Large Tactical Sensor Networks
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Industry Brief

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Large Tactical Sensor Networks

Program Objective

Enable Tactical Persistent ISR, Relevant to the War on Terror

1. **Sensor Models**
   - Translate threats to detectable features
   - Translate a specific sensor to its ability to detect relevant features

2. **Smart Sensors**
   - Processing at the sensor node to translate raw data to useful information
   - Indexed distributed data structure that enables sensors nodes to have "context"

3. **Service Oriented Sensor Network**
   - Hardware and software that enable current or planned sensors to transition to a netcentric environment
   - Enable distributed control of persistent ISR assets

Relevant raw data to useful information for tactical situational understanding

Large Tactical Sensor Networks

1. **Fusion**
   – Aggregation algorithms, rules & formulas, pattern definition and analysis, space/time correlation to events
   – Match analytic resources to volume of persistent ISR assets

2. **Automated Tactical Platform & Sensor Planning and Management**
   – Algorithms to control and direct persistent ISR assets
   – Aligned set of multi-INT collection plans
   – Software enabling dynamic sensor management
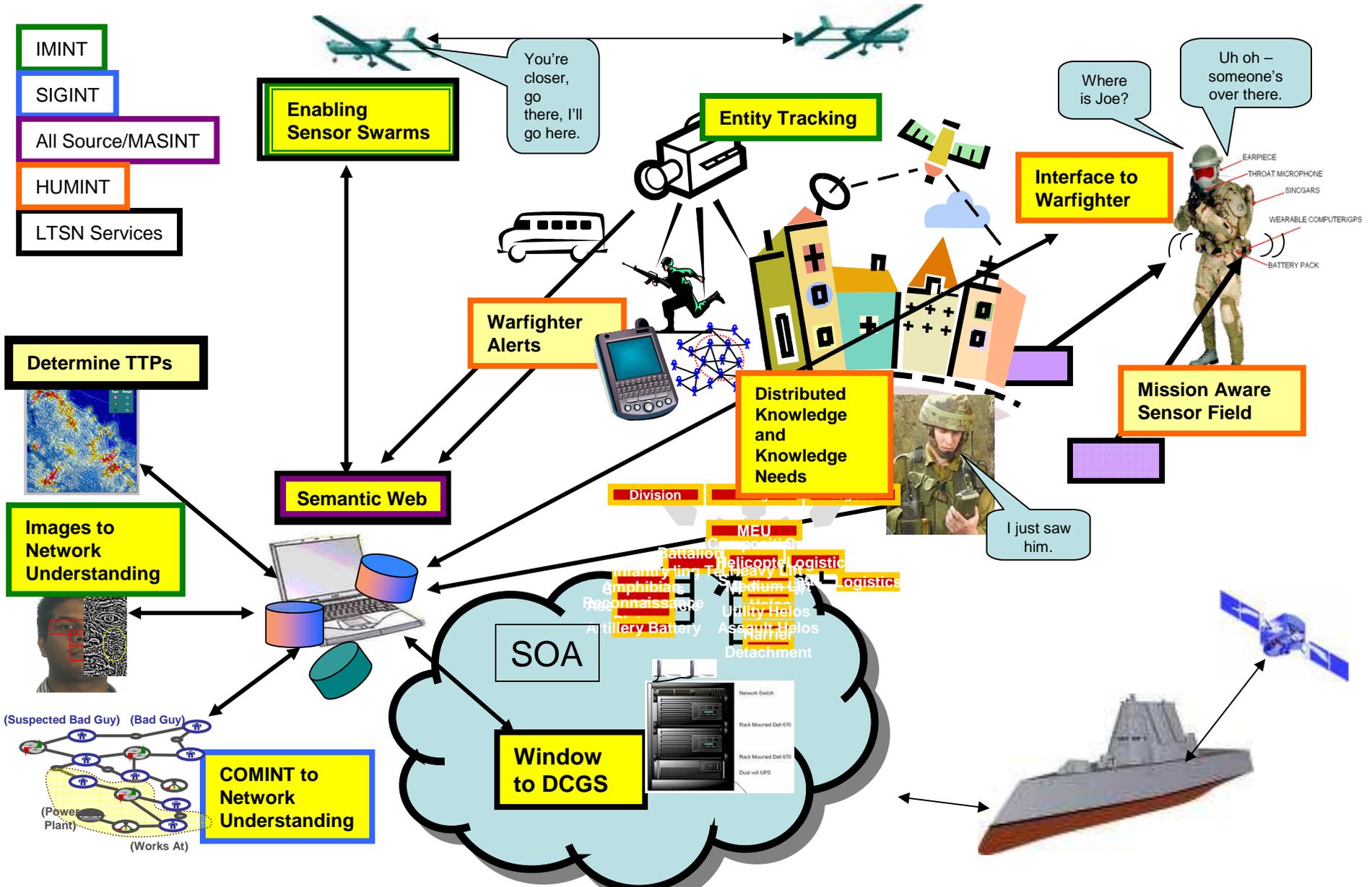
3. **Human to Sensor Field Interface**
   – Alert quick reaction forces
   – Interface between the operator and knowledge repository

4. **Local Tactical Net & DCGS Integration**
   – Smart agents that manage bi-directional flow of data, useful information and knowledge between DCGS and the tactical user

Relevant raw data to useful information for tactical situational understanding

Large Tactical Sensor Networks
Product Integration

ONR — Office of Naval Research — 60 Years 1946-2006
Relevant Research and Results . . .Yesterday, Today, and Tomorrow

IMINT
SIGINT
All Source/MASINT
HUMINT
LTSN Services

Enabling Sensor Swarms

Entity Tracking

Interface to Warfighter

Warfighter Alerts

Determine TTPs

Distributed Knowledge and Knowledge Needs

Mission Aware Sensor Field

Semantic Web

Images to Network Understanding

Division
MEU
Battalion
Helicopter Logistic
Infantry
Combat Service
Medium-Lift
Heavy-Lift
Amphibians
Utility Helos
Reconnaissance
Assault Helos
Artillery Battery
Harrier
Detachment
Logistics

SOA

Window to DCGS

Network Switch
Rack Mounted Dell 670
Rack Mounted Dell 670
Dual volt UPS

(Suspected Bad Guy) (Bad Guy)

COMINT to Network Understanding

(Power Plant)

(Works At)

EARPIECE
THROAT MICROPHONE
SINCGARS
WEARABLE COMPUTER/GPS
BATTERY PACK

You're closer, go there, I'll go here.

Where is Joe?

Uh oh – someone's over there.

I just saw him.

1- Design Tools

- Semantic Web
  - Create an ontology which provides a standard representation that users can query for meaningful information.
  - Create a set of standards, tools and test bed that will demonstrate how a tactical ontology and semantic-based sensor networking can dramatically improve the effectiveness of intelligence resources
- Statistically Determine TTPs
  - Create Statistical-based modeling of features to sensor modalities
  - Model the capability of each defined sensor to acquire detectable features and characteristics
- Distributed Knowledge and Knowledge Needs
  - Tactical Intelligence Ontology Development
    - Ontology for All levels of Command
  - Proof of Concept Tactical Intelligence Community Of Interest

FY07 Work in Progress

2- Smart Algorithms

- **Entity Tracking**
  - Distributed Smart Sensor EO nodes for Wide Area Surveillance
  - Vehicle signature based tracking
  - Matching people to HUMINT descriptions
  - Integrated system for vehicle tracking and forensic analysis combining multiple sensors (GMTI, EO/IR, IMINT and HUMINT)
- **Images to Network Understanding**
  - Dynamic face recognition watch list
    - Best shot Facial Recognition from video
  - Detect suspicious aggregate population or individual activity and provide warnings
  - SNA for terrorist/insurgent networks, identify key individuals in the organization, and analyze the organizational dynamics based on Video-INT

FY07 Work in Progress

3- SOA and 7- Tactical Network/DCGS Integration

- ## Service Oriented Architecture
  - Service Oriented Architecture (SOA) for LTSN, based on the DCGS Integration Backbone (DIB)
  - Disadvantaged User Interface
  - Create Software developers toolkit for interfacing to the SOA software framework
  - Sensor visibility

- ## Link to DCGS-MC
  - Adapt to small tactical unit environments with metadata catalogs at three simulated PoR sensor interfaces

FY07 Work in Progress

4- Tactical, Distributed Data Analysis and Automated I&W

- COMINT to Network Understanding
  - Detect aggregates from COMINT datasets
  - Analyze and propagate suspicion at the entity and aggregate level
  - Analyze aggregate evolution over time
  - Develop pattern analysis and event correlation tool
- Warfighter Alerts
  - Multi-INT Fusion for Detection of Enemy Activities and Threat Networks (Probabilistic Approach)
    - Sensors: Radar GMTI, EO/IR Video, SIGINT, Wide Area EO, SAR, HSI Imagery, Lidar Scans, HUMINT

FY07 Work in Progress

5- Automated Tactical Platform & Sensor Planning and Management

- Enabling Sensor Swarms
  - Optimization algorithms and collaborative control protocols for allocation of tasks to UAVs
  - Various Airborne platforms with various sensor modalities: lidar, near infra-red, or thermal infra-red
  - Geographically Distributed Users with different priority rights on different platforms
  - Allow for sensor fusion for multiple intelligence sources (Multi-INT)

FY07 Work in Progress

6- Human to Sensor Field Interface

- **Interface to Warfighter**
  - o HUMINT via Spoken Interface, Alerting Agents
  - o Structuring of HUMINT Reports
  - o Develop System Architecture, Interaction Paradigms, User Interface Mock-ups and specs for Tactical Users
  - o Cognitive Task Analysis, Workflows
- **Mission Aware Sensor Field**
  - o Real-time, context dependant situational awareness for the warfighter
  - o Mission-based I&W to warfighter
    - o Investigate methodology for delivery
      - o Vibro-tactile, speech, etc
    - o Create methods for push of I&W
  - o CLENS as demo sensor

FY07 Work in Progress

LTSN BAA Refresh 2008 – Key Areas

1. **Smart Sensor Algorithms**

    Processing at the Sensor Node for better Situational Awareness and to lower bandwidth needs

2. **Multi-INT Sensor Data Preparation for Network Understanding**

    Provide space/time correlated information about entities and entity associations.
    - Biometrics – fingerprints, iris scans, photos, etc.
    - Wide Area Surveillance – videos, images, GMTI, etc.
    - Unstructured Text – Open source information, HUMINT
    - Acoustics – conversations, vehicle signatures, background noise etc.
    - COMINT – communications

3. **Level One Data Fusion for Entities**

    Calculate the ontological distance between disparate data points and entities

4. **Automated Collection Planning Tool**

    Adaptive Placement of Sensors based on Dynamic Mission Needs

5. **Cultural Awareness at the Tactical Level**

    Prepare cultural information for entry into the common distributed data structure to shape Indications and Warnings (I&W)