M2M united

People ◆ Devices ◆ Systems

Emerging Trends that Will Transform M2M

Presented by:

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Emerging Trends that Will Transform M2M

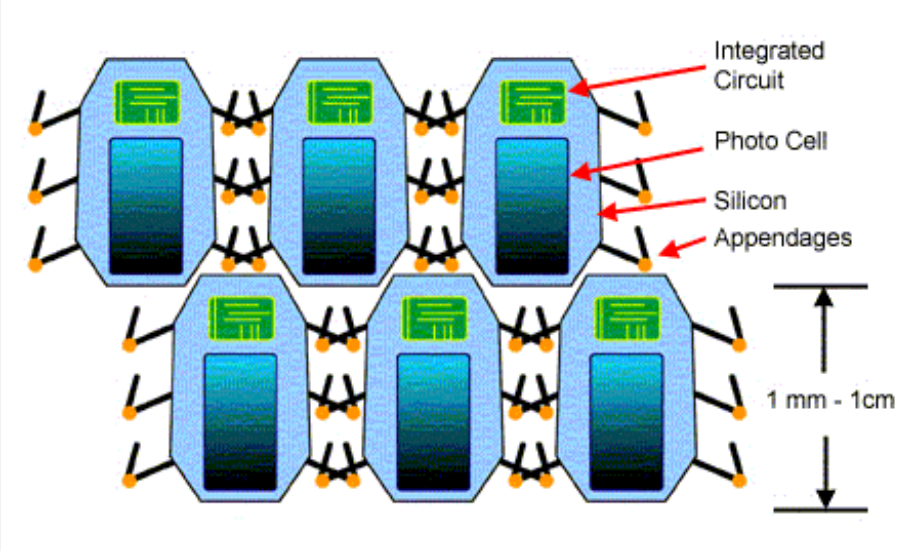
- **4th Generation M2M is Now! Far out M2M stuff, but its already HERE!!**
- DOD thrust to *Net-Centric-ize* its M2M from their standard "system engineering" methods
- SIP – the "key" to communications convergence, M2M included
- SensorNet – another major net-centric M2M thrust on a nationwide scale
- M2M via SIP in the consumer space

Self-Transforming Intelligent Nano-Bots (INBs)

- Current NASA systems may be intelligent and adaptive.
- The system components are not.
- Intelligence resides at the systems level—e.g., a microcontroller.
- Next logical step in intelligent systems evolution.
- Build intelligent adaptive systems from components that are themselves intelligent and adaptive.
- Systems designed & built to be more adaptive, reliable, & intelligent.
- Systems engineering concerns such as fault-tolerance become much more readily achievable.
- New systems that have yet to be conceived will be possible.
- UNIVERSAL NASA PAYLOAD

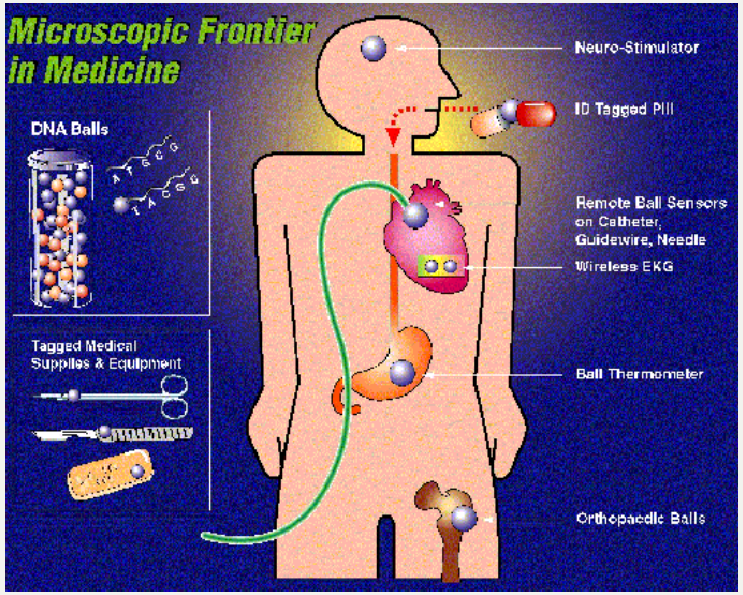
Shape-Shifters: Terminator II, and Odo of Deep Space Nine

- Systems self-designed & built through collaboration of their intelligent components.
- Intelligence resides in each INB that composes the system, not just an embedded controller.
- A robot dynamically constructed by and from INBs is not pre-constrained to a particular number or type of appendage with which to move.



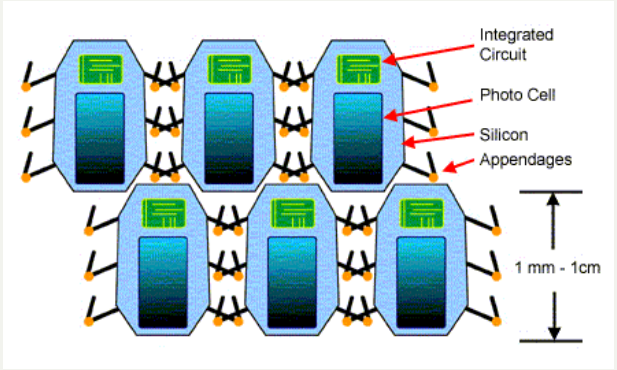
Spherical Silicon and Med-Balls

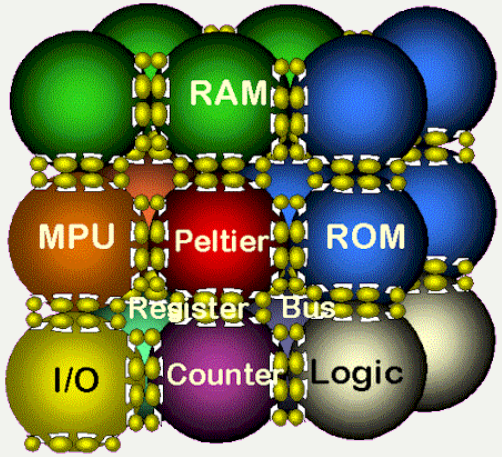
- BALL Solution: Spheres in motion
- One-millimeter spherical semiconductor in place of today's flat, rectangular chip.
- Production of spherical (ball) semiconductors in a single, enclosed process.
- Patent #6,464,687 Implantable drug delivery system



Intelligent Nano-Bots (INBs) Revisited

- 1 mm diameter sphere has 3.14 mm^2 surface area compared to a 1 mm^2 chip.
  - More circuits can be created than on a flat chip of comparable size.
  - Spherical processor decreases rather than increases in size to incorporate new functions.
- New Complexity Paradigm
  - Instead of adding functions on a single component making the processor more complex
  - Functions are contained on separate spheres that have been clustered together.





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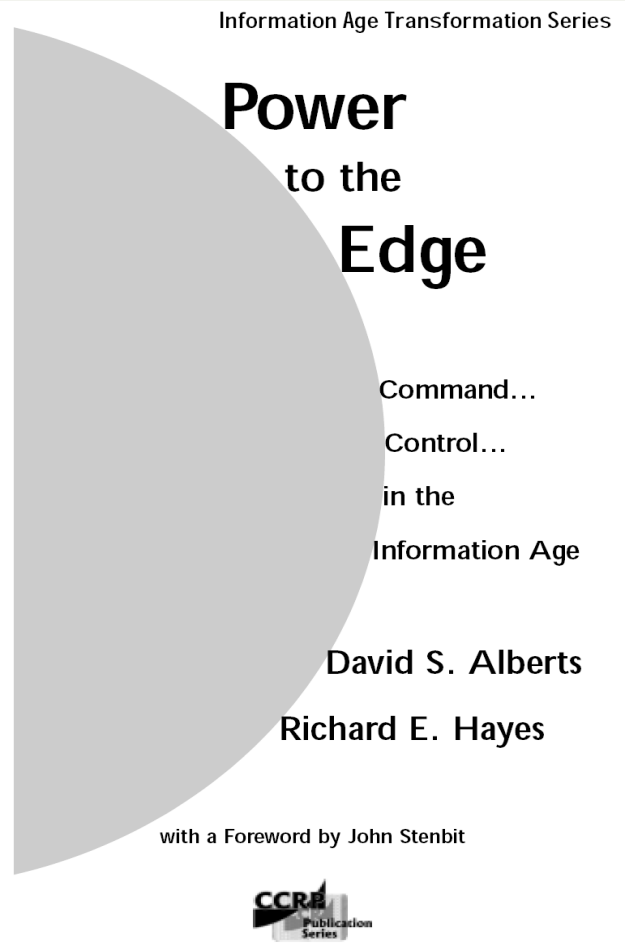
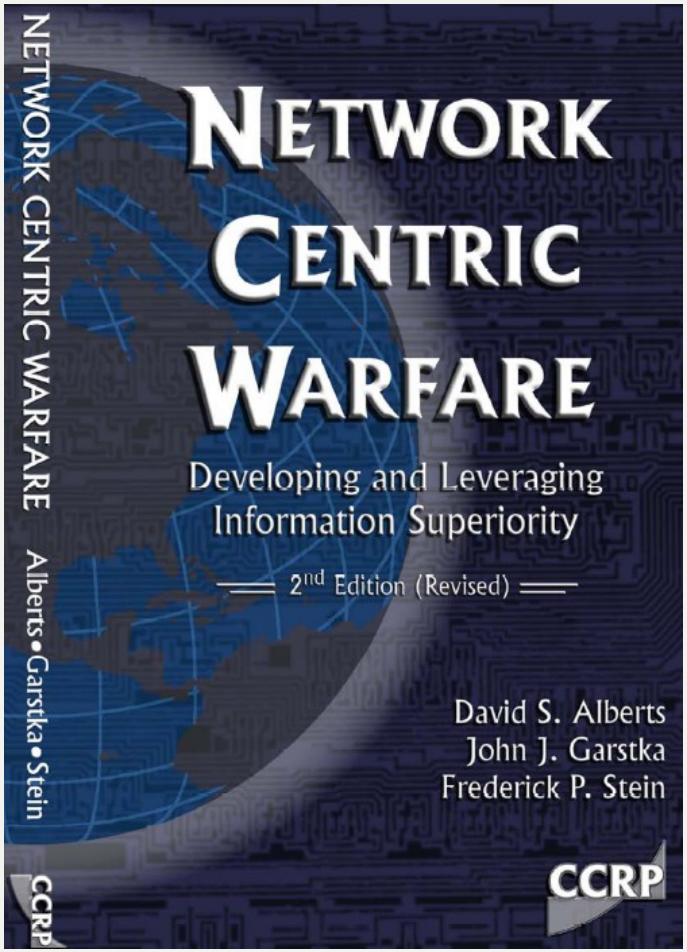
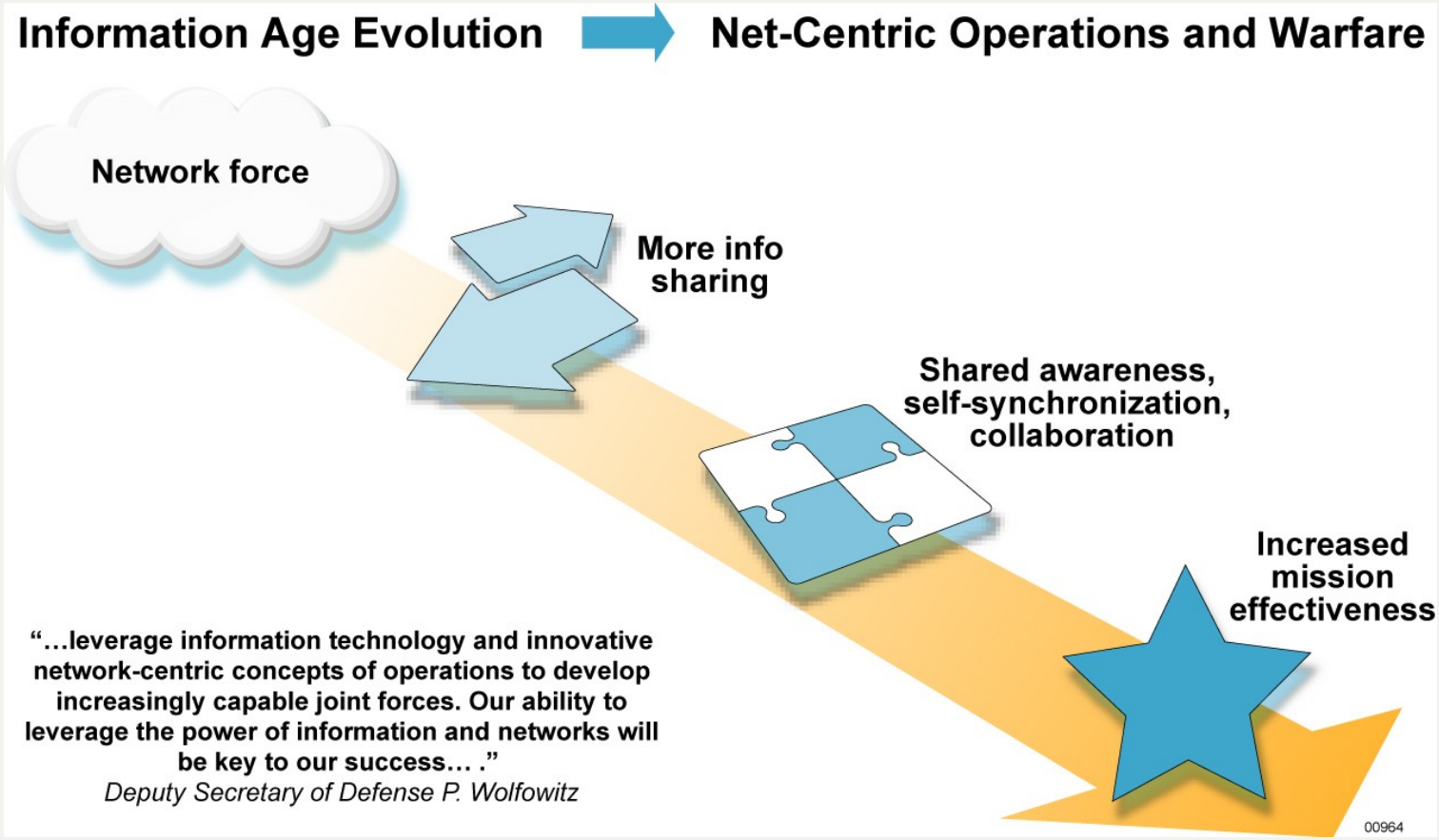
Net-Centric Operations — Theory

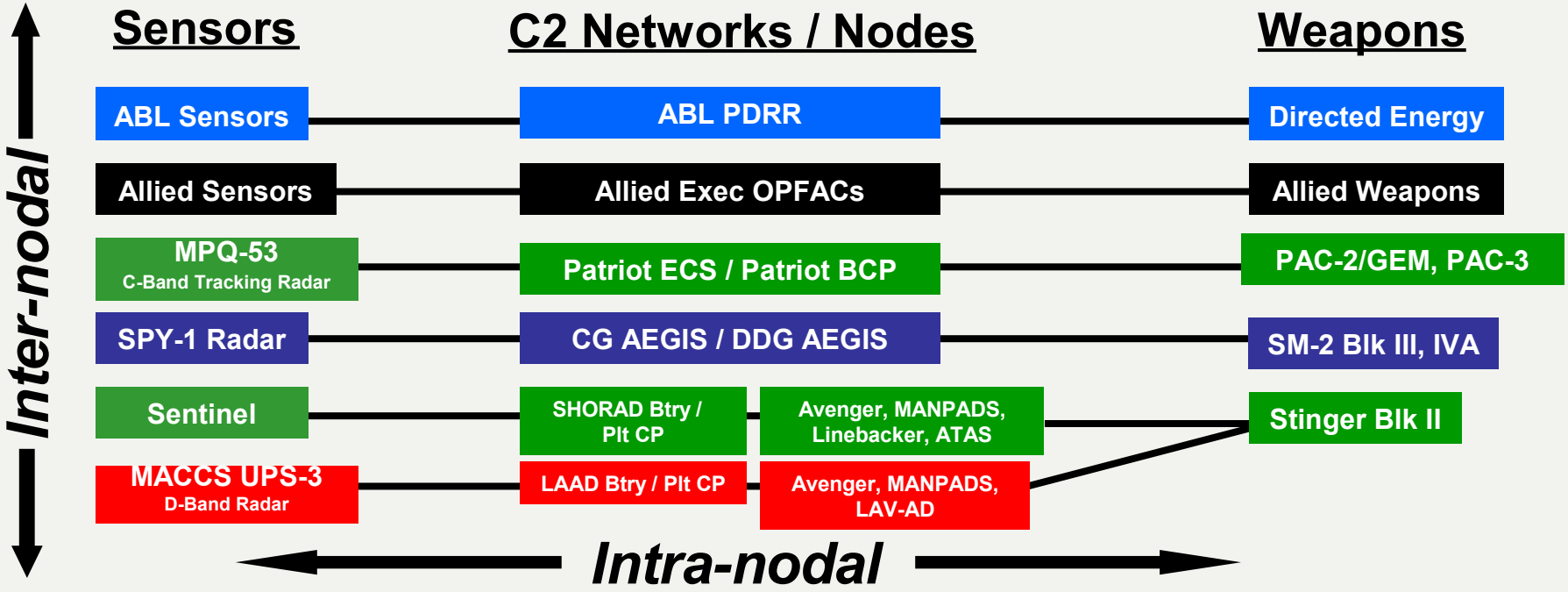




Net-Centricity **is a transformation enabler that empowers all users to easily discover, access, integrate, correlate and fuse data/information that support their mission objectives.**



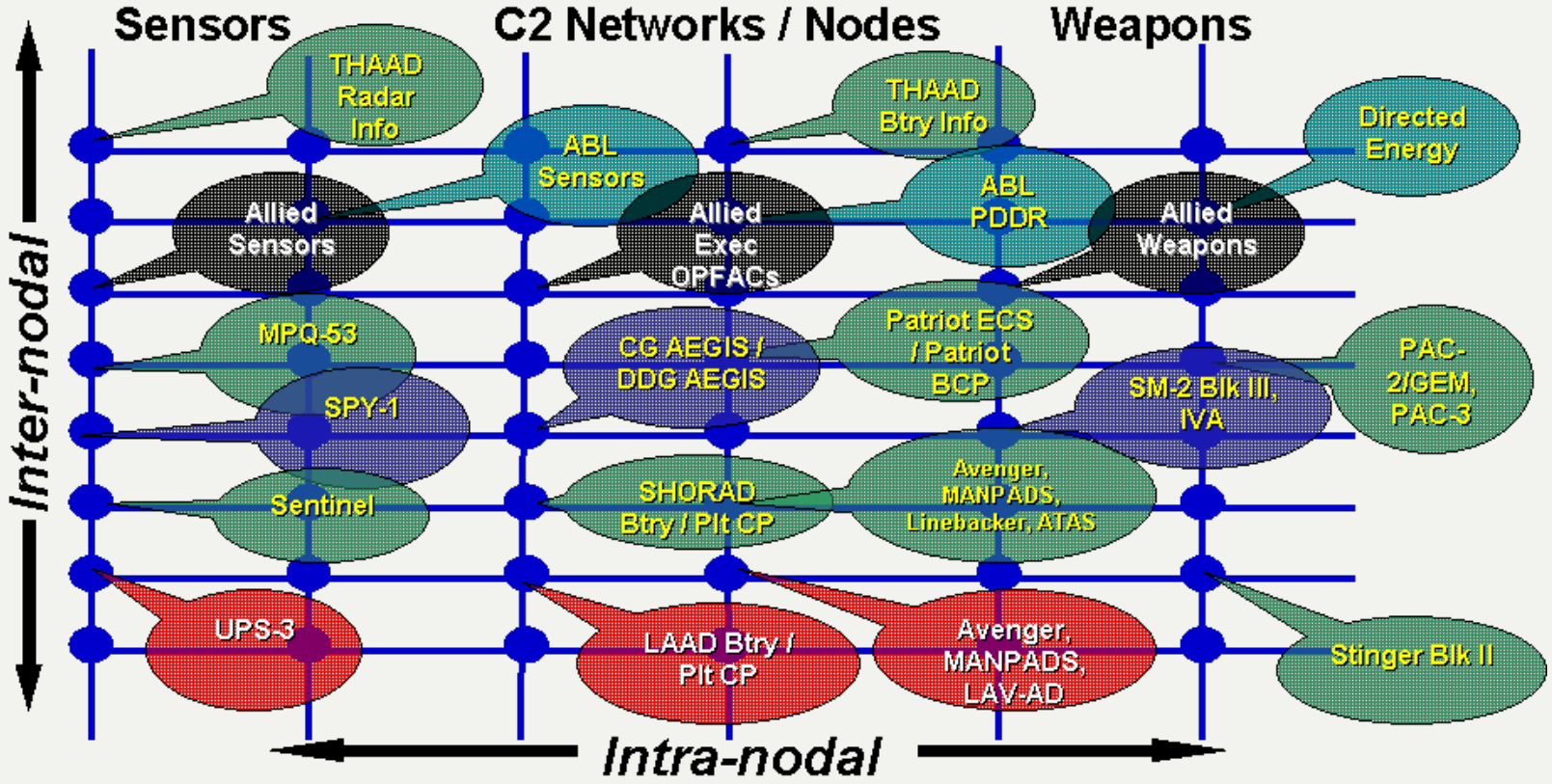
Distributed Systems Capabilities – Today



ABL PDRR – Airborne Laser Program Definition and Risk Reduction
CG / DDG – Guided Missile Cruiser / Guided Missile Destroyer
LAAD – Low Altitude Air Defense
LAV-AD – Light Armored Vehicle Air Defense
MACCS – Marine Air Command and Control System
SM-2 – Land Attack Standard Missile
THAAD – Terminal High-Altitude Area Defense

Today's information flow

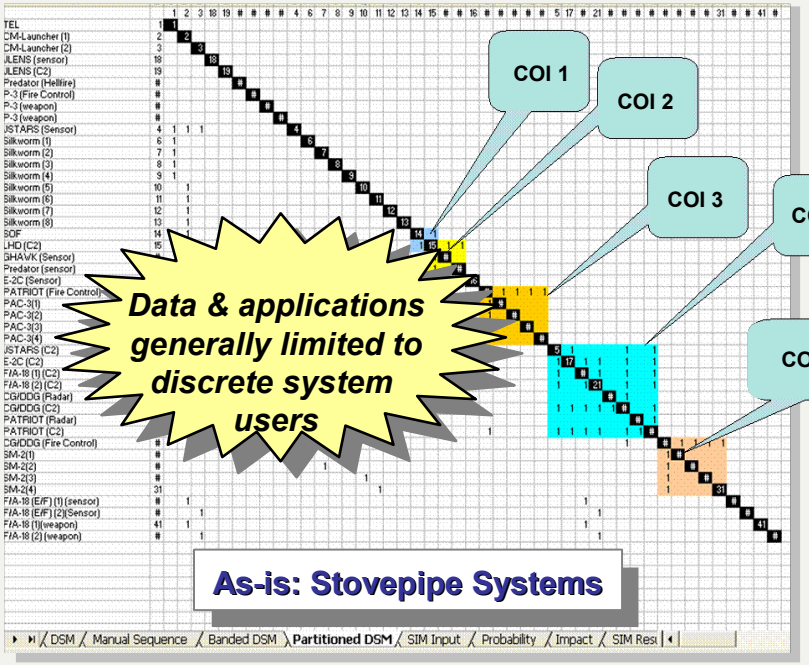
Distributed Systems Capabilities – Tomorrow

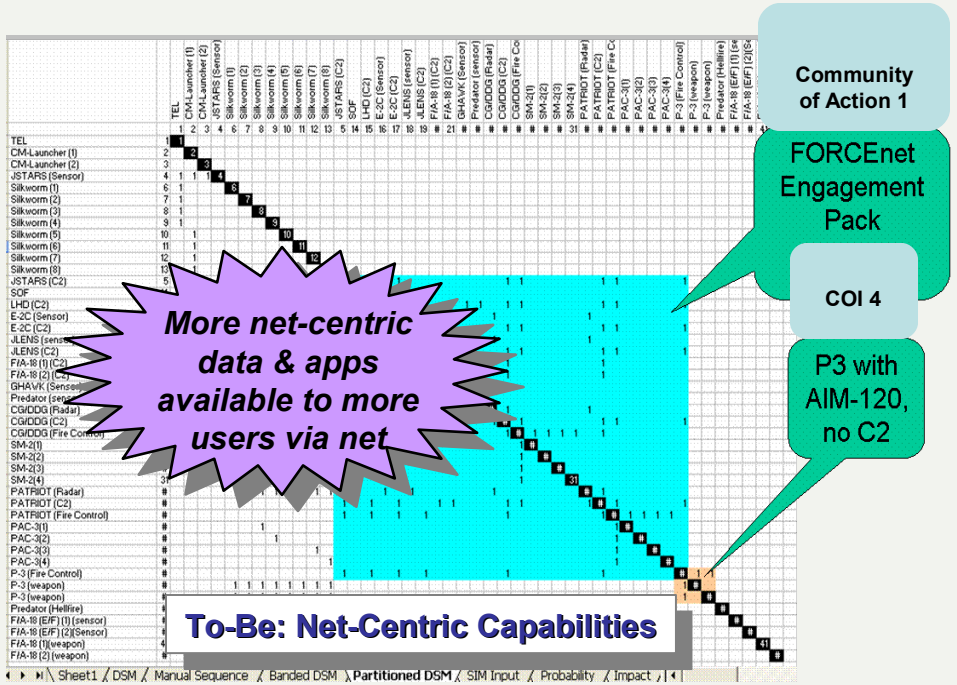


NCES Will Allow Information Exchange Across Weapons Systems and Sensors

Tomorrow: NCES / GES

Opens Information to Wider Communities of Interest



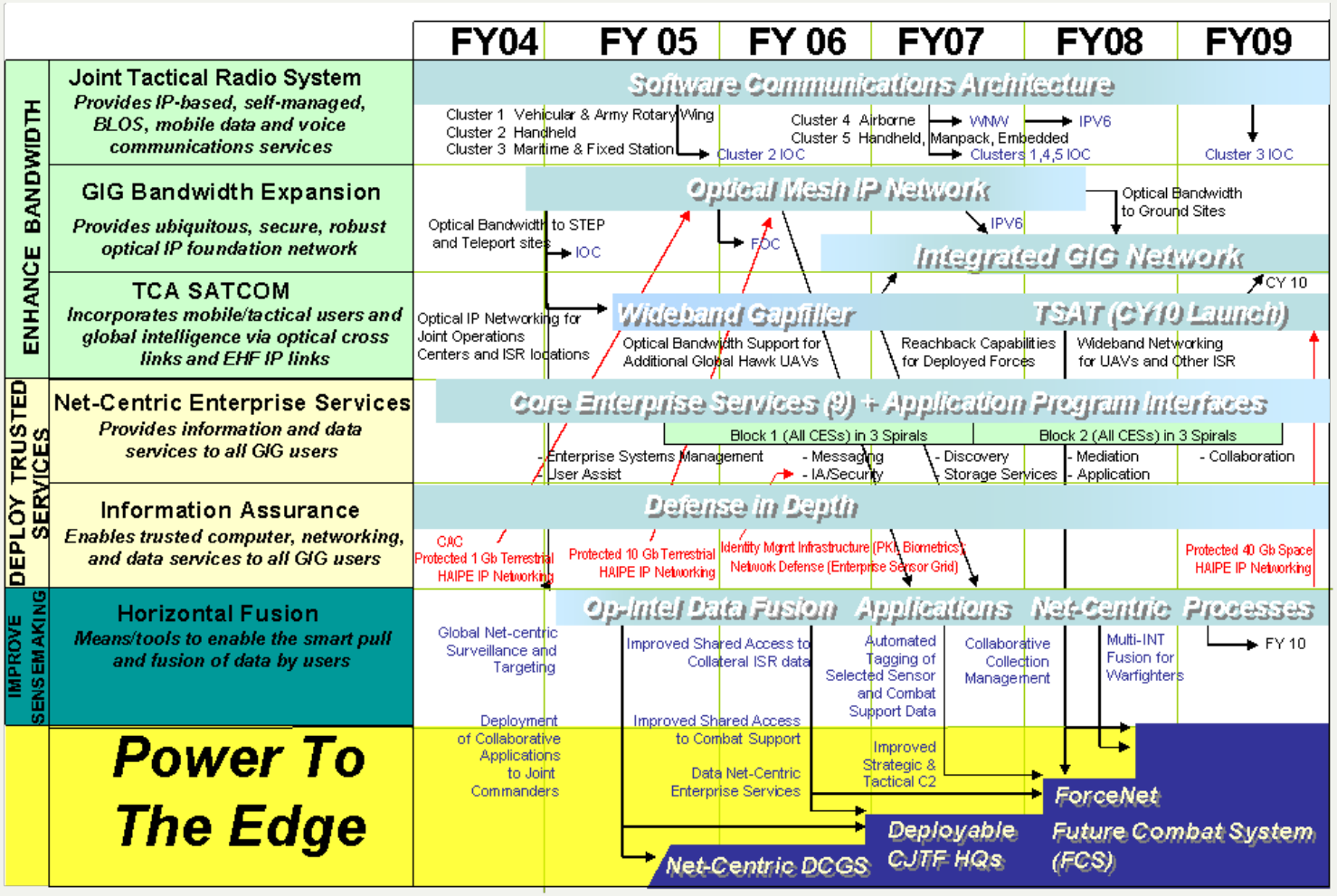


- Limited data – tightly integrated with system
- Requires thick client / system
- Limited access – systems' users

- Broad data & application availability through Service Oriented Architecture (SOA)
- Available via thin client / web browser
- Broad Community of Action / users

Even the smallest units can pull whatever data they need, whenever they need it, from wherever they are…

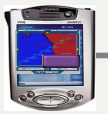
Growing Communications Bandwidth Requirements



CIO Vision for a NET-CENTRIC DoD, Guthrie, UK Ministry of Defense, A Net-Centric DoD NII/CIO, November 16, 2004

Net-Centric Enterprise Services (NCES) Capabilities






Allied/ Coalition & Multi-national

Controlled Info Exchange

Business Mission Area
- Installations & Environment
- Human Resources
- Strategic Planning & Budget
- Accounting & Finance
- Logistics
- Acquisition

Warfighting Mission Area

National Intelligence Mission Area

Institutional COIs

Expedient COIs

Information Exchange

Cross Domain COIs

Controlled Info Exchange (CIE)

Specialized functional area information and services

User Assistant | **Application** | **Storage** | **Messaging** | **IA/Security**

Discovery | **Collaboration** | **Mediation** | **Enterprise Service Management (ESM)**

Core Enterprise Services (CES)

Core information and services anyone can use

Communications **Computing** **Core Enterprise Services**

Enterprise Information Environment Mission Area

Users

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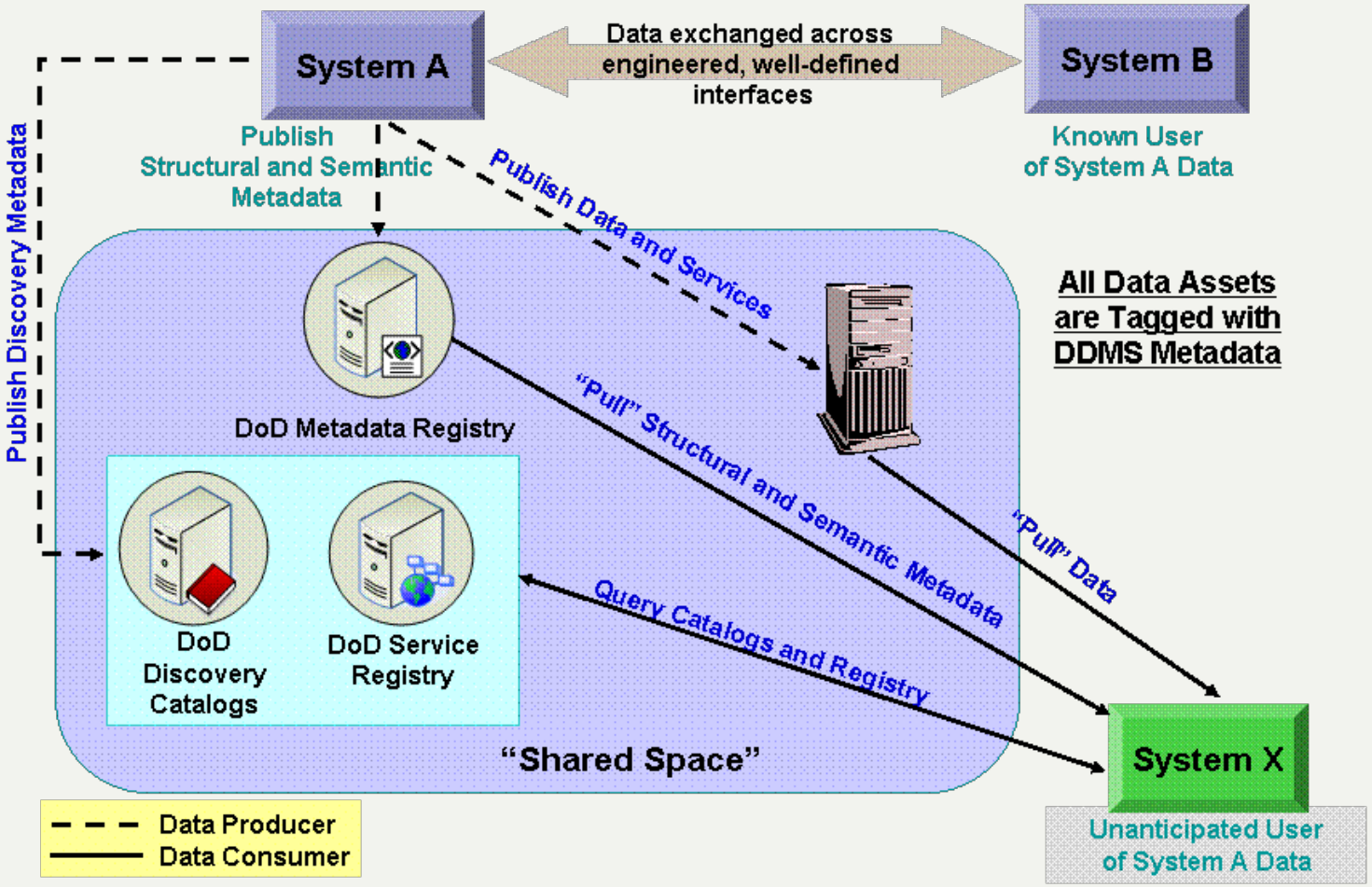
NCOW-Enabled M2M



It is all about the DoD Net-Centric Data Strategy, Michael Kreiger, Dir. Information Management, A Net-Centric DoD NII/CIO, November 16, 2004

Transforming to NCOW M2M

GIG Communications

- Legacy M2M implementations utilize GIG communications infrastructure rather than application specific infrastructure
- Most difficult step – touching legacy infrastructure

GIG Gateway

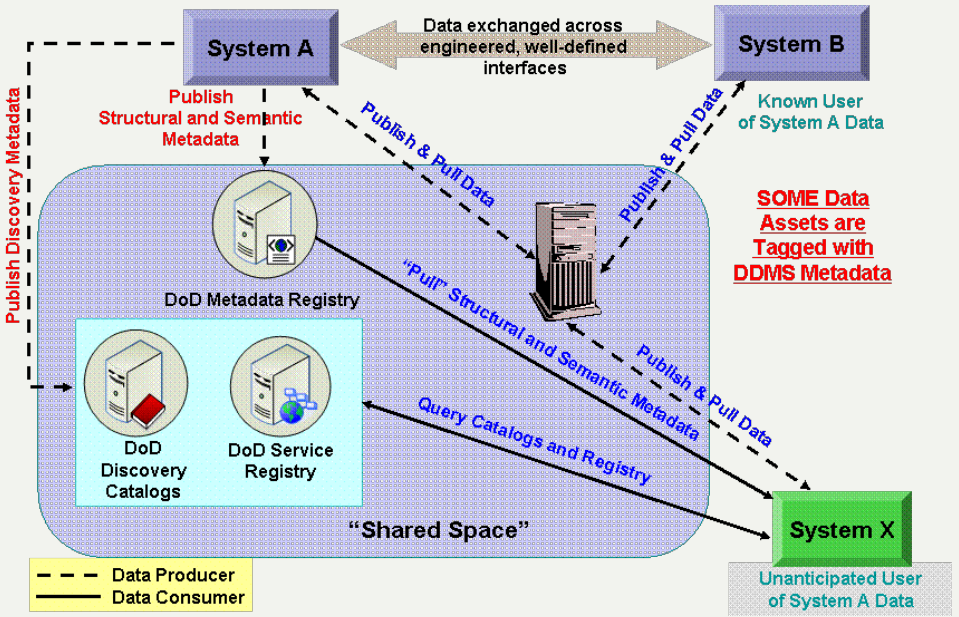
- GIG *Shared Space* functions as an advanced GIG-enabled gateway/wrapper to systems-centric enablement of M2M systems
- Commence functional decoupling and aggregation

GIG Information Cache

- GIG *Shared Space* enables capture and caching information of this particular M2M interaction
- Step toward core principle of net-centric paradigm: to make all information ubiquitously available.

GIG Service Provider

- Appropriate meta-tagging of information enables accessibility by other fully net-centric participants (human agents, machines, etc.)
- Despite fact machines originally producing and consuming information remain GIG-unaware.



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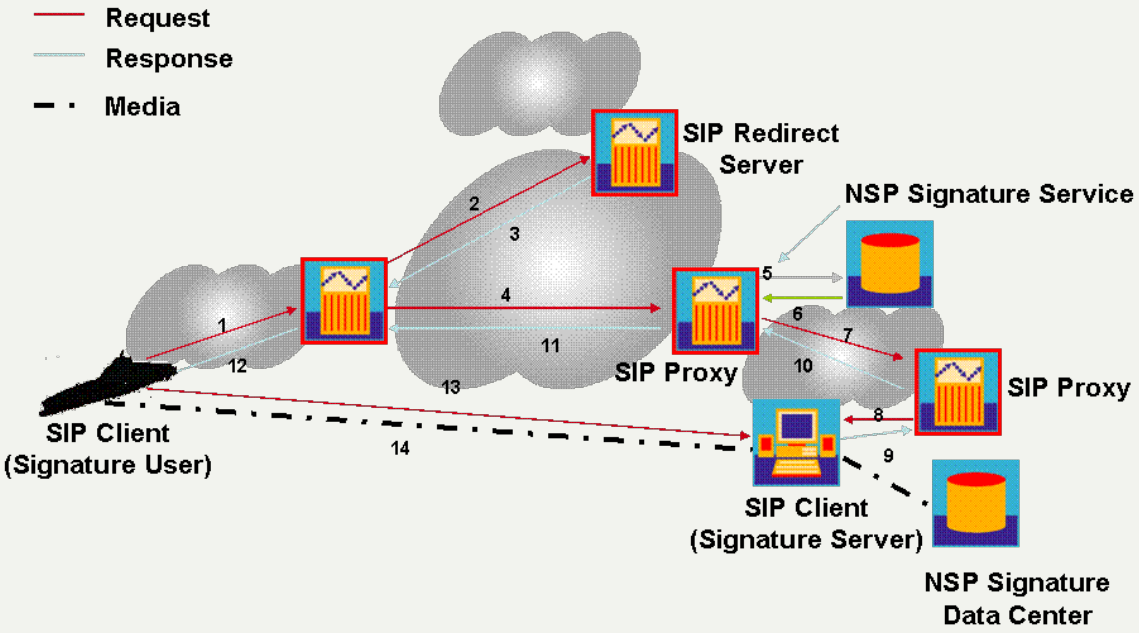
SIP Enabled Signature Service

To make User Agent communications work, SIP has to provide five key things:

- ***user location*** – a method of finding the called party
- ***user availability*** – settling whether the called party wants to, or can, participate
- ***user capabilities*** – determining what media and media parameters to use
- *session setup* – establishment of the communications session
- ***session management*** – ending and modifying the session in various ways, such as invoking new *services*, transferring to new *users*, or changing certain session parameters

SIP offers other capabilities also, such as ***encryption*** and ***security***.



Session Initiation Protocol (SIP) – Rendezvous Protocol

- SIP is a rendezvous protocol – a protocol that allows endpoints on the Internet to discover one another and negotiate the characteristics of a session they would like to share.
- Converges on best way to communicate, given preferences, and capabilities of available devices and networks.
- Establishes sessions over numerous communications media.
- Allows policies and services to be provided at the rendezvous level.
- Promises to place SIP firmly in the hands of billions of consumers worldwide.
- New paradigm of Internet-based mobile multimedia communications.
- Adoption of SIP by 3GPP and 3GPP2 has been a definitive success for SIP in the global marketplace.
- IP Multimedia Subsystem (IMS) of 3GPP & 3GPP2, the core of this strategy, is a SIP-based core.
- Mandatory DOD technology

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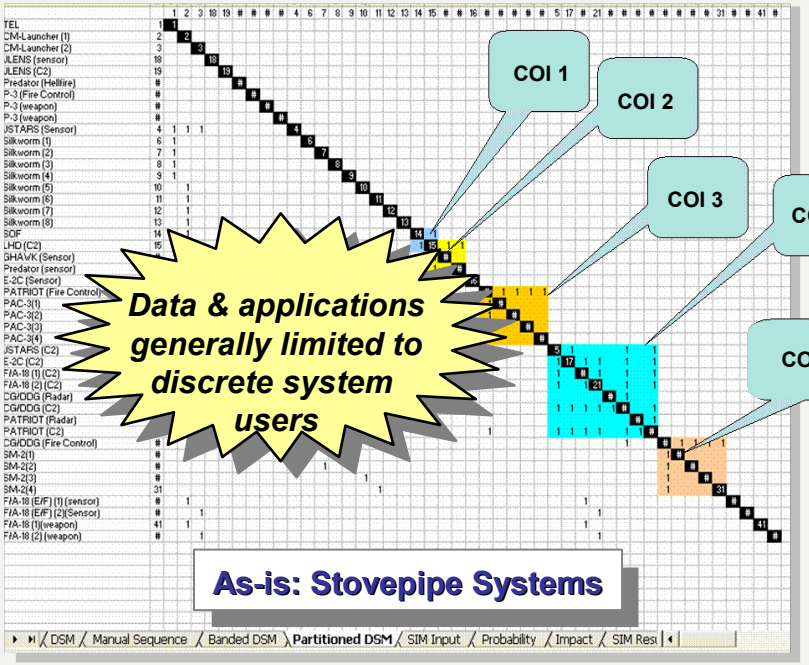
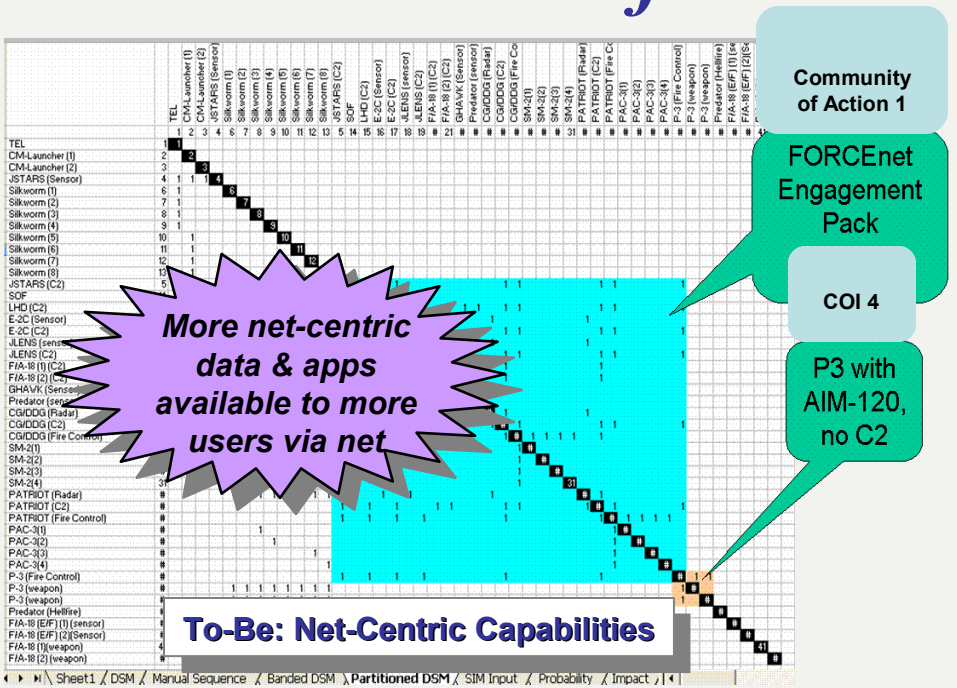
Remote Mobile Deployment of SensorNet for Large Public Events

Bristol Speedway:

- 300,000 – 400,000 visitors
- 100,000 passenger vehicles

Opens Information to Wider Communities of Interest





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Multiple Distributed Intelligence Sources (multi-INT) – Data Fusion Levels

- ***Level One – Object Refinement***
  - Iterative process Combining data from multiple sensors/sources
  - Determine position, kinematics, identity or attributes of objects or events
  - *Data alignment* - Normalization of data with respect to time, Space, and units to permit common data processing
  - *Data association* - Determination of whether or not newly received observations relate to existing tracks, other contacts, or data in the database
- ***Level Two – Situation Refinement***
  - Aggregate entities,
  - Capture events and interpret them in contest with entities,
  - Develop hypotheses about current behavior.
- ***Level Three – Threat Refinement***
  - Projects current situation into the future,
  - Draws inferences on threat and vulnerabilities,
  - Predicts intent and strategy.

SENSORNET

The New Science of Public Protection and Awareness

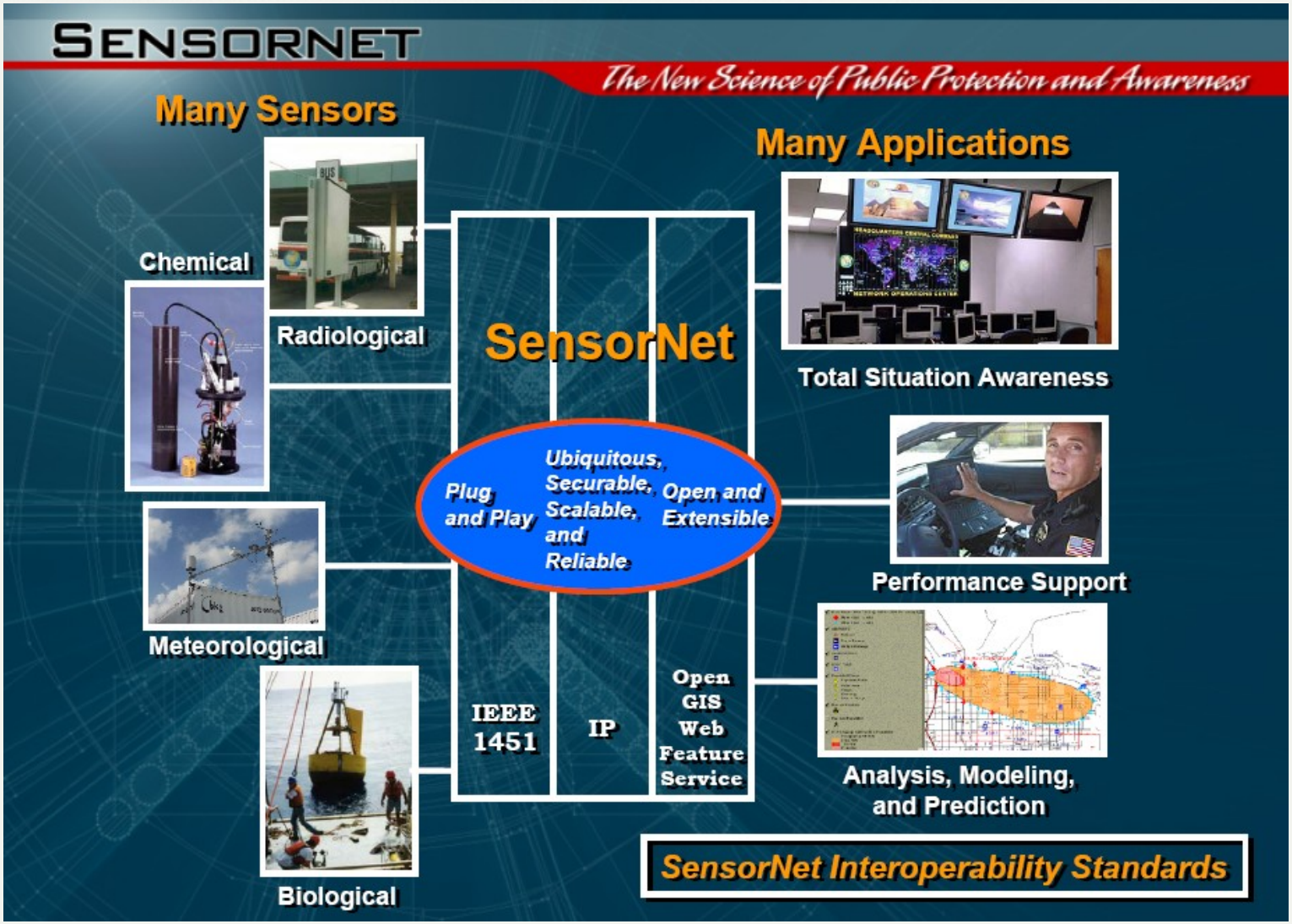
Mobile SensorNet

- ***Objective**: develop a mobile capability that allows for remote deployment of SensorNet assets. The most likely employment of the Mobile SensorNet would be to support large public events where fixed sensors are not available.*

- ***Composition**: The Mobile SensorNet consists of transportation assets, sensors and nodes, and a self contained operations center. The mobile SensorNet can be deployed by ground or air.*

- ***Status**: A working prototype is available for testing. Coordination is ongoing to test the system at a large public event .*

http://computing.ornl.gov/cse_home/sensornet/



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SENSORNET

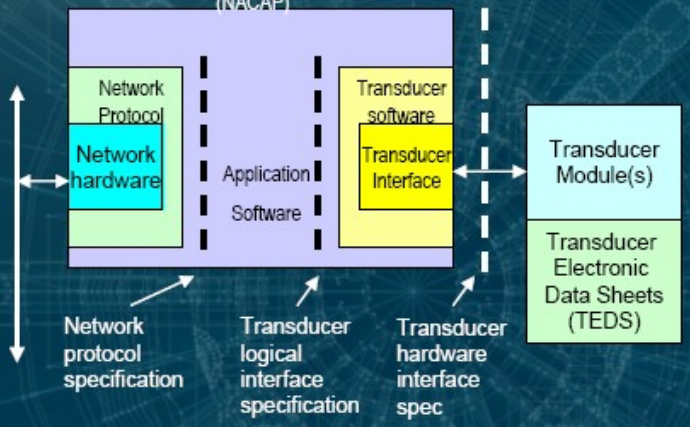
The New Science of Public Protection and Awareness

Interfaces | Data | Security | Services | Transport/Comms

A standardized core leads: Interoperability- Plug and Play - Lower Cost

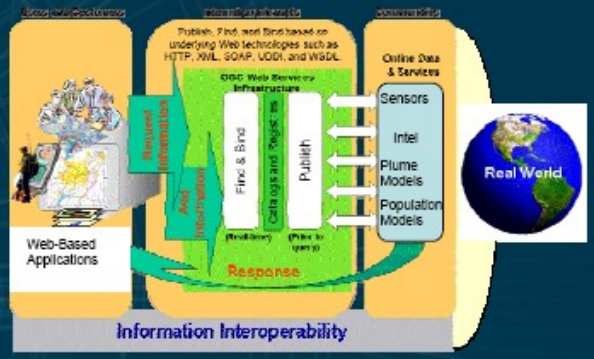
IEEE 1451

Network Capable Application Processor (NACAP)



- An industry-wide, open standard
- Providing common interfaces between sensors/actuators and instruments, microprocessors, or networks
- Analog, digital, and wireless interfaces
- Self-describing sensor via the Transducer Electronic Data Sheet (TEDS)

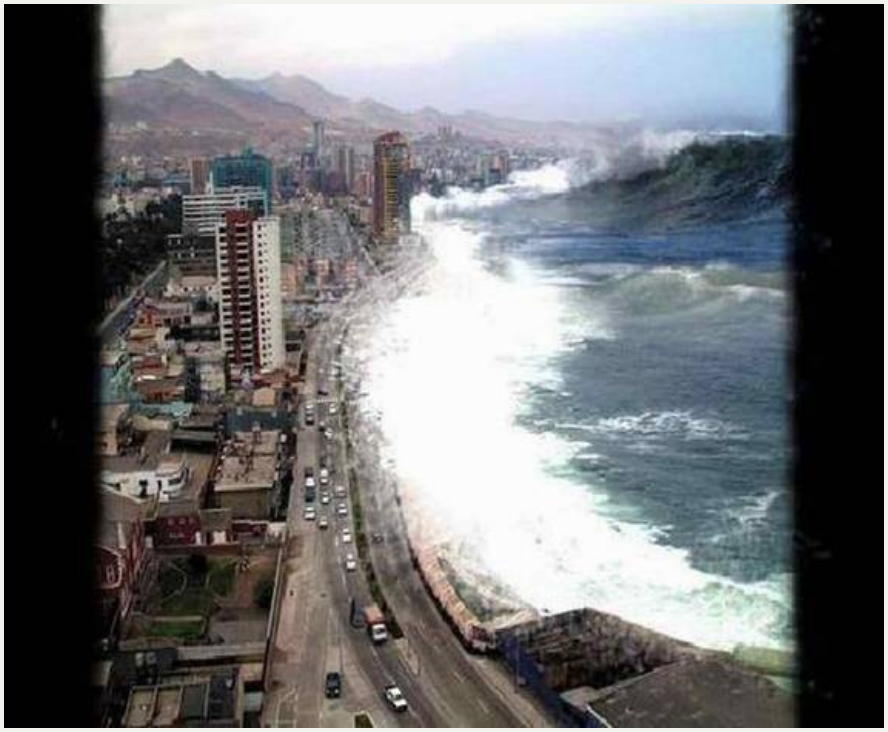
OGC



- Information Interoperability
- Integrated Web Services technologies
- Reduced barriers between real world, information about the real world, and distributed users
- Framework for next-generation vendor-neutral distributed geoprocessing and location systems
- Flexible future applications assembled from multiple, network-enabled geoprocessing and location services

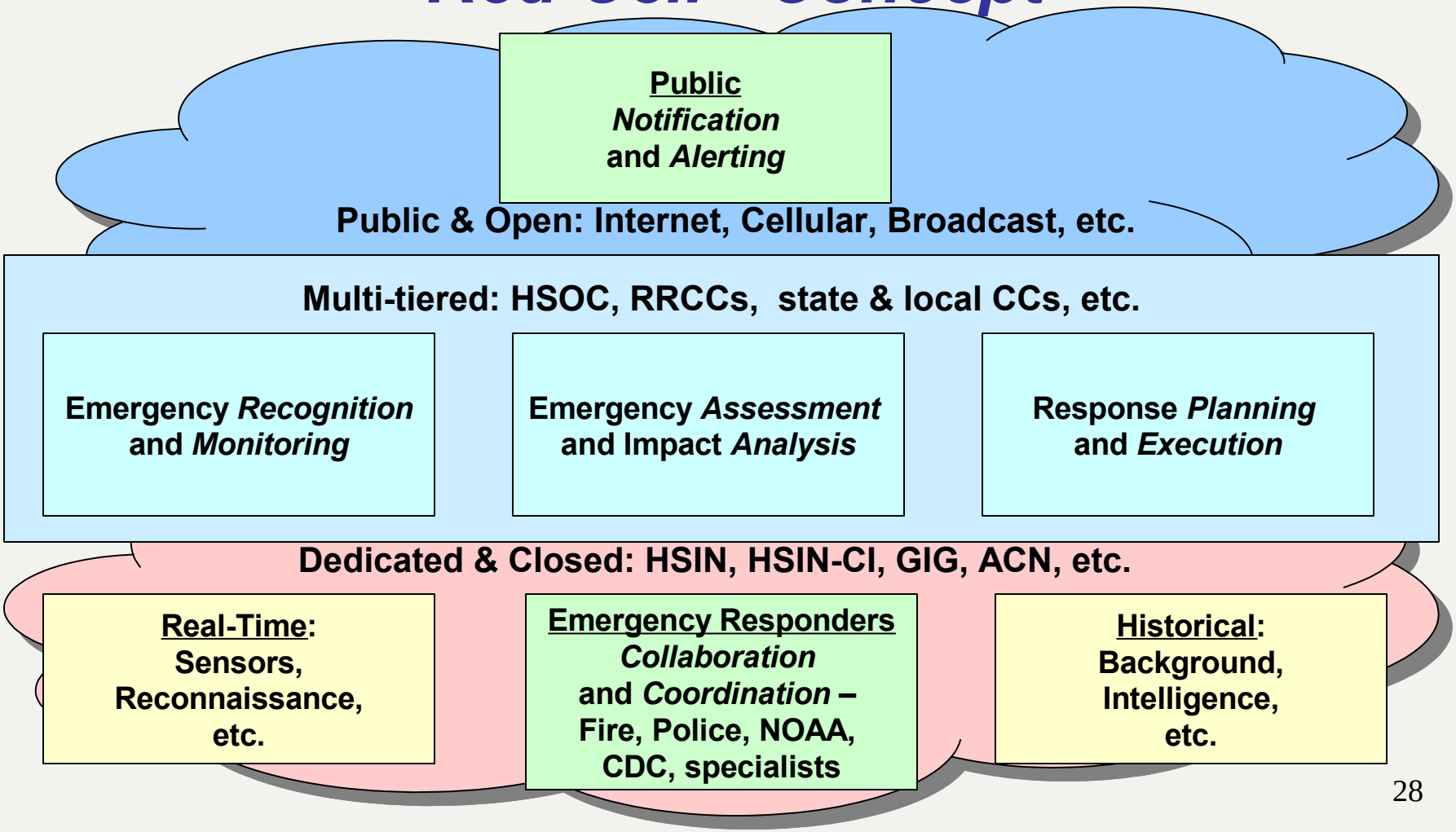
http://computing.ornl.gov/cse_home/sensornet/

Red Cell – Emergency Alert



- Cell Phone Infrastructure for Alert
  - Force Protection
  - Terrorist Actions
  - Amber/Tornado/Tsunami Alerts
- Advanced CBRNE Detection Technology
  - ORNL SensorNet
- Plume Modeling (ORNL, NCS, NRL)
- Cellular Infrastructure Modeling
  - NCS Wireless Priority Service
- Concept of Operations (Red Cell)

Red Cell - Concept



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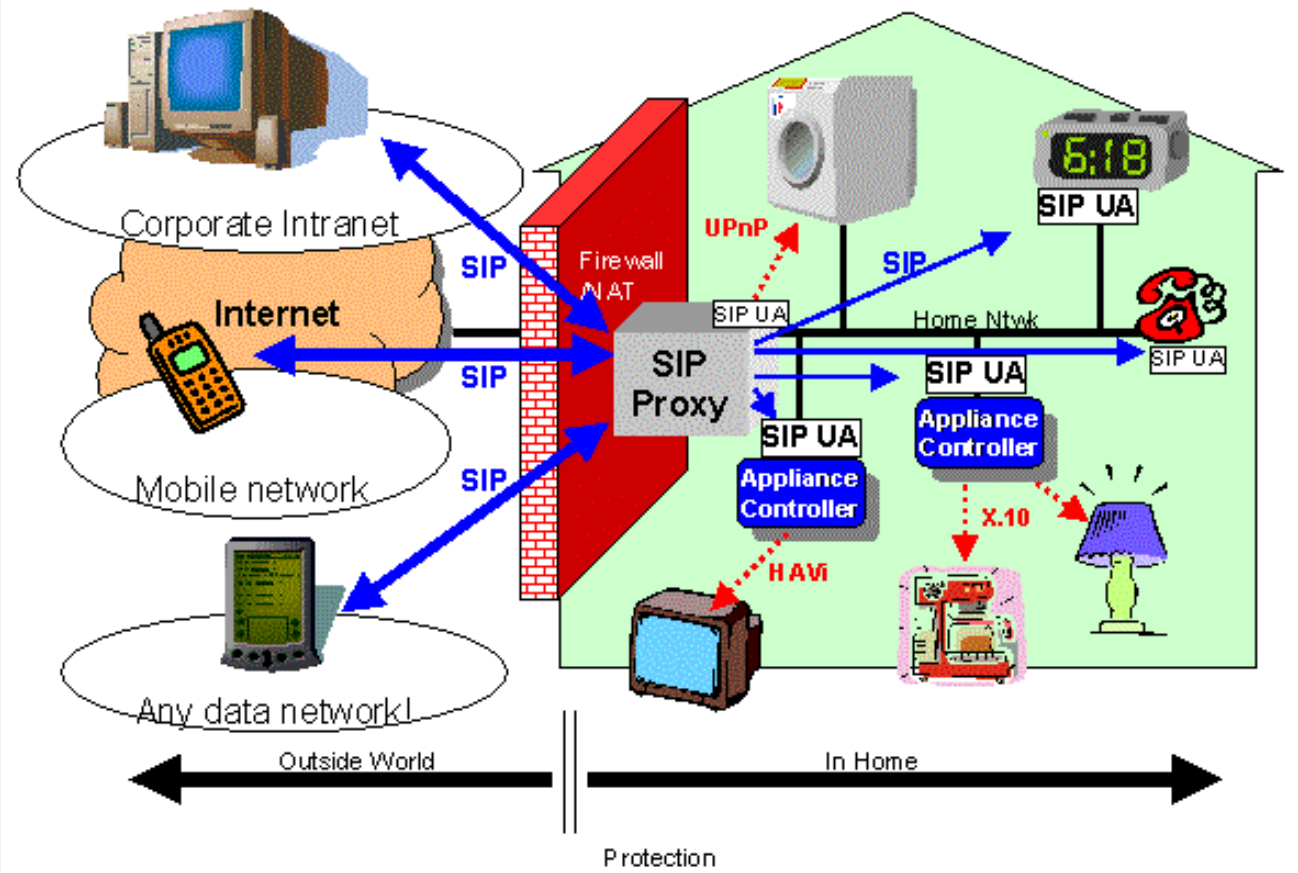
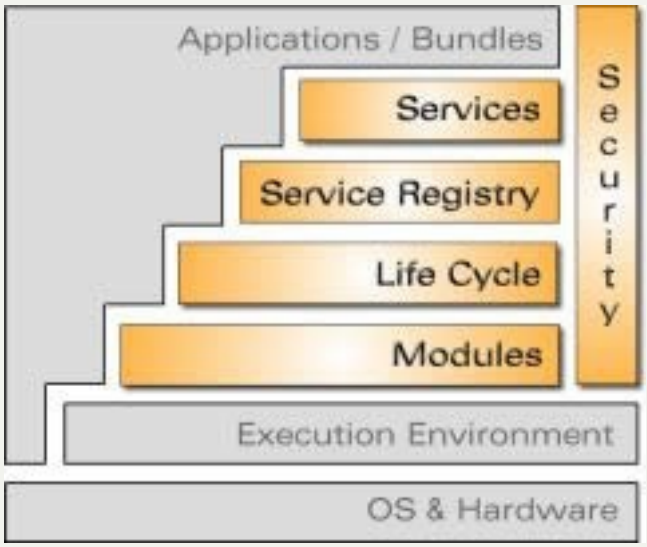
SIP Enabled Smart Home



Telcordia R&D Labs http://www.argreenhouse.com/iapp/

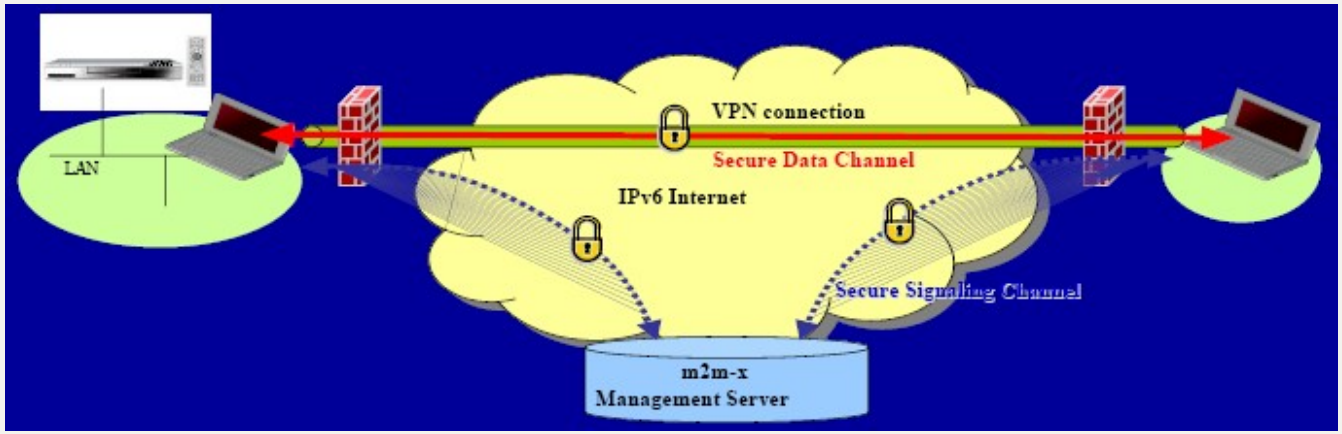
OSGi – Open Services Gateway Initiative



- Specify, create, advance, and promote wide industry adoption of an open service delivery and management platform.
- Extend OSGi framework to support interoperable mobile devices.
- Based on the use of SIP
- OSGi framework in Eclipse

http://www.osgi.org/

NTT Communications m2m-x Technology



- ***m2m-x*** = machine to machine security (authentication and encryption) anytime, anywhere
- Designed to facilitate secure communications between appliances, computers, and any other device
- Based on IPsec and SIP
- Authentication, connection management, and configuration controlled by central m2m-x management server
- Data communications between devices is conducted peer-to-peer with IPsec encryption with no intervention by the m2m-x server

Revealing the Security Benefits of IPv6, Chuck Sellers, NTT/VERIO, June 2004

Introducing "m2m-x"

- **m2m-x: Net Appliance Connection Management Technology**
  - First demonstrated at the IPv6 Business Summit in Japan in Tokyo on February 16, 2004
  - Establish end-to-end secure connections for anything, anytime, anywhere
  - Trial currently under way with various manufacturers
  - Commercial availability 4Q, CY-2004
  - Will be proposed to the International Standardization bodies
  - Developed by NTT Communications
- **Central m2m-x Management Server Provides Signaling for:**
  - Authentication
  - Encryption Key Management
  - Visibility and Access Control
  - Auto-configuration
  - Other parameter negotiation
- **Management Protocol**
  - SIP over IPv6/IPsec with AES
- **Data Communication Is True Peer-to-Peer**
  - Data protected end-to-end with IPSec native in IPv6
  - No Management Server involvement once connection is established
  - (Encryption Key refresh may be done via server)

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