SensorNet Standards at Ft. Bragg

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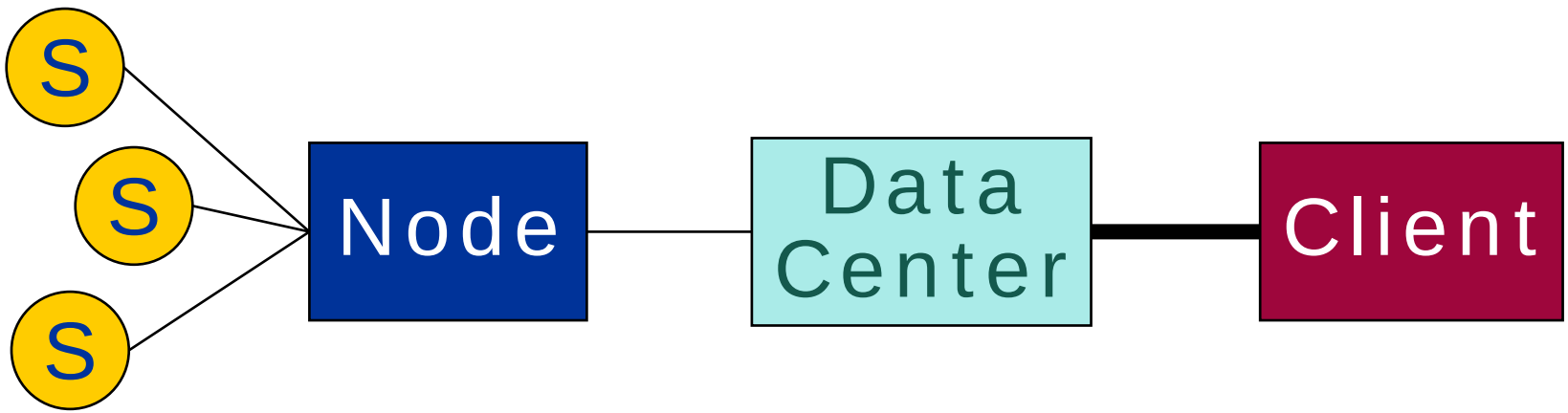
SensorNet Program

- **Brief description of the scalable SensorNet architecture**
- **Standards based, end-to-end, as much as possible**
- **Why use standards?**
- **Why use the standards we chose?**
- **History and results**
- **Future plans**

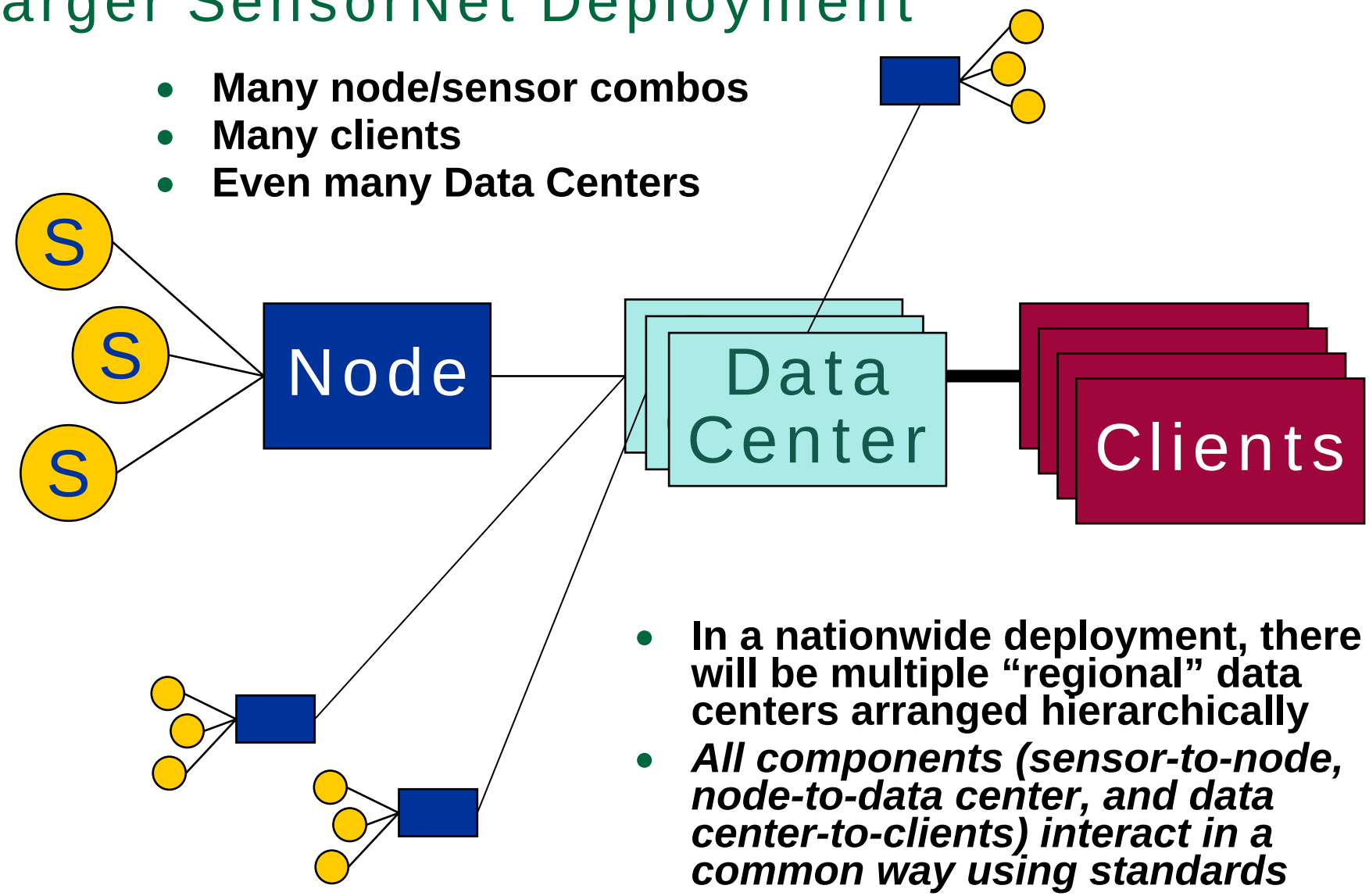
SensorNet Block Diagram



- **Nodes are small computers with CPU, local storage, database, software services**
  - **Sensor reading software (1451 NCAP emulation when necessary)**
  - **Failover network communications**
  - **Services to package and send sensor readings to Data Center**
  - **Services to respond to commands from Data Center**
- **Network between the Node and Data Center is generally low-bandwidth ("thin pipe")**
- **Clients do not generally connect directly to the node but instead get their data from the well-connected Data Center ("fat pipe")**

Larger SensorNet Deployment

- **Many node/sensor combos**
- **Many clients**
- **Even many Data Centers**



- **In a nationwide deployment, there will be multiple "regional" data centers arranged hierarchically**
- ***All components (sensor-to-node, node-to-data center, and data center-to-clients) interact in a common way using standards***

Why Standards?

- **The overriding reason is *cost***
- **Sure, we could have designed and built SensorNet using proprietary ORNL-invented software and protocols**
  - **Any large scale integrator could do the same**
  - **Not part of our charter, as a National Lab**
- **Would have been faster (quicker "to market")**
- **Would have had trouble "selling" it since it wouldn't interoperate with anything**
- **In the end, would have been more expensive for the government to implement because of vendor lock-in**
- **The use of standards promotes vendor buy-in and competition, lowering the cost to the government**

Approaching the Problem: Integrated or Interoperable Solutions?

Integrated Systems

Tightly-coupled,
monolithic architecture
Homogeneous system
Autonomous or stand-alone

Interoperable Systems

Loosely-coupled,
modular architecture
Heterogeneous components
Standards-based interfaces

Successful Examples: Apple Macintosh, Amazon.com, Private Branch Exchange (PBX), Maneuver Control System (MCS), Land Mobile Radio (LMR) networks, systems integrators (e.g., SAIC, Boeing, Raytheon, BAE Systems).

Successful Examples: IBM PC, eBay, Public Switched Telephone Network (PSTN), Net-Centric Enterprise Services (NCES), WiFi (802.11x) networks, open standards bodies (e.g., OASIS, OGC, IEEE)
.

The Strengths

Integrated Systems

Strong design values: The "integrated system" design typically has a branded "look and feel" that is specific and unique.

Fewer maintenance issues: In superior integrated systems, the components are tightly matched and carefully sized for the specific requirements.

Deterministic costs: The costs for the base system and accessories are finite.

Interoperable Systems

Scalability: The "interoperable system" can scale with a "pay as you go" model to address performance and functional requirements.

Configurability: The system can be configured and reconfigured to meet a range of operational metrics from the most simple to the most complex.

Evolvable: The system can adapt to the availability of new technology.

The Weaknesses

Integrated Systems

Inflexibility: In many cases one size ***doesn't*** fit all.

Weakest Link: One improperly integrated component can undermine the utility and performance of the entire investment.

Interoperable Systems

Complexity: Interoperable systems can become very complex and difficult to maintain and support.

Money Pit: The bottom line costs for system acquisition and maintenance are difficult and sometimes impossible to determine beforehand.

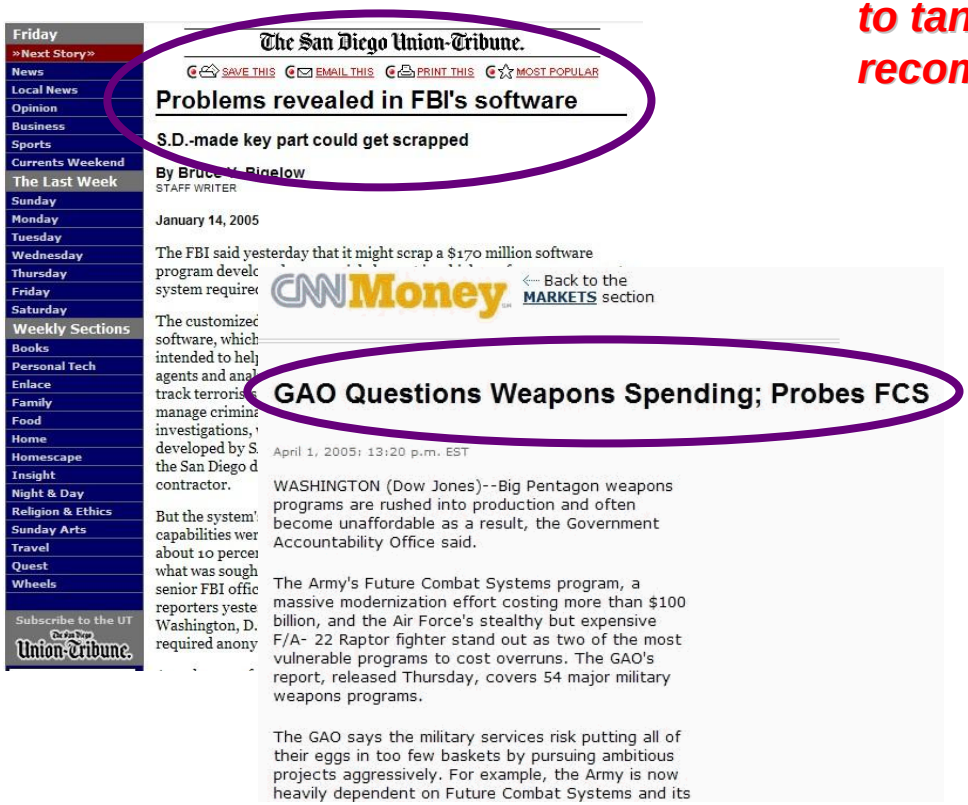
Large Integrated Systems Problems

88%** of large IT integration projects **fail or overrun** their target budgets by an average of **66%

Standish Group, 1999

Germany was able to circumvent the line by passing its Panzers through hills and marshlands which **had been impenetrable to tanks when Maginot made his recommendations.

from Wikipedia, 2006



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Problems revealed in FBI's software

S.D.-made key part could get scrapped

By Bruce V. Bigelow
STAFF WRITER

January 14, 2005

The FBI said yesterday that it might scrap a $170 million software program develo
system require

The customized
software, which
intended to hel
agents and anal
track terroris
manage crimina
investigations,
developed by S.
the San Diego d
contractor.

But the system'
capabilities wer
about 10 percer
what was sough
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reporters yeste
Washington, D.
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CNNMoney ← Back to the MARKETS section

GAO Questions Weapons Spending; Probes FCS

April 1, 2005: 13:20 p.m. EST

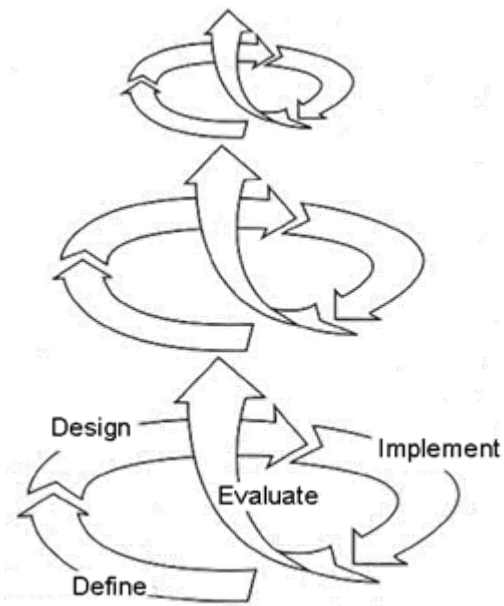
WASHINGTON (Dow Jones)--Big Pentagon weapons programs are rushed into production and often become unaffordable as a result, the Government Accountability Office said.

The Army's Future Combat Systems program, a massive modernization effort costing more than $100 billion, and the Air Force's stealthy but expensive F/A- 22 Raptor fighter stand out as two of the most vulnerable programs to cost overruns. The GAO's report, released Thursday, covers 54 major military weapons programs.

The GAO says the military services risk putting all of their eggs in too few baskets by pursuing ambitious projects aggressively. For example, the Army is now heavily dependent on Future Combat Systems and its

Unbounded and dynamic problems are not suited for integrated systems.

The BEST Approach



1. Define the **basic system requirements** and **review existing design examples**.

2. Reduce technical ***risks and costs*** by implementing in modest increments, evaluating and revisiting requirement and design assumptions along the way.

3. In projects where the requirements and technologies are ***likely to change***, build upon fundamental ***interoperable components,*** particularly those that are already developed and commercially available in the competitive market place, and ***avoid integrated, special purpose systems*** with ***proprietary interfaces*****.**

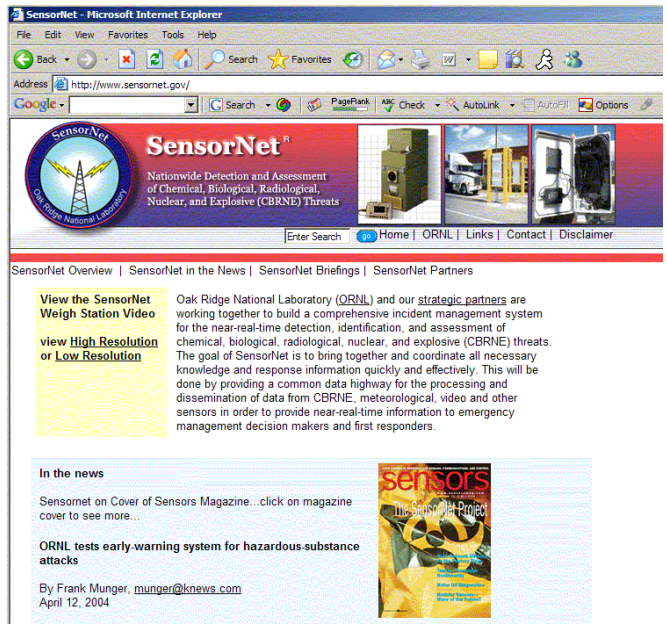
4. Always work within the context of big picture, and always insist on three things from vendors and collaborators: ***open interfaces, standards, and interoperability.***

SensorNet

Two goals of the Oak Ridge National Laboratory's (ORNL) collaboration with the Open Geospatial Consortium (OGC), the National Institute for Standards and Technology (NIST), and the Organization for the Advancement of Structured Information Standards (OASIS) are:

- to implement and promote industry-wide **interoperability and information sharing standards** for **ubiquitous, cost-effective,** and **secure** networks for chemical, biological, radiological, nuclear, and explosive (CBRNE) sensors;

- to address the issue of standards for interfacing **autonomous sensor networks** to local and regional emergency centers.



http://www.sensornet.gov

Which Standards

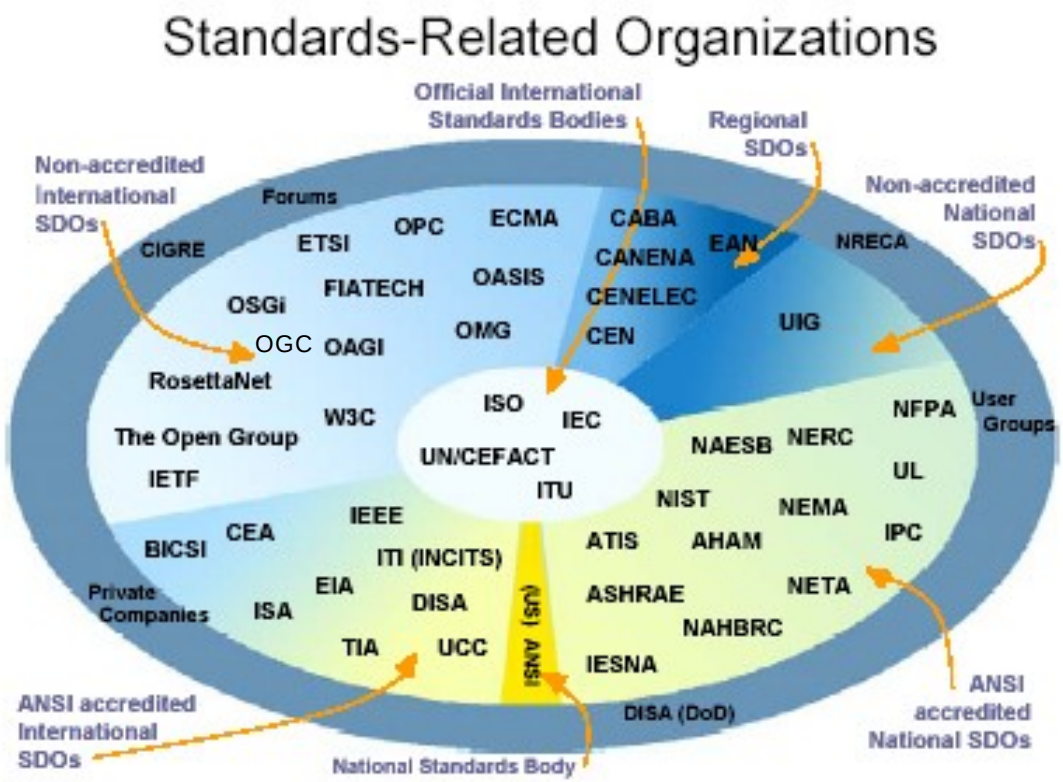
- **So many to choose from**
- **Three years ago, when we started working on SensorNet in earnest, there were only a few sensor standards from which to choose**
- **Today, it could be argued that there are too many!**

Standards Activities for CBRN Sensors

	DoD	DHS	NIST	OASIS	OGC	DOT
Activity	JPEO-CBD	Standards Portfolio S&T Directorate	Sensor Interface Standards	Emergency Interoperability Consortium	Sensor Web Enablement	Incident Management
POC	Prof. Tom Johnson, NPS	Dr. Bert Coursey, DHS	Mr. Kang Lee, NIST	Ms. Elysa Jones, OASIS	Mr. Sam Bacharach OGC	Ann Lorscheider NCDOT
Standards	JPM-IS Data CBRN Common Data Model NATO NBC Standards (Allied Tactical Publication 45B) STANAG 5523	ANSI N42.32 ANSI N42.33 ANSI N42.34 ANSI N42.35 ANSI N42.38 ANSI N42.42 ASTM E54 AOAC International	IEEE 1451.0 IEEE 1451.1 IEEE 1451.2 IEEE 1451.3 IEEE 1451.4 IEEE 1451.5 IEEE 1451.6	Common Alerting Protocol Emergency Data Exchange Language	Sensor Observation Service Sensor Planning Service Sensor Alerting Service Geospatial Markup Language Web Feature Service	IEEE Std 1512.3-2002 (HAZMAT Standard)

There are on-going and, in some cases, overlapping efforts to develop CBRN standards within industry, federal, and international standards organizations. ORNL has invested a significant amount of R&D into implementing, testing, de-conflicting, and harmonizing these efforts to establish an overarching set of working interoperability standards to connect CBRN sensors, detectors, and data to emergency response, homeland security, and defense applications.

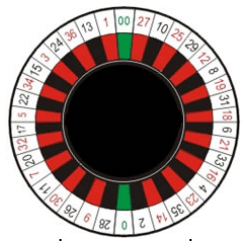
The Standards Roulette Wheel



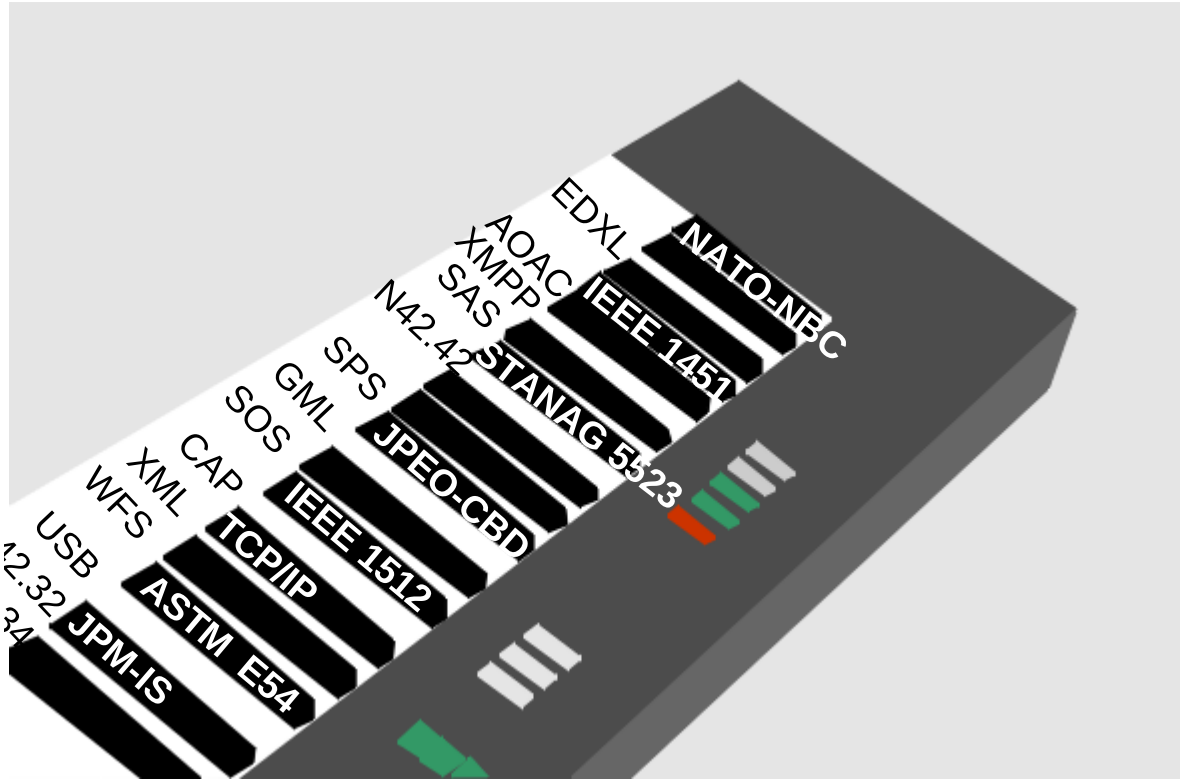
Spinning the Wheel and Picking Winners

(Some succeed and others do not)

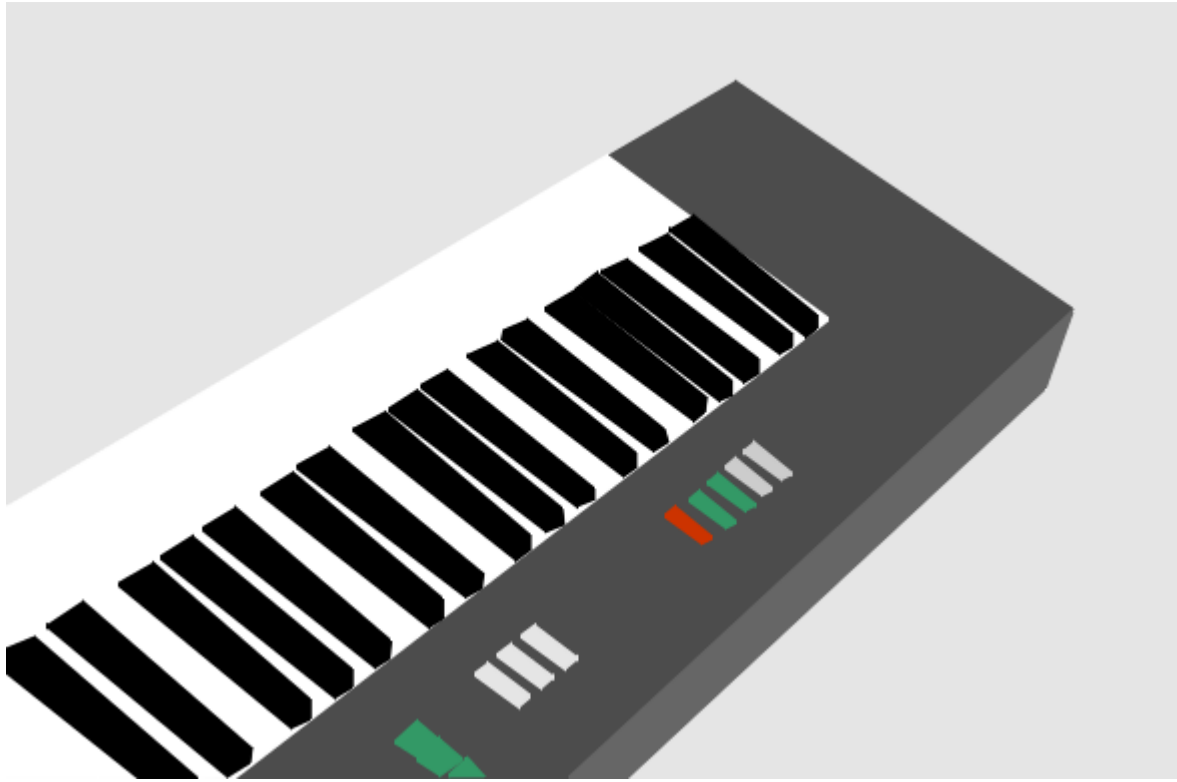
TCP/IP	OSI/TP4
XML/Web Services	CORBA
Java	Ada
LDAP	X.500
IEEE 802.3/Ethernet	IEEE 802.5/Token Ring
	ATM to the Desktop
	isoEthernet
802.11x (WiFi)	Home PNA/Home RF
SMTP	X.400
SNMP	TINA-C



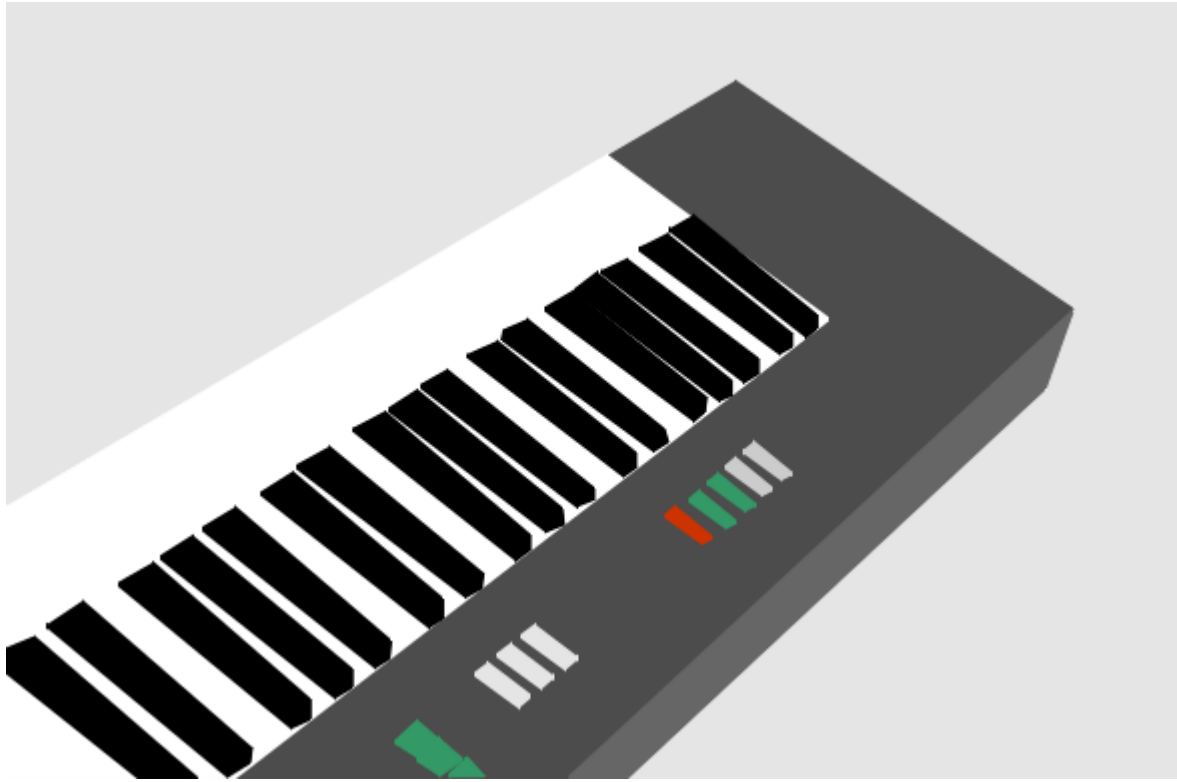
So many standards



Try to Interoperate With All the Standards, and ...



Choose the Right Standards, and ...



Use Proprietary Software, and …

Bragg Experimental SensorNet Testbed (BEST)

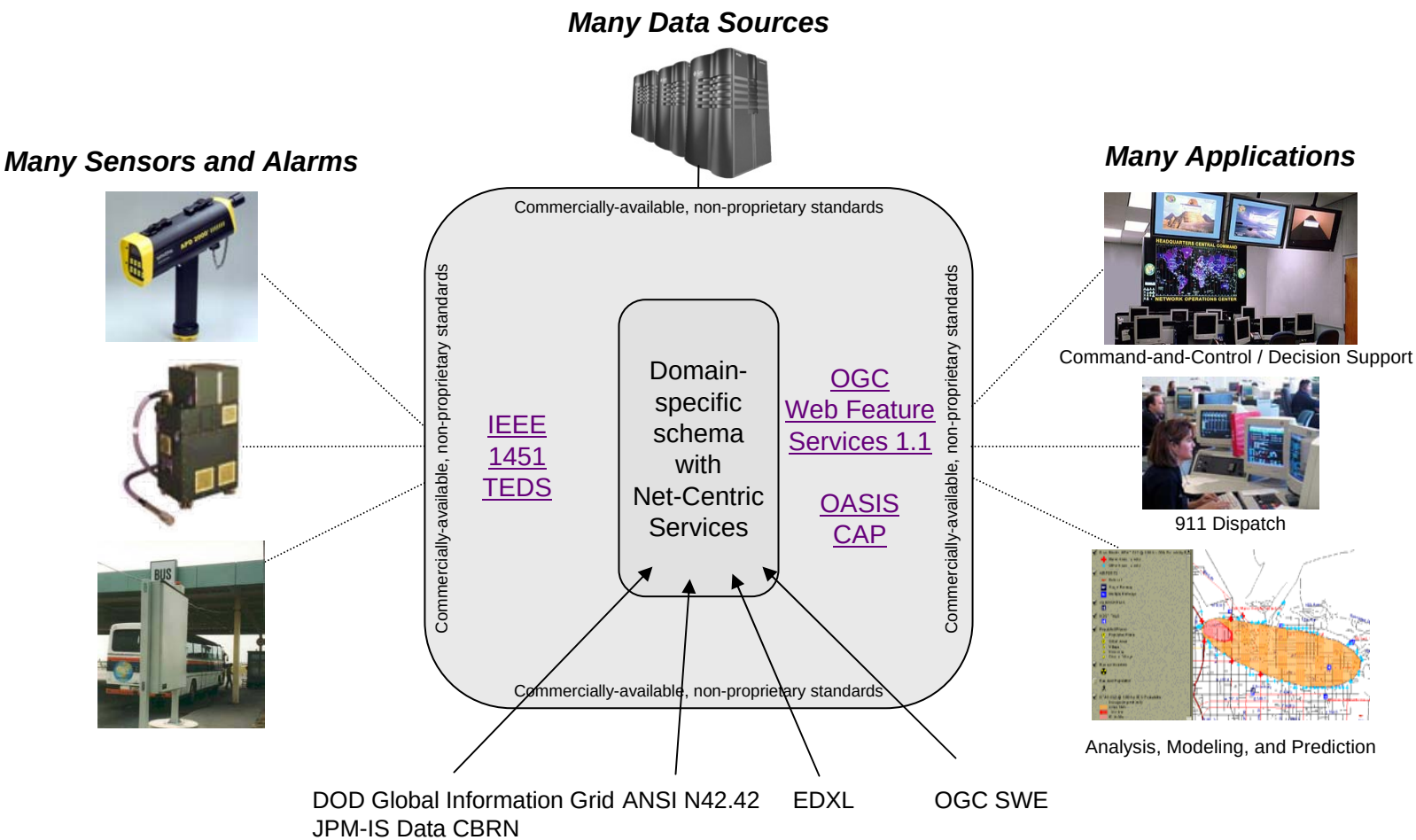
- A 5-year DOE WFO collaboration between Fort Bragg's Directorate of Emergency Services and ORNL, BEST is the primary venue for the integration of the ***SensorNet*** program with a state-of-the-art 911 center to produce the prototype for a standardized ***Integrated Incident Management Center (I2MC).***

- BEST is providing PMO with an ***Automated Personnel Locator System (APLS).***

- BEST is providing Fort Bragg with an ***Automated Visitor Registration System (AVRS)*** for their access control points.

- BEST is providing Fort Bragg with a ***Mass Notification System (MNS)*** and will be trialing an ***Intelligent Video Surveillance System (IVS2).***

ORNL's Net-Centric Framework for a Standardized Architecture To Link CBRN Sensors to a 911 Center



The Bragg Experimental SensorNet Testbed (Years 1-3)

Next Generation 9-1-1 (I2MC)

WorkTrack Overview

As your mobile workforce expands, it becomes increasingly impor
for how long. Unfortunately it also becomes more difficult—until now!

Aligo's WorkTrack is a mobile solution that offers an easy, accurate way to manage the time of y mobile employees, raising productivity and bringing substantial cost savings to your business. And it's all d ugh the GPS-enabled phones they already carry, without any additional hardware or software investments.

Simple to Use

Intuitive, one-button commands are all that's needed to complete time logs, while location tracking occurs automatically, requiring very little employee training. With a single push of a button on a GPS-enabled mobile phone, employees can:

- Instantly record job and time logs
- Alert the central office of their status and availability to take new jobs

Centralized View and Control

Thursday, November 18, 2004

Intergraph dispatches E911 tech to Fort Bragg

BY Aliya Sternstein
Published on Nov. 17, 2004

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Intergraph has won a $2 million contract to develop a data-rich emergency dispatch system for Fort Bragg, N.C.

Company officials have developed E911 systems for numerous cities. In bidding for this contract, awarded by Oak Ridge National Laboratory, Intergraph officials are applying that experience "to the mini-city of Fort Bragg," said Kerry Fehrenbach, the company's executive marketing manager.

The system will pull together information from 911 calls, fire alarms, emergency alerts and predictions of potential incide the same contract, UT-Battelle will manage a network of sensors s chemical, biological, radiological and nuclear hazards. That netw ed th dispatch system.

This fusion of data with un dispatchers complete situa type of problem that has o to respond, Fehrenbach sa

Also, in the event of major alerts via public safety netw

RELATED LINKS

"Urban alert: Tracking harmful gases" [Federal Computer Week, May 3, 2004]

"House passes E911 bill" [FCW.com, Nov. 5,

Automated Visitor Registration System (AVRS)

Fayetteville Online — Local

Published on: Monday, Nov 15, 2004

Print story
Mail story

Bar codes may hold key to who gets on Fort Bragg

By Justin Willett
Staff writer

Fort Bragg is ting a system that extracts information from the drivers' licenses of people going through checkpoin get on post. Those who are flagged by the system will be turned away.

The p egan testing the system Nov. 6. Eventually, proponents say, it will allow officials to check every per no attempts to enter the installation against multiple criminal databases, creating a virtual "walled c eep out unwanted visitors.

ification card readers and laptop computers have en installed at the Chicken Road and Longstreet oad access control points, security officials said.

High-tech checks

Over the next three months, civilian contract security employees at the two gates will swipe the licenses of visitors - and soldiers - through the card readers instead of visually checking them.

he information embedded in the driver's license bar odes will then be compared to Fort Bragg databases hat contain the names of people who have been barred om post and those who have had their on-post driving rivileges suspended.

It takes about five to 10 seconds for the computer to return an "entry granted" message for most people.

People who appear on one of the lists will be turned away.

The goal of the test is to expose the civilian security force to the technology, to see how long it takes to process people through the gates and to see how many people are trying to get on post who are not supposed to.

"We're ensuring only those persons with a legitimate reason enter Fort Bragg," said Fort Bragg's Provost Marshal Lt. Col. Susan Danielsen.

The Chicken Road and Longstreet Road gates were chosen for the test because they see a low volume of traffic.

Staff photo by Stephanie Bruce

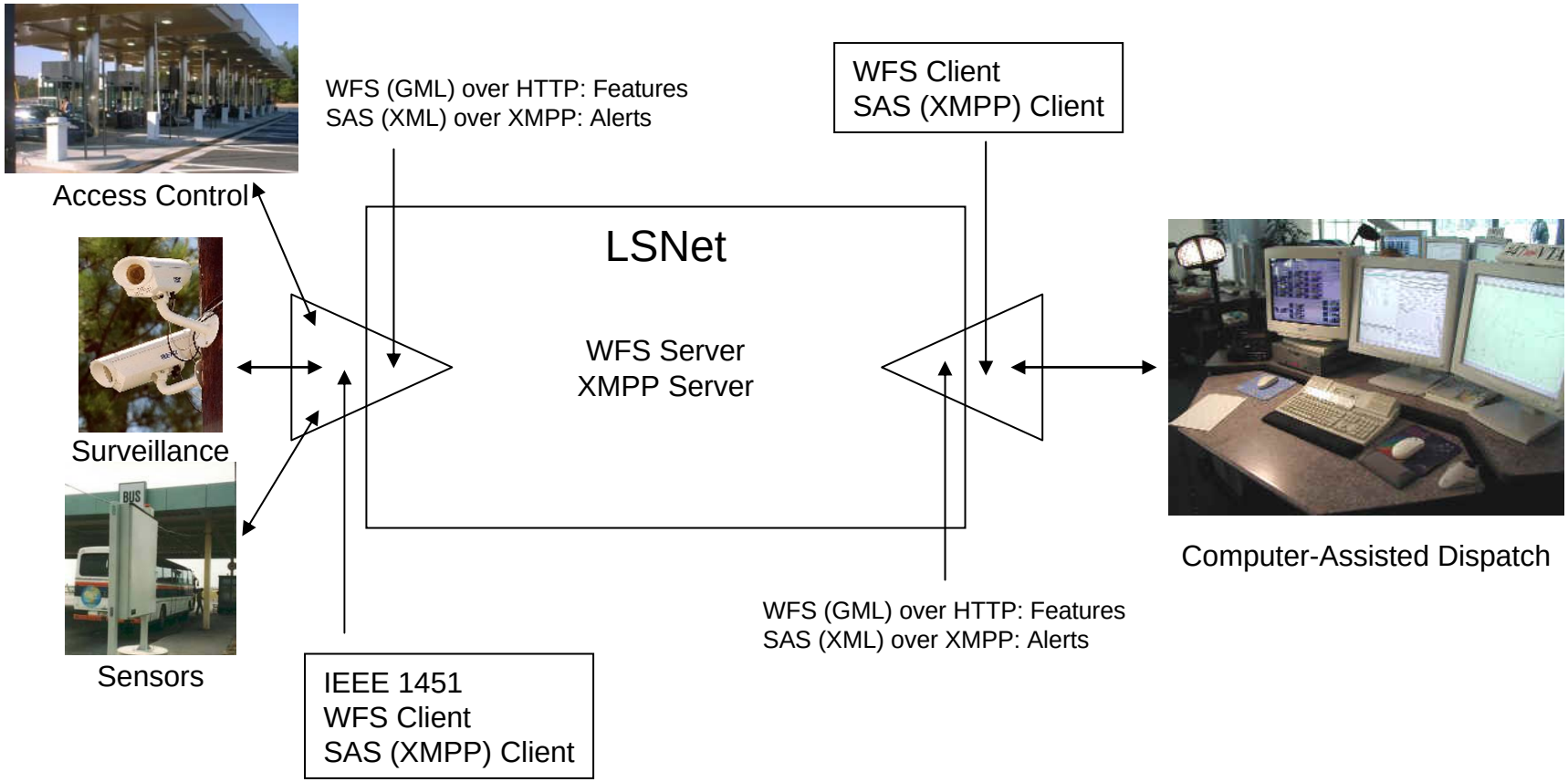
Fort Bragg security officer Jesus Vias swipes a driver's license as the driver watches Nov. 8 at the Longstreet Road access gate on Fort Bragg.

WEEDING OUT UNDESIRABLES

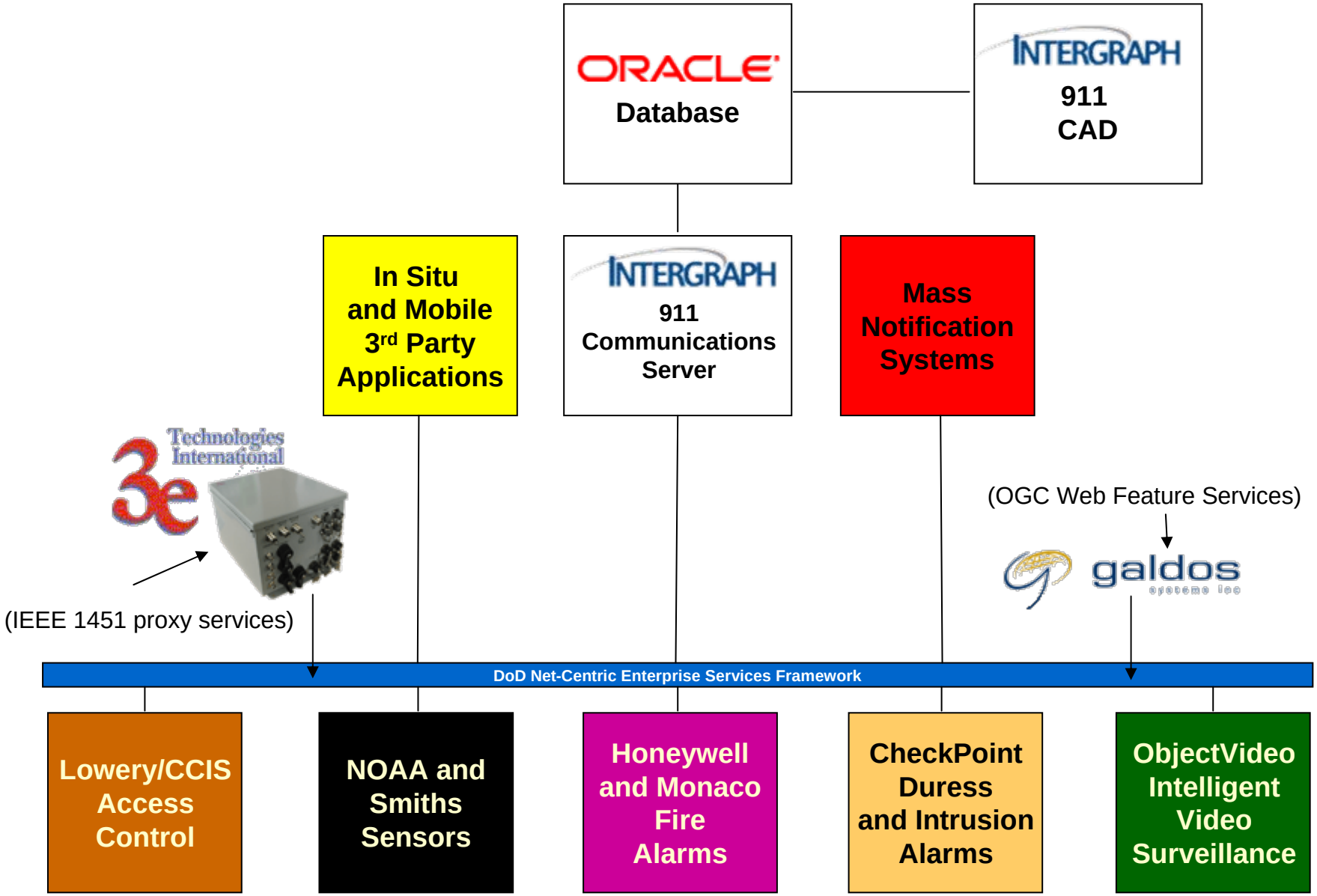
- **Identification-card readers** are at the Chicken Road and Longstreet Road access control points
- **Civilian security workers** swipe drivers' license of visitors and soldiers through the card readers instead of visually checking them
- **The information is compared** against databases that contain the names of people who have been barred from Fort Bragg
- **It takes about five to 10 seconds** for the computer to return an 'entry granted' message for most people

Automated Personnel Locator (APL)

Which Net-Centric Standards is BEST Implementing?



Vendors in the BEST Architectural Framework



SensorNet, redux

- **Data Center built around OGC Web Feature Service (WFS)**
  - **WFS was a mature standard when we began**
  - **SWE was just getting started**
  - **In SensorNet, everything is a "feature"**
    - **Sensor data**
    - **Sensor and node metadata**
      - **Location, ownership, associations**
    - **For now, even alerts are features**
- **IEEE 1451 sensors plug-and-play into nodes**
  - **For now, requires hand-built translation layer**
- **Nodes communicate to Data Center over public internet**
  - **Sometimes CDMA networks (relatively slow)**
  - **SSL security**

SensorNet, continued

- **Routine data is archived in WFS**
  - **SensorNet does data archiving, not just alert dissemination**
  - **Archived data good for data mining, analysis**
- **All features (data) tagged with owner labels**
- **Certificate-based access control based on data ownership**
  - **Access determined at request time based on requestor's credentials**

Will Evolve Toward Newer, Better Standards, when and *if* needed

- **SWE**
  - **Sensor Observation Service (SOS)**
    - **May augment WFS data interfaces**
    - **May even replace WFS in some instances**
    - **SOS is simpler and may be easier to implement than WFS**
      - **I.e., cheaper (lower cost to the government)**
    - **Might be a better choice for pushing "down" the scalable architecture toward local data centers**
  - **Sensor Planning Service (SPS)**
    - **For data center-to-node communication and control**
  - **Sensor Alert Service (SAS)**
    - **Higher performance alert handling**

Sensor Alert Service (SAS)

- **An developing standard**
  - **OGC Interoperability Experiment last summer/fall**
  - **To be discussed at this OGC TC Meeting**
- **Primarily a transport mechanism**
  - **Publish-subscribe paradigm**
  - **Alert sender need not know recipient's address**
  - **Interested recipients subscribe for alerts**
- **Does not compete with CAP and EDXL**
- **Can use CAP at the consumer end**
- **Designed for performance even with low-bandwidth networks**
  - **Based on efficient XMPP standards**
  - **Still XML, but as small a footprint as possible**
  - **Raw alert data formatted as TML**

SAS, cont'd

- **XMPP provides the publish-subscribe paradigm**
  - **Push instead of pull for alerts, no need for polling**
- **TML over XMPP from sensors/nodes to data center**
  - **Very efficient**
- **CAP or EDXL over XMPP to end users**
  - **More verbose, more complete**
- **XMPP is popular (Google Talk) and efficient**
  - **Both well-developed open source and commercial implementations available**
  - **Easy to program to using open-source libraries in a variety of computer languages (Java, perl, C/C++, etc.)**

SensorNet Summary: It works!

- **Standards based**
- **Competing commercial implementations in use**
  - **At least two commercial vendors of WFS**
    - **Galdos and Ionic**
  - **Oracle and Intergraph also building WFS interfaces to data**
- **Will use new standards only if/when needed**
- **Several deployments already in service or planned for near future**
  - **Completed 3 years of 5 year program at Ft. Bragg**
  - **Port of Memphis**
  - **Weigh Stations in three states**
  - **Mobile (deployable) systems**
  - **Military District of Washington**
  - **Port of Charleston**