U.S. ARMY MEDICAL RESEARCH & MATERIEL COMMAND

Major Gen. Eric B Schoomaker, Commanding

HealthGrid: Grid Technologies for Biomedicine

Mary Kratz
Advisor to the Director, HealthGrid

United Nations/Zambia/European Space Agency
Regional Workshop on the Applications of GNSS
28 June 2006

TATRC

Telemedicine & Advanced Technology Research Center

Cutting Edge Medical Technology

Col. Jeffrey Roller, MD, Director

"Insanely great ideas are our number one priority"

Thank you!

Agenda

- Telemedicine Advanced Technology Research Center (TATRC) organization
- HealthGrid: Grid Technologies for Biomedicine
- Biomedical ICT Applications for GNSS in Sub-Saharan Africa
- Future opportunities

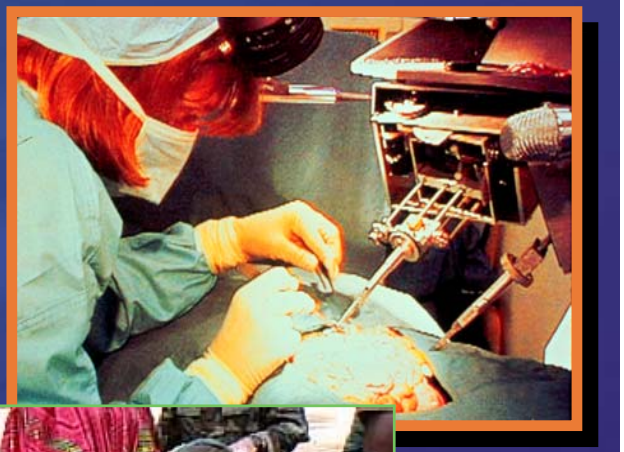
TATRC Mission

Telemedicine & Advanced Technology Research Center

Cutting Edge Medical Technology

Apply physiological and medical knowledge, advanced diagnostics, simulations, and effector systems integrated with information and telecommunications for the purposes of enhancing operational and medical decision-making, improving medical training, and delivering medical treatment across all barriers.

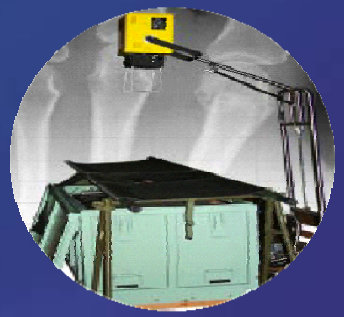
The program scope is to identify, explore, and demonstrate key technologies and biomedical principles required to overcome technology barriers that are both medically and militarily unique.



Real Medical Technology … For The Real World

BMIS-T

Chest Tube Simulator



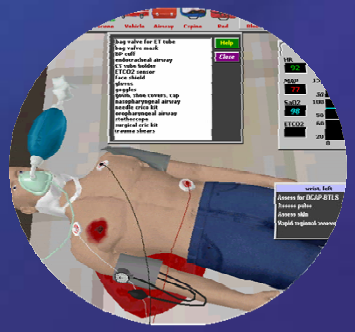
Digital X-ray

Dreams Digital Ambulance

Smallpox Inoculation Training Unit

Medical Robotics

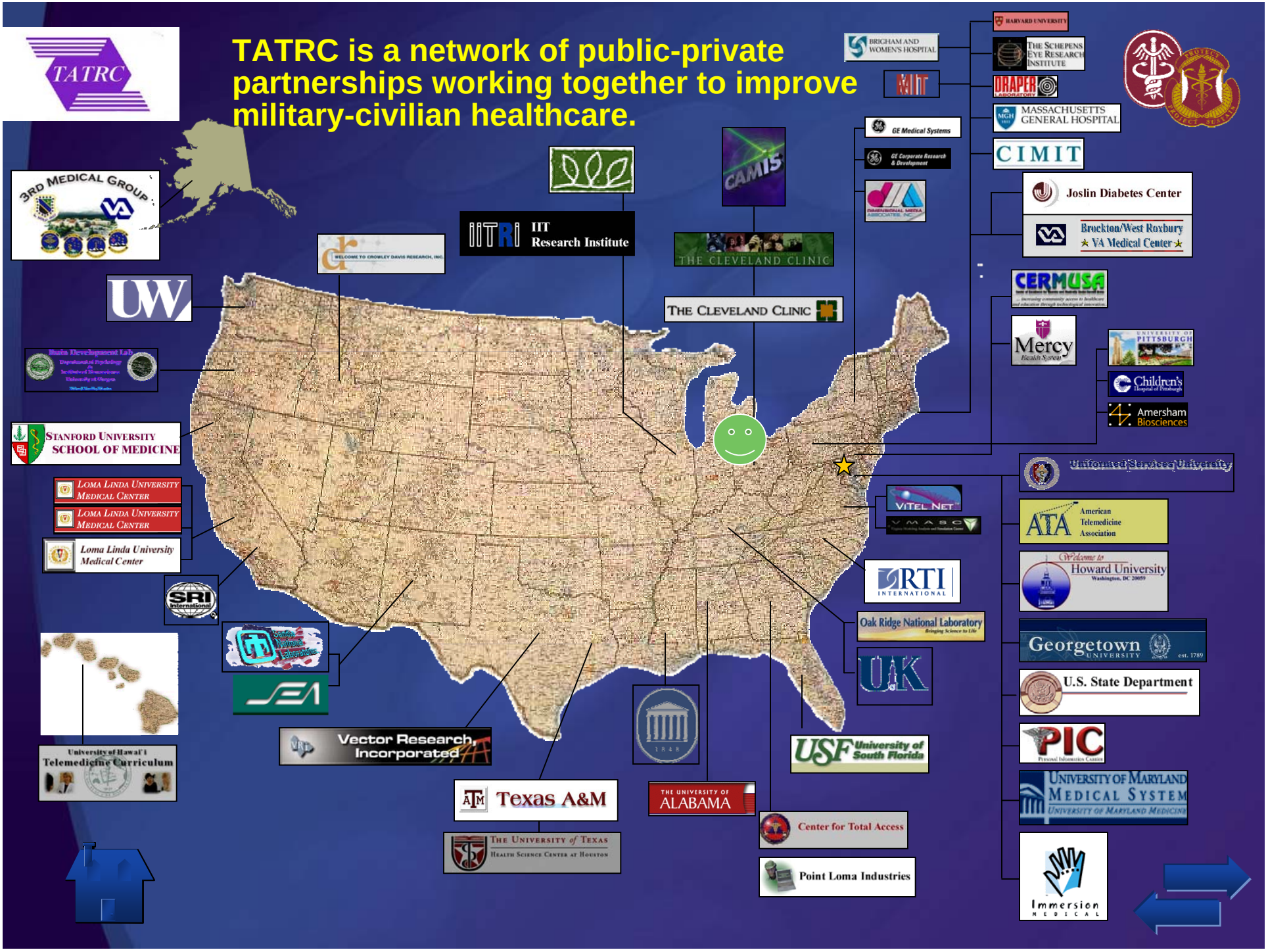
BRSS



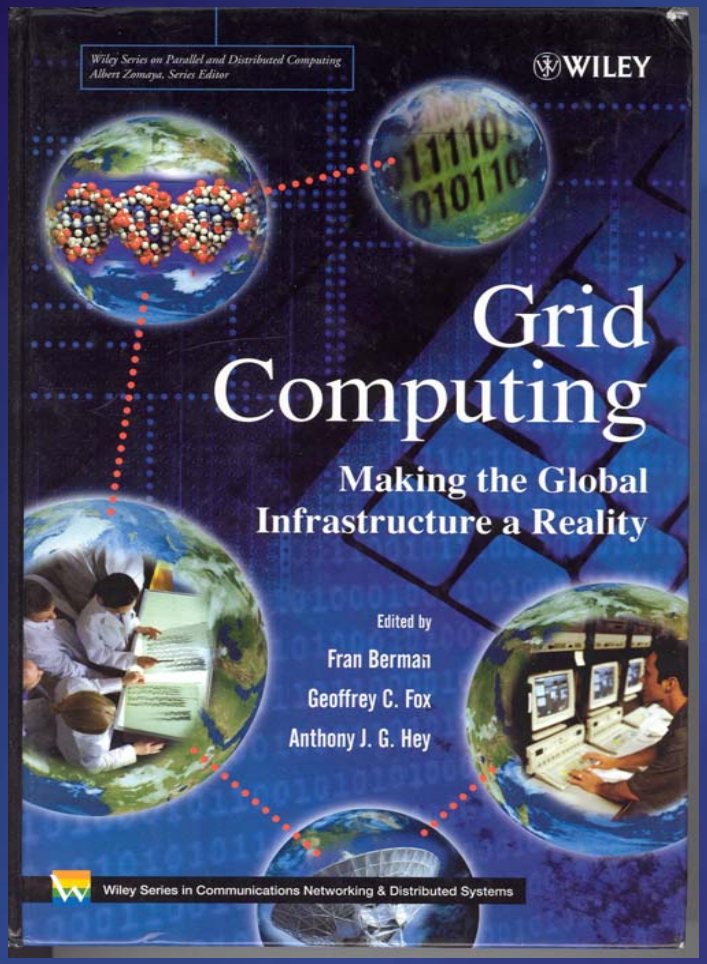
STAT-Care

Retinal Imaging

TATRC is a network of public-private partnerships working together to improve military-civilian healthcare.



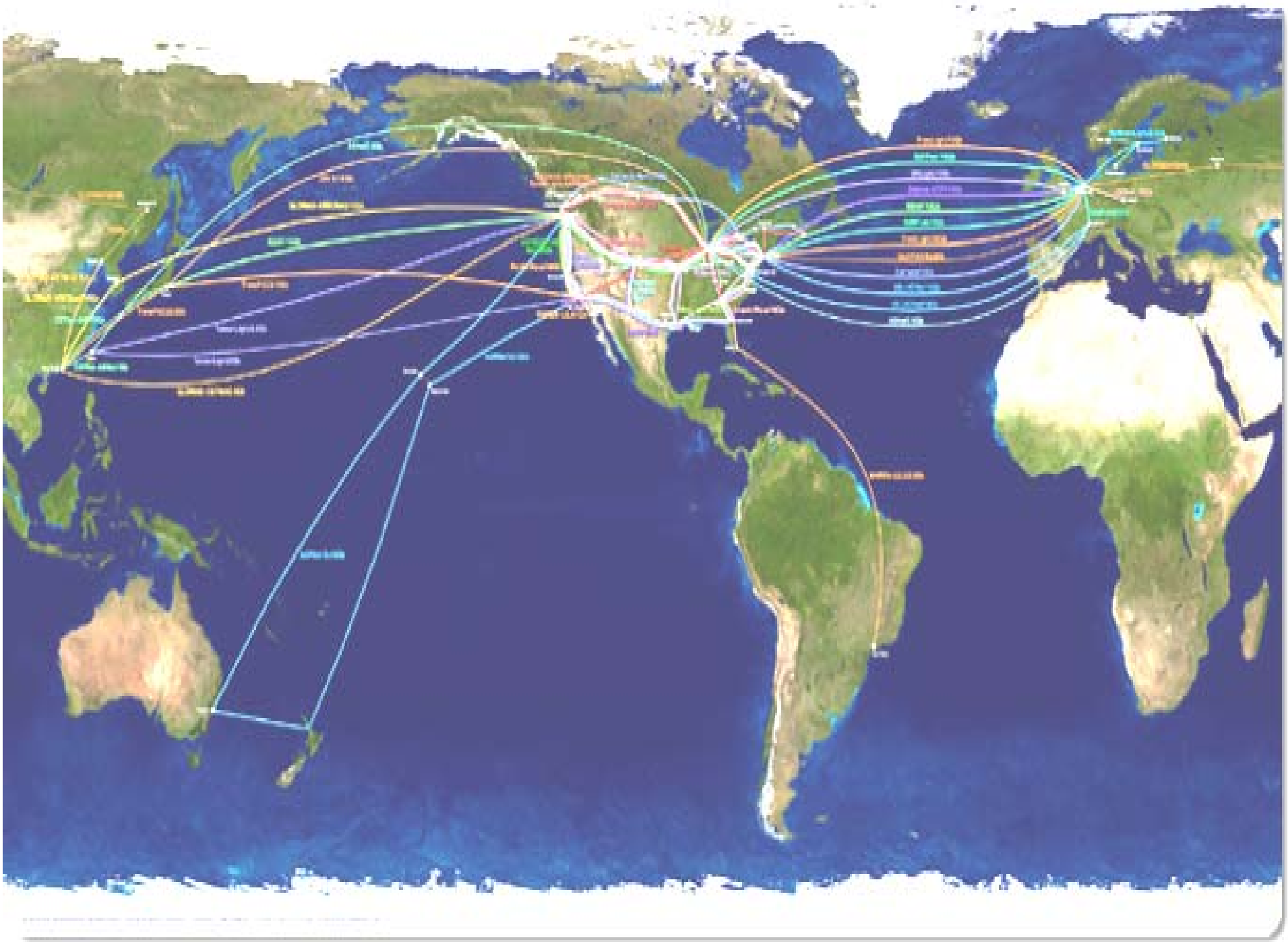
Let's talk Grid and Biomedical



Technical architecture for scalable secure interoperable information

Value of HealthGrid

- Wide area communication
  - Networks finally have enough bandwidth
  - Networks are the 21st Century highway system
  - Analogy of road system in 19th Century
- Access to Data Resources
  - Complexities of interaction has caused a data tsunami
  - Future is mobile device fusion
    - Circuit density + network capacity
    - RFID/Nanotechnologies/biosensors

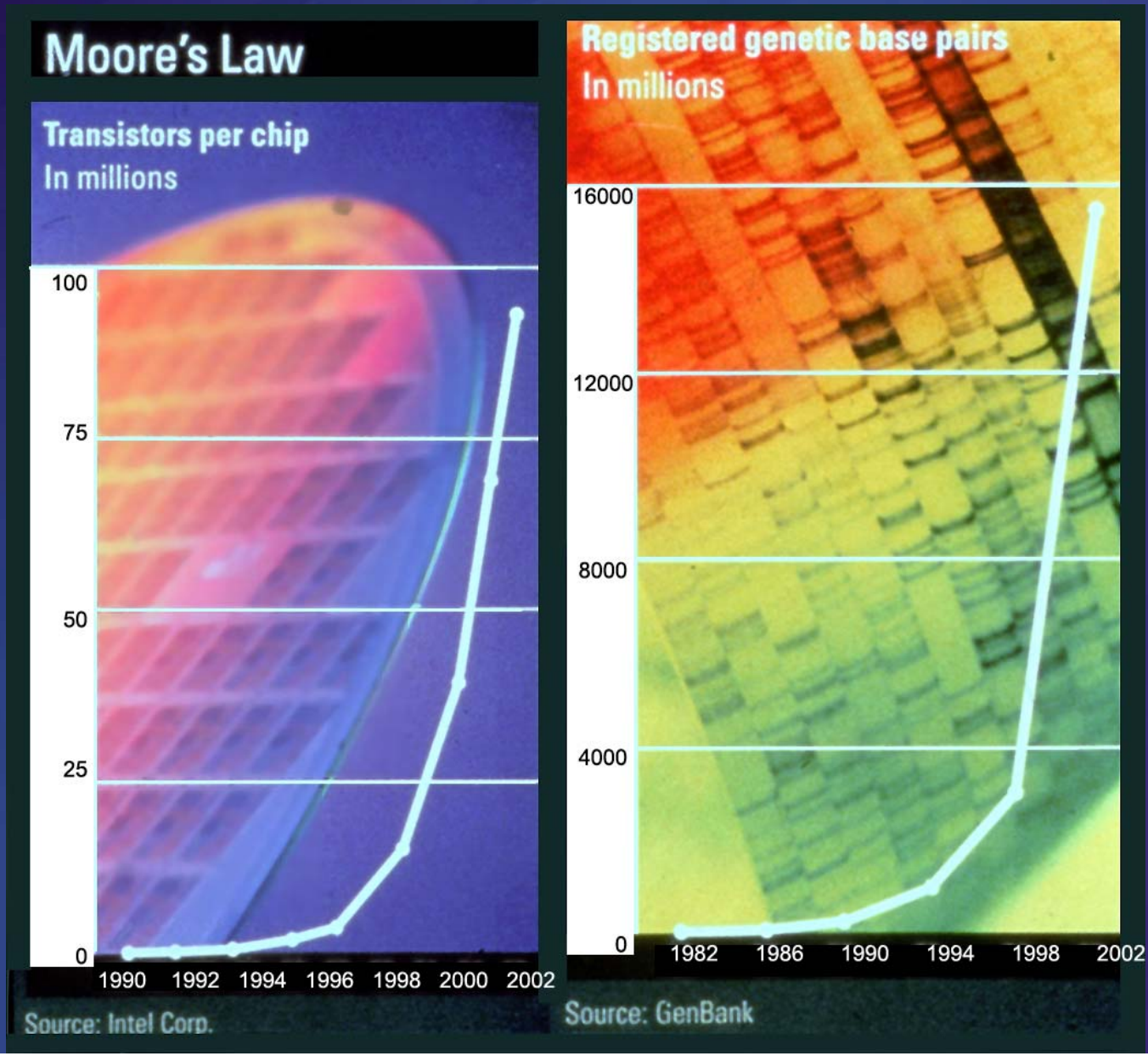


Bandwidth and Data

Megabyte (Mb)	Book
Gigabyte (Gb)	DVD Truck full of paper with a whole lot of latency
Terabyte (Tb)	1 million books All the text in the U.S. Library of Congress ($1000)
Petabyte (Pb)	All us.edu library holdings One fMRI brain image 4.5 Pb
Exabyte (Eb)	All the works ever spoken in the history of humanity

Ref Hal Varvian, UC Berkley

Digitization of Biomedicine



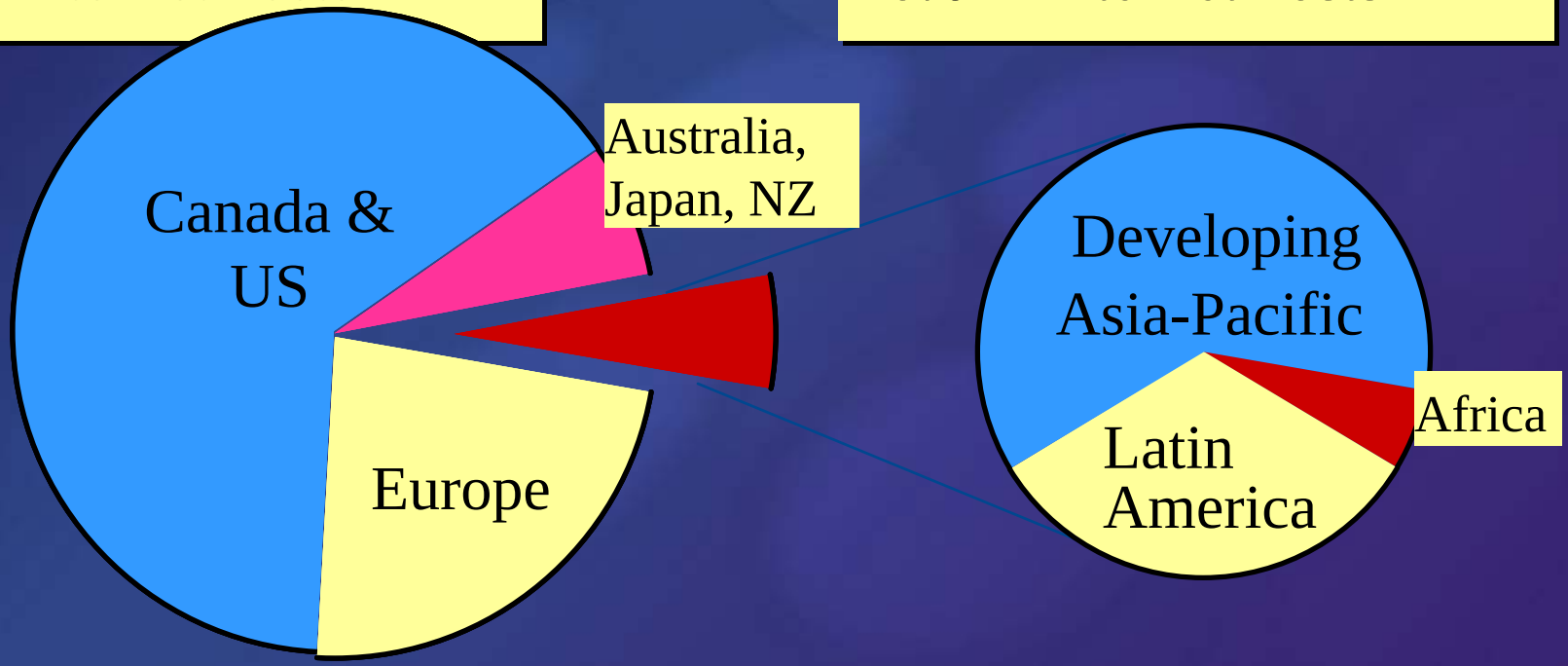
Internet Hosts

High-income countries

16% population
7% burden of disease
89% health spending
94% Internet hosts

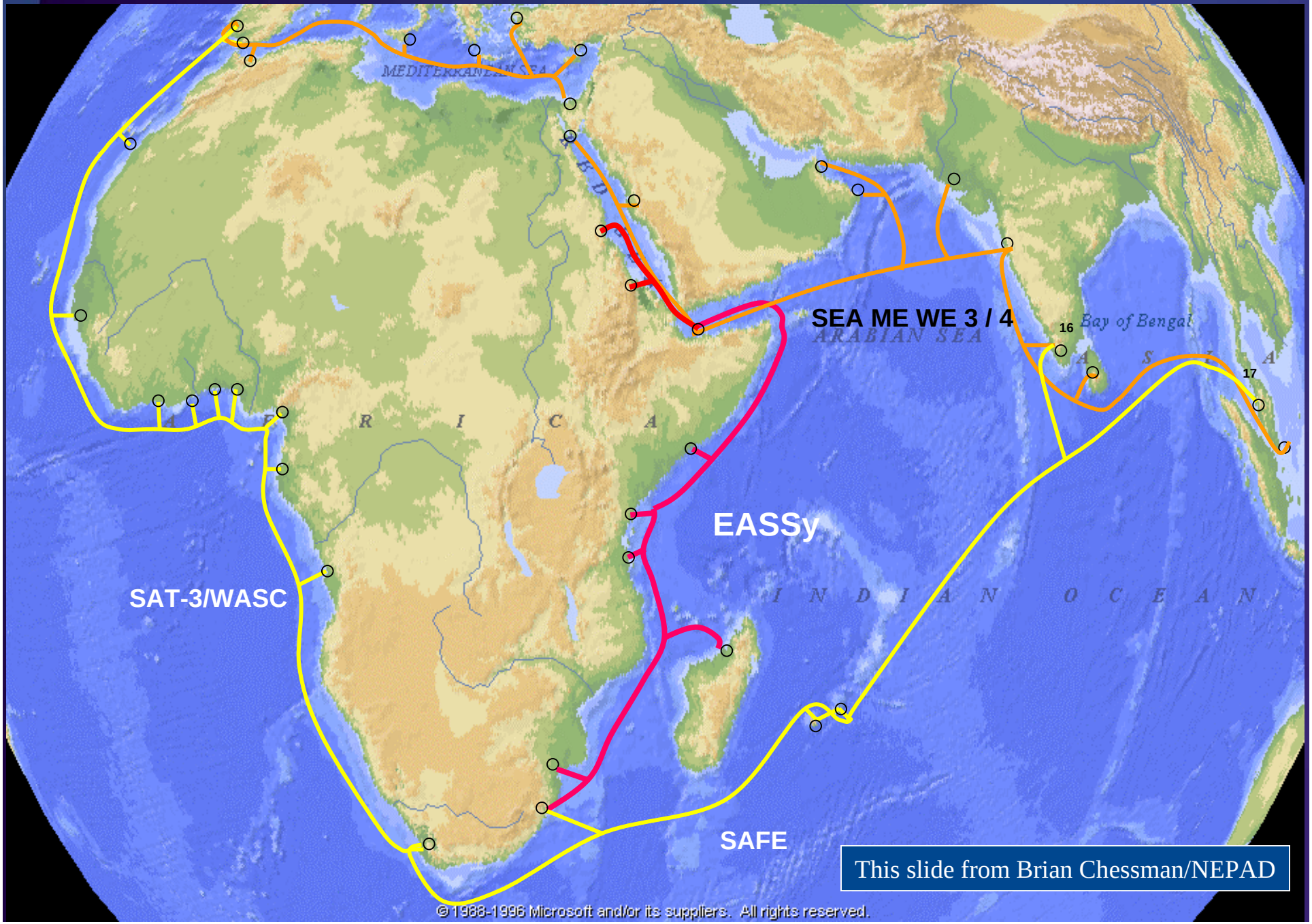
Low-income countries

84% population
93% burden of disease
11% health spending
6% Internet hosts



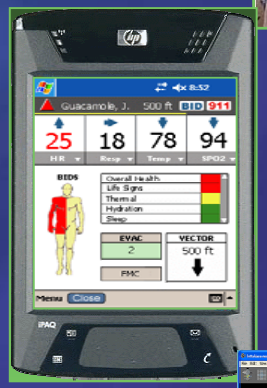
Source: ITU 2000

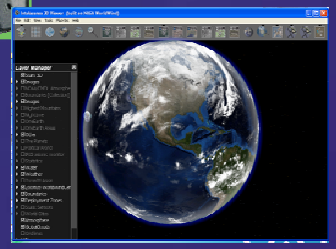
EASSy – GLOBAL PERSPECTIVE



Situational Awareness Research Technology Implementation Group (SARTIG)

- To Identify or develop real technologies to enhance situational awareness in bio-defense
- Research that applies algorithms and analysis to data where it is need, when it is needed
- Integrate bio-event detection solutions and effector systems





Creating Innovative Solutions

TATRC/PEPFAR Ethiopia Project

- Key Issue Inability to access information
  - Continuity of care/data management
  - Build human capacity
  - Logistics management
- Technology needs
  - Portable Electronic Health Record
  - Wireless mesh network/self-powered data transmission
  - Remote Video Teleconferencing
  - Inventory tracking/RFID

TATRC Interagency Agreement with PEPFAR

- President's Emergency Plan for AIDS Response
  - Health and Human Services (CDC)
  - Department of Defense
  - Peace Corp
  - USAID
- Applied operational research to move technology innovation into practice

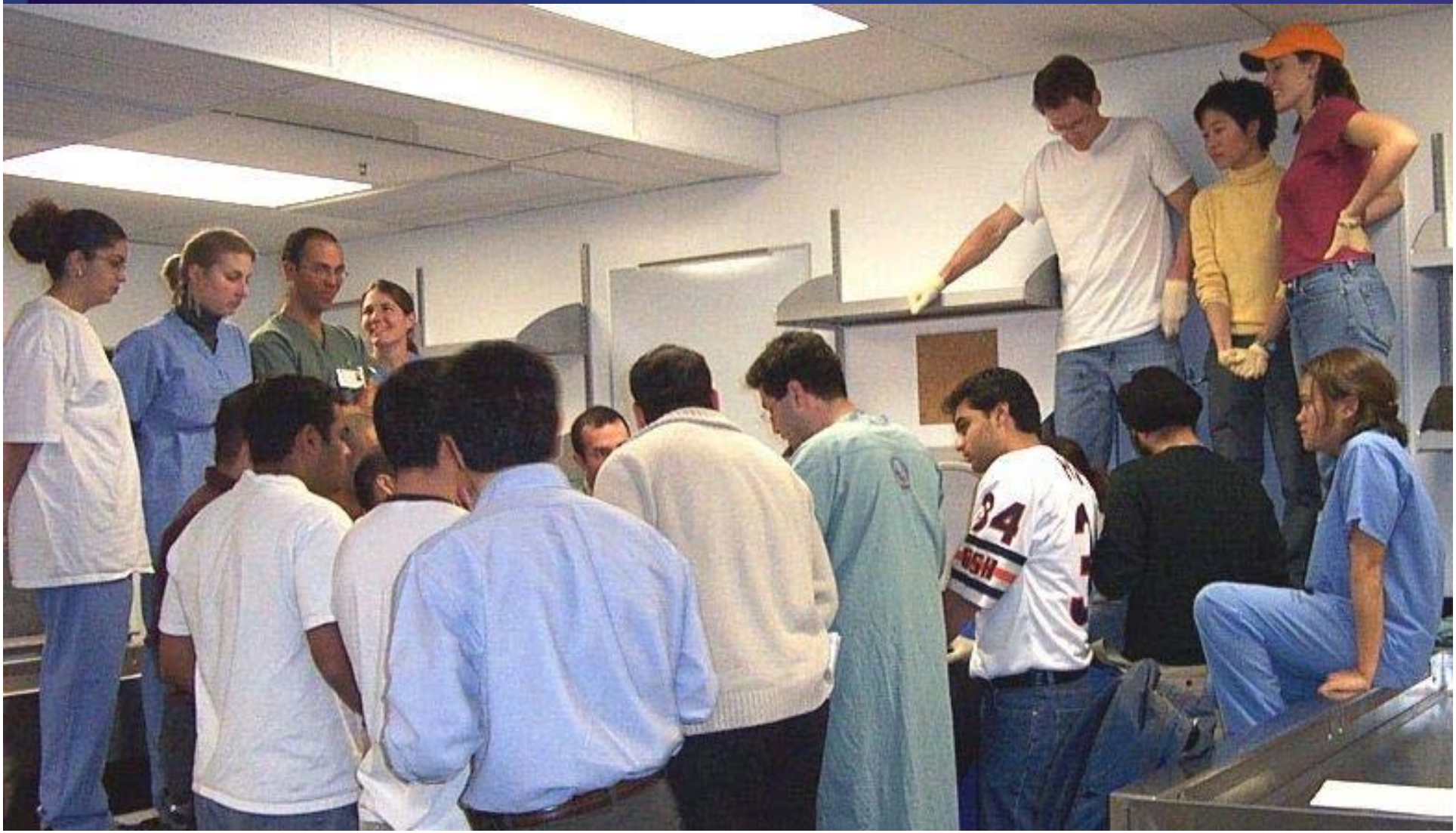
Landscape Epidemiology Technologies

- Learning Resource Centers
- BMIST
- Remote self-powered wireless networking infrastructure
- Easy to use, field-deployable clinical devices

Learning Resource Centers:
Human Capacity Building

- Books to electronic media
  - Words to pictures to streaming media (video)
- Procedural simulation
  - Plastic head phantom for dentistry/anesthesiology
  - Phlebotomy
- Manikins with computer based physiological systems
  - Team learning
- Virtual Reality
  - 3D visualization
  - Computer Games

Some specialties disappearing



Video for remote learning

- Collaboration Grid

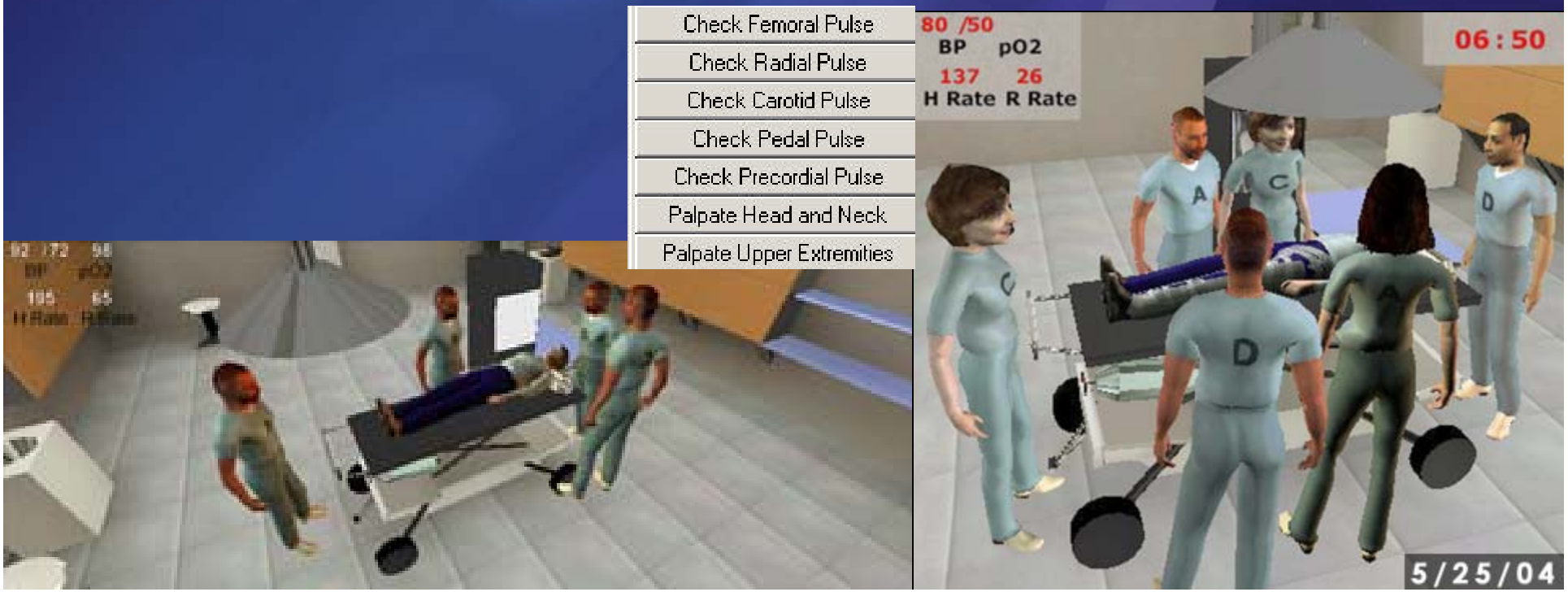
Procedural Based Learning

Team based learning - with manikin

- Patient under anesthesia lapses into cardiac arrest

Virtual Emergency Room

Multiple users (players)
One 3D space



Landscape Epidemiology Technologies

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Battlefield Medical Information System Tactical (BMIST-J)

- Provides all-in-one suite of mobile applications that empower providers via access to critical medical information and powerful clinical & decision support tools to accurately create an electronic health record.
- Synchronizes with Joint health surveillance and medical information systems from the earliest echelons through chronic care provided by the Veterans Administration

U.S.ARMY

Top Tem Army's Greatest Invention

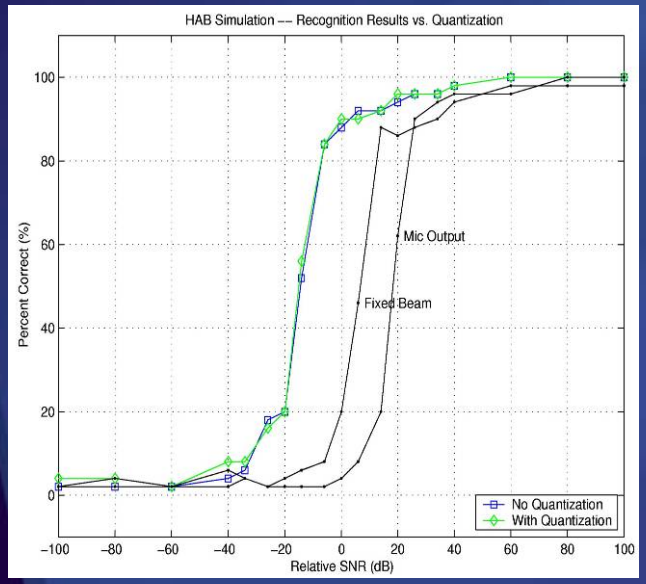
BMIST-J is the approved Joint solution for the Department of Defense surveillance need at the forward area of care with more than 10,000 in use world-wide

Mobile CAC Card Reader

- Interface can be enabled

Smart Card reader compatible with ISO 7816 smart cards, including US DoD Common Access Card (CAC)

Speech Capable PDA (SCPDA)



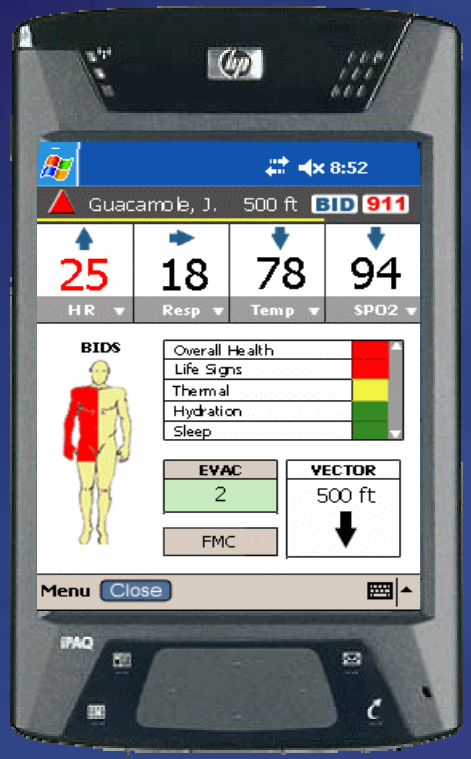
- Provides Basic Hybrid Adaptive Beam forming Array (HAB) to PDA

- Enable first responder Army medics to input, control, store, and retrieve medical data via speech in high-noise environments using a portable computer platform

Planning Systems Inc.

Wireless Sensors

- Multiple patient monitoring
- Multimedia electronic health record



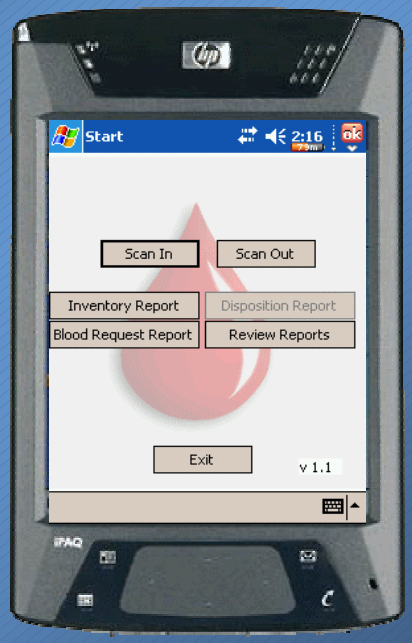
WelchAllyn

Blood Information Program (BIP)

Built on the BMIST Architectural Standard

Better Quality of Care

Imbedded References



Wireless inventory System

- Provides all-in-one suite of mobile applications that empower blood teams via access to critical information and powerful decision support tools to manage blood inventories
- Includes:
  - Blood Inventory Program
  - Blood report generator
  - Transfusion/Disposition Module

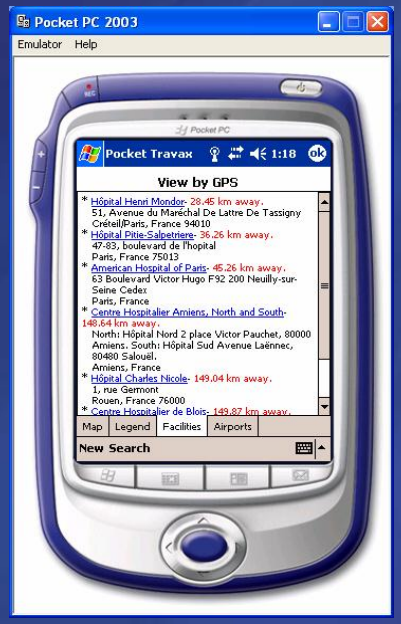
U.S.ARMY

Army's Greatest Invention

BIP is currently be used by our blood teams worldwide

Pocket TRAVAX

Nearby hospitals and airfields are displayed in relation to your location.



Hospitals are listed in order nearest to you

Hospital description Contact information & GPS location

- Pocket Travax is a handheld tool that allows users to to locate hospitals or clinic that can provide needed emergency services by country location or GPS coordinates
- Providing travelers information for medical emergencies
- Eventually provide dynamic/real-time local capabilities data

SHORELAND

Landscape Epidemiology Technologies

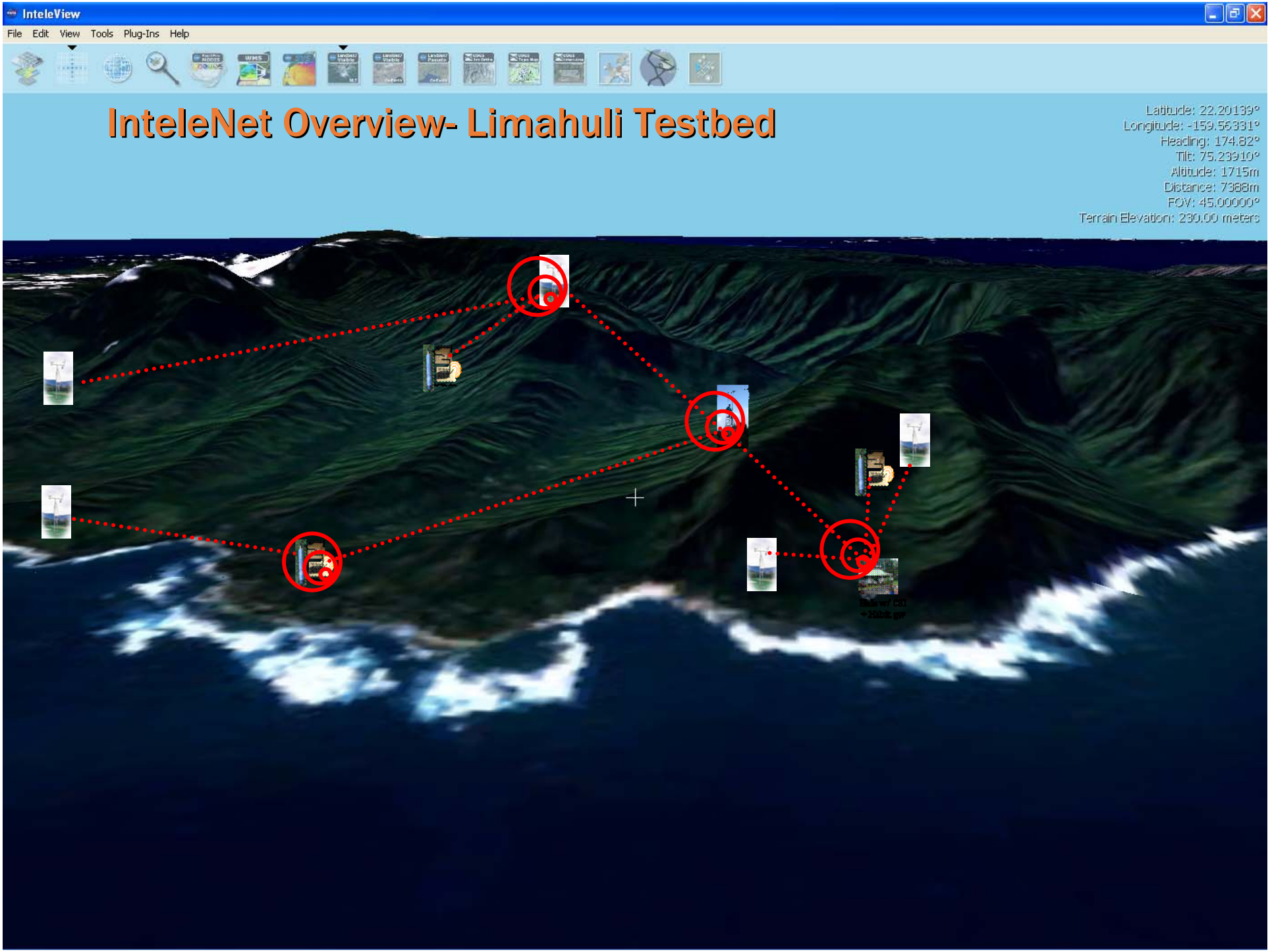
- Learning Resource Centers
- BMIST
- Remote self-powered wireless networking infrastructure
- Easy to use, field-deployable clinical devices

InteleCell™ - Wireless Sensor Device

- Remotely deployable, rugged smart sensors monitor many locations:
  - Sensor: Water, air, weather, soil, video, biosensors
  - Processor: Small, low power computer, can control devices/actuators
  - Wireless: Up to 14 miles between stations (40 miles directional), sensor network can cover hundreds of miles
  - GPS-Enabled: automatically knows location, sensors can be mobile
  - Uplink: Local Internet, Cellular, Satellite

- Any sensor (analog, digital, serial, …) easy to integrate
  - Many labs developing new sensors- we make it easy to deploy and integrate these devices and *get them out of the lab and into the field*
  - Typically deploy nonspecific, continuous, low-cost simple physical sensors (*change detectors*), then use specific tests when anomaly detected
  - Currently designing cheap, specific biochemical sensor module- rugged, sensitive/specific, multiagent, reusable

- Secure transmission: Authentication + Encryption (256-bit AES)
- Frequency: Transmit on-schedule, on-event, on-demand
- Future-proof: Remotely upgradeable while deployed in the field
- Advanced power management:
- Self-Powered (*3 years without recharge*, indefinite with solar recharg


InteleView
File Edit View Tools Plug-Ins Help
InteleNet Overview- Limahuli Testbed
Latitude: 22.20139°
Longitude: -159.56331°
Heading: 174.82°
Tilt: 75.23910°
Altitude: 1715m
Distance: 7388m
FOV: 45.00000°
Terrain Elevation: 230.00 meters

Landscape Epidemiology Technologies

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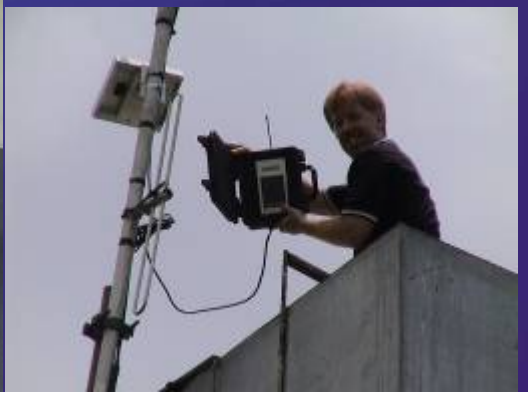
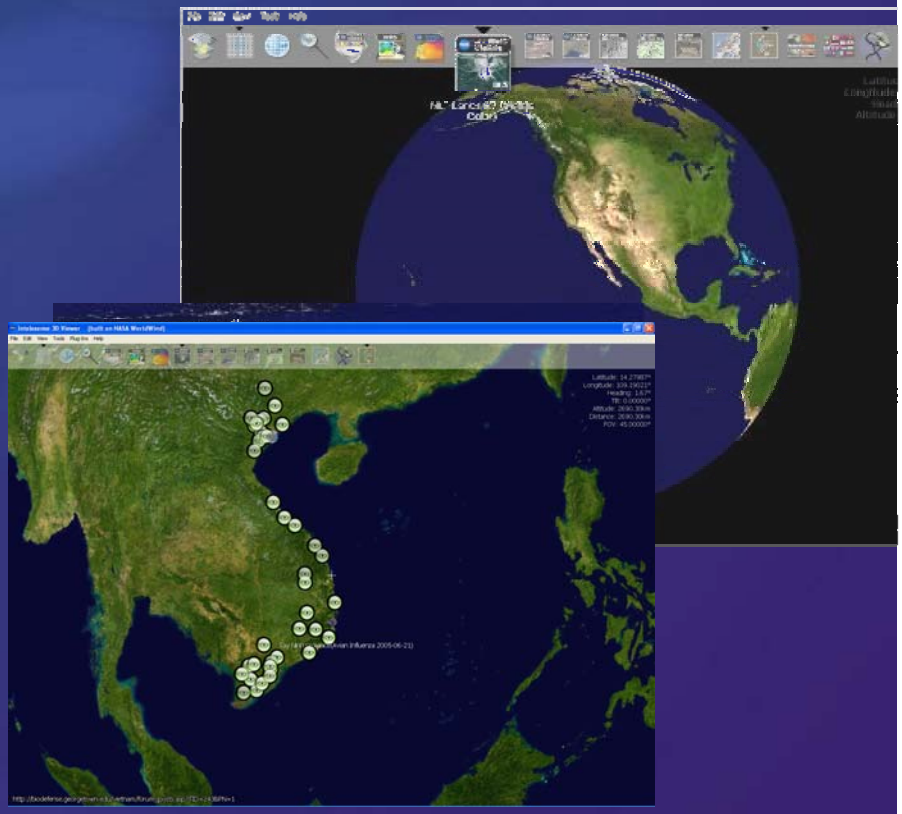
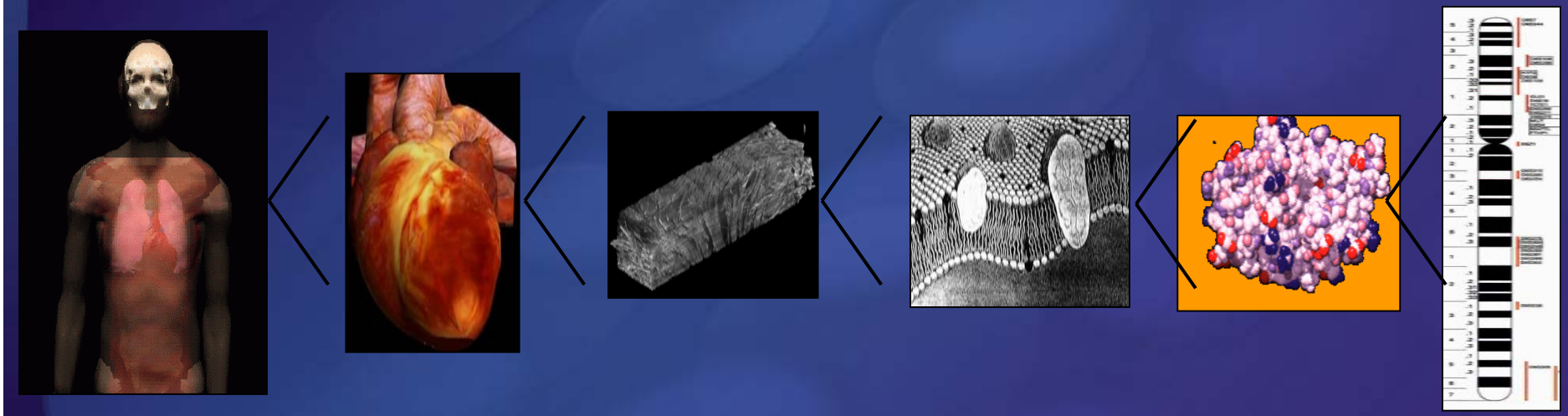


Clinical Devices

- Patient Monitoring
  - Vital Signs
  - Drug therapy compliance
- Laboratory Instrumentation
  - Diagnostic Testing
  - Digital Microscopy for Tele-Pathology
- Bio-Sensors
  - Water, Air and Environment Quality
  - Measurements for Disease Vectors
- Visualization



Systems Medicine

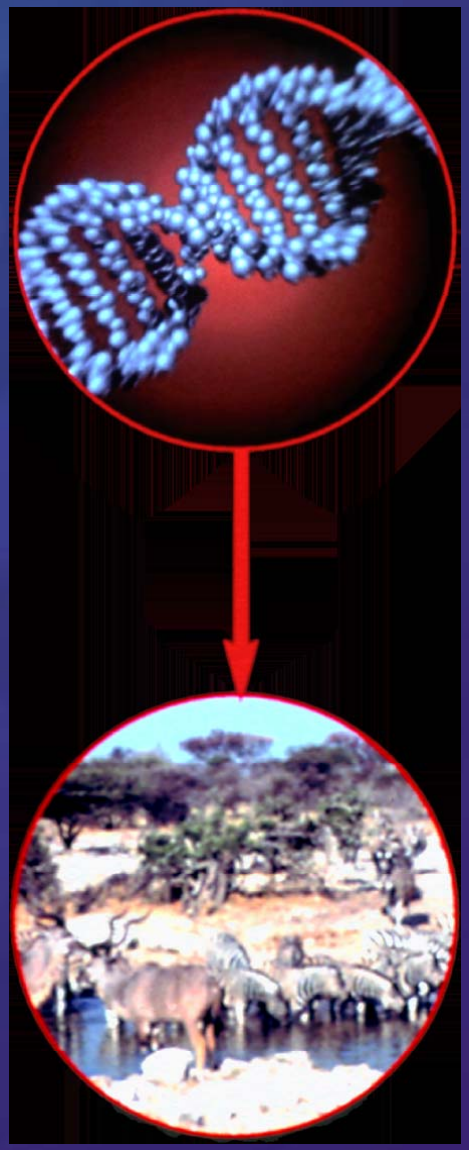


Population, Person, Organ, Tissue, Cell, Protein, Molecules

Courtesy: Peter Hunter, University of Auckland

Consilience the unity of knowledge

- Bridging of technologists & medical providers
- Learn the languages of science & technology
  - Engineering
  - Physics
  - Biomedicine
  - Physicians & Care Providers



Acknowledgements

- National Institutes of Health
  - Ken Beutow, NCI
  - Peter Kovitz, NCI
  - Peter Highnam, NCRR
  - Mike Marron, NCRR
  - Michael Ackerman, NLM
- Leroy Hood, Institute for Systems Biology
- Chris Johnson, SCI @ UUtah
- Ian Foster, ANL
- Jonathan Silverstein, UChicago/ANL
- Parvati Dev, Stanford University
- Tommy Morris, TATRC
- Greg Mogel, TATRC
- Kevin Montgomery, Stanford University
- Yannick Legre, HealthGrid
- Vincent Bretton, CNRS
- Howard Bilofsky, UPenn
- Dan Reed, RENCI
- Chris Johnson, SCI University of Utah