世界兩大文石產區，而澎湖文石質色均美，是舉世公認最佳的文石。

蘭嶼情人洞

National Taiwan University

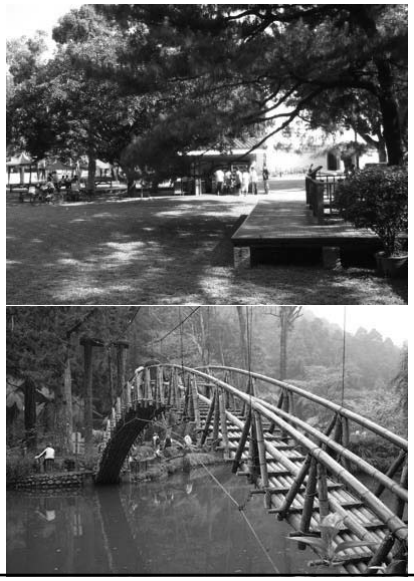
About NTU The predecessor of National Taiwan University was Taihoku (Taipei) Imperial University, founded by the Japanese in 1928.

National Taiwan University

National Taiwan University


National Taiwan University



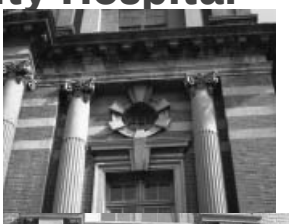
National Taiwan University

- As of the 2004 academic year, the University has a total of eleven colleges, 54 departments, 96 graduate institutes (which offer 96 Master's programs and 83 doctoral programs), and four research centers: the Division of Population and Gender Studies, the Center for Condensed Matter Sciences, the Center for Biotechnology, Japanese Research Center, and the Biodiversity Center. The number of students reached 29,877 in 2004, including the students from the division of Continuing Education & Professional development. A new library was built in 1998, and now contains over 3,000,000 volumes of books.

National Taiwan University Hospital

臺大醫院創建於西元1895年，院址初設於台北市大稻呈，1898年遷至現址（現稱爲西址）；當時爲木造建築，1912年開始進行整建爲文藝復興風格之熱帶式建築，於1921年完工，是當時東南亞最大型、最現代化之醫院。1991年新院區（現稱東址）整建完成，兩院區間由景福地下通過貫連。現今全院有員工四千餘人，病床二千張，每日門診服務量逾六千人次。

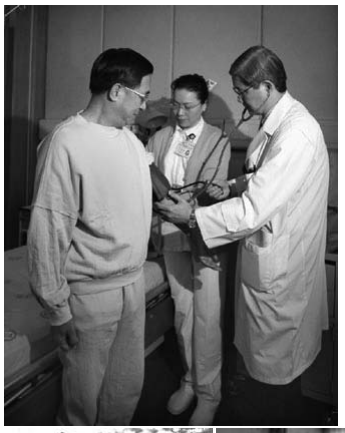
National Taiwan University Hospital



National Taiwan University Hospital

National Taiwan University Hospital

National Taiwan University Hospital





The 2nd technology roadmapping workshop in Taipei

Main Theme

The Converging Technologies to Combat Emerging Infectious Disease (EID): Technology Roadmap Workshop



Conference Venue

http://www.thcc.net.tw/index.asp

Program

- **Opening Remark**: Minster of National Science Council
  Chien-Jen Chen Sc.D., 陳建仁 主委
  Also an Expert of Epidemiology, Hygiene and Public Health

- **Opening Remark**: Minster of Department of Hea
  Sheng-Mou Hou MD PhD 侯勝茂 署長

- **Keynote speech**: Director of Dept Intl Cooperation, NSC 林光隆處長

02-27377810
傅 sdfuh@nsc.gov.tw

- **Speaker** : Dr. Nares

Introduction of "Roadmapping Converging Technologies to Combat Emerging Infectious Diseases (EID)," the APEC-wide project and the progress and activities by Dr. Nares Damrongchai (Executive director, APEC CTF)

- **Speaker** : Dr. Steve H. S. Kuo 郭旭崧 (Director of Center for Disease Control, Taiwan)

SARS experiences in Taiwan

- **Speaker** : Dr. Minoru Kuniya (Director-General NISTEP)

- **Speaker**: Professor Lee (Director, Dept of Eng and Applied Science, NSC)

- **Speaker**: Professor Lin (林世明)

New technologies of combating the Emerging Infectious Disease (EID)

- **Speaker:** Professor Chang, MD/PhD (張上淳, NTUH)

New strategies of combating the Emerging Infectious Disease (EID

Thank you for your attention

参考資料

Appendixes

Converging Technologies to Combat Emerging Infectious Diseases (EID): Technology Roadmap Workshop
22-24 May 2007
Toshi Center Hotel, Tokyo, Japan

Day 1: 22 May	
08.45	Registration
09:00	Opening Remarks: by Mr. Minoru Kuniya (Director-general, NISTEP)
09:10-09:30	Introduction of "Roadmapping Converging Technologies to Combat Emerging Infectious Diseases (EID)," the APEC-wide project and the progress and activities by Dr. Nares Damrongchai (Executive director, APEC CTF)
09:30-09:50	Converging Technologies: Concept and Examples by Dr. Suthee Phoojaruenchanachai (NECTEC)
09:50-10:00	Introduction to the workshop by NISTEP
Session 1 10:00-10:50	Keynote speech 1: The Surveillances of EID by Dr. Nobuhiko Okabe (Director, Infectious Disease Surveillance Center, National Institute of Infectious Disease)
10:50-11:00	Coffee Break
11:00-11:50	Keynote speech 2: Asian Research Network for Infectious Disease: Its Concept, Aims and Activities by Dr. Yoshiyuki Nagai (Director, Center of Research Network for Infectious Disease, RIKEN) & Dr. Yoshiko Okamoto (CRNID, RIKEN)
11:50-12:40	Keynote speech 3: Potential ICT Infrastructure for EID Research Collaboration by Dr. Chalermpol Charnsripinyo (NECTEC)
12:40-14:00	Lunch
Session 2 14:00-14:30	Recap from the Scenario Workshop by Dr.Nares Damrongchai (APEC CTF)
14:30-14:40	Introduction to 3 Exercises by NISTEP
14:40-17:00	Exercises 1 (3 groups) ・ User's requirements for emerging infectious disease ・ Solutions (Products & Service) ・ Technology applications (15:10-15:30 Coffee break is available)
17:00-18:00	Group Presentations 1
18:30-20:30	Welcome Banquet (at Restaurant Iris in the Hotel)

Day 2: 23 May	
09:30	Objectives of Day 2
Session 3	
09:40-10:10	Strategic Technology Roadmapping by Prof. Akio Kameoka (Japan Advanced Institute of Science and Technology)
10:10-10:30	A Case of Technology Roadmapping: Optical Molecular Imaging Technology by Prof. Shotaro Kohtsuki (Ritsumeikan University)
10:30-10:40	Coffee Break
10:40-10:50	Introduction to Exercise 2 by NISTEP
10:50-12:20	Exercises 2 (3 groups) ・ What are the challenges ahead for the technology applications in the next 5-15 years? (Technology factor, Social factor, Economic factor, Policy Factor)
12:20-13:30	Lunch
Session 4	
13:30-13:40	Introduction to Exercises 3 by NISTEP
13:40-15:10	Exercises 3 (3 groups) ・ How research could be linked to initial industrial application and then widespread social application of the technology? ・ What challenges do APEC members have to the widespread social application?
15:10-15:30	Coffee Break
15:30-16:30	Group Presentations 2
Session 5	(Chair, Prof. Kameoka)
16:30-17:30	Evaluation of TRMs ・ What would be the strongest point about TRMs in your economy? ・ What do you see as the most significant barriers to undertaking TRMs in your economy and collaboration between economies? ・ What would be possible future collaboration among APEC members?
17:30-17:40	The 2nd Technology Roadmapping Workshop in Chinese Taipei by Dr. Yi-You Huang (National Taiwan University)
17:40	Closing Remark by Mr. Terutaka Kuwahara (Deputy Director, NISTEP)
18:20-22:00	Reception (at Tokyo bay) ・ Departure from the Hotel at 18:20 by bus. ・ Back to the Hotel at 22:00

Day 3: 24 May *
08.00 Departure from the Hotel
10:00-11:30 Visit at DoCoMo R&D Lab. (Yokosuka)
11:30-12:30 Lunch
14:30 Arrival at the Hotel

*A person who wants to attend.

An APEC-wide Foresight Project

Converging Technologies to Combat Emerging Infectious Diseases (EID)

Technology Roadmap Workshop

22 May- 24 May 2007
Toshi Center Hotel, Tokyo, Japan

Organized and Sponsored by

National Institute of Science and Technology Policy (NISTEP)
Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan
&
APEC Center for Technology Foresight and
National Electronics and Computer Technology Center (NECTEC),
National Science and Development Agency (NSTDA), Thailand

Asia-Pacific Economic Cooperation

List of Participants
Total number of participants 42 from 9 APEC Economies

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