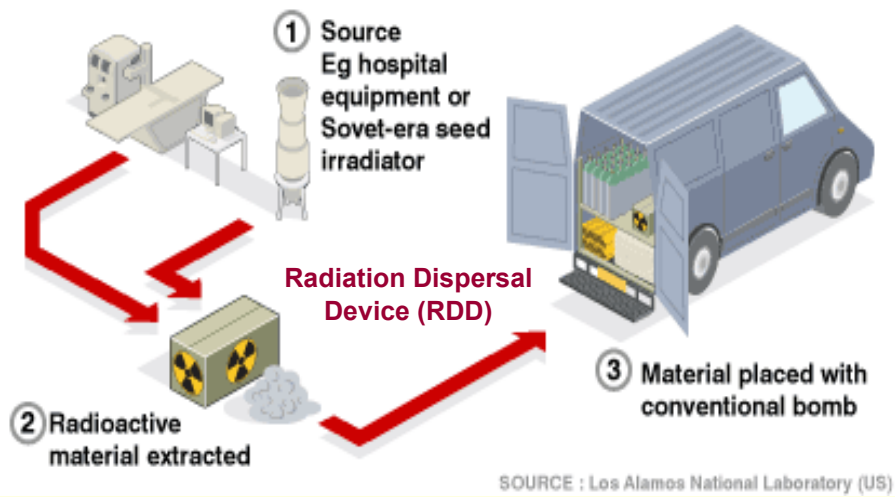
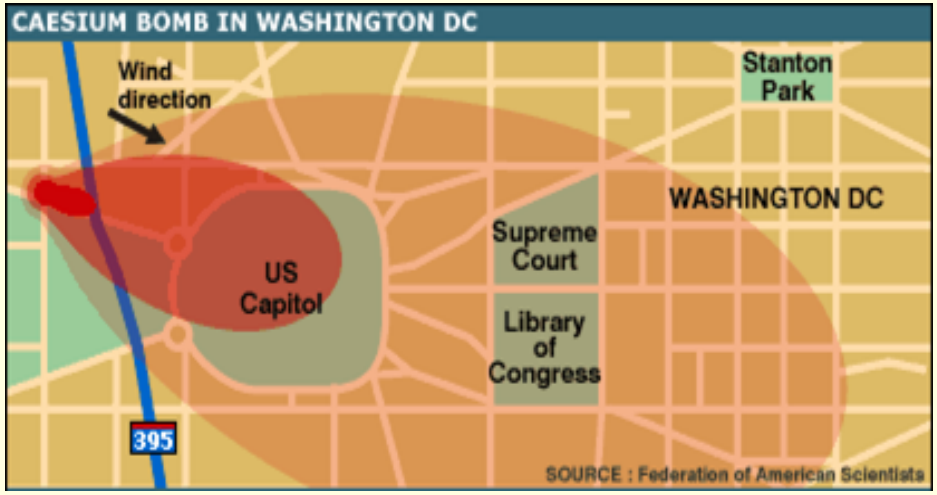
Using Smart Threads to Interdict Radioactive Materials

C. D. Hull[1], R. Seymour[1], S. Pauly[1], A. Proctor[1], LTC M. Johns[2], MAJ S. Frederiksen[2], J. Tumminello[1], L. Sideropoulos[1]

[1] Nucsafe Inc., 765 Emory Valley Road, Oak Ridge, Tennessee 37830

[2] DTRA, Nuclear Technologies Division, 8725 John J. Kingman Road, Stop 6201, Ft. Belvoir, VA 22060





Nucsafe

Presentation Overview

- Definitions & Goals
- Smart Threads Components – Platform Architecture
- Smart Threads Integrated Radiation Sensors (STIRS)
- Components and Examples of ‘Scale-ability’
- Communications and Reach-back
- Synopsis
- Questions & Discussion

Uranium Yellowcake

Nucsafe

Definitions & Goals

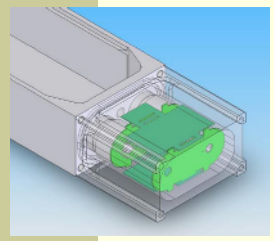
Definitions

- Smart Threads is a modular architecture for Chemical, Biological, Radiological, and Nuclear (CBRN) detectors
- Smart Threads is a dynamic, easily expandable, self-configuring platform
- Smart Threads Integrated Radiation Sensors (STIRS) used for radiation measurements are described

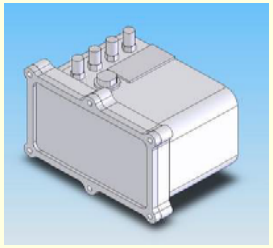
Goals – Goals of the STIRS platform are to enhance both deterrent and inconspicuous detection capabilities for SNM and radiological materials.

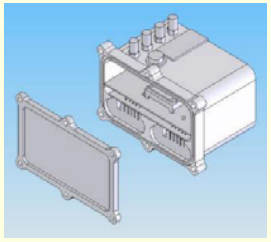
Smart Threads Components

- **Hardware** – Two main hardware components
  - Smart Sensors. Each Smart Sensor contains:



    - Radiation detector – gamma-ray, neutron, *etc.*
    - HV supply, signal processing electronics, microprocessor
  - Smart Sensor Aggregator (SSA)
    - Aggregates Smart Sensor data – RS485 bus polls sensors
    - Microprocessor – Evaluates alarm conditions
    - Transmits data *via* Ethernet or wireless protocols
    - Includes GPS, Bluetooth, and 802.11b wireless communications modules
    - Other components as needed

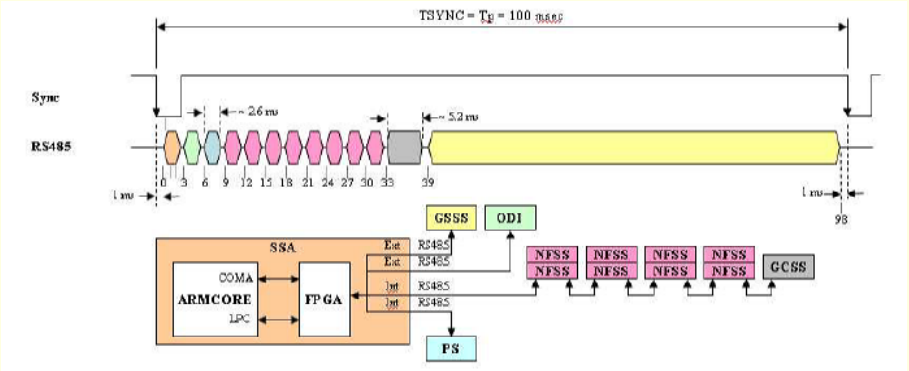




Nucsafe

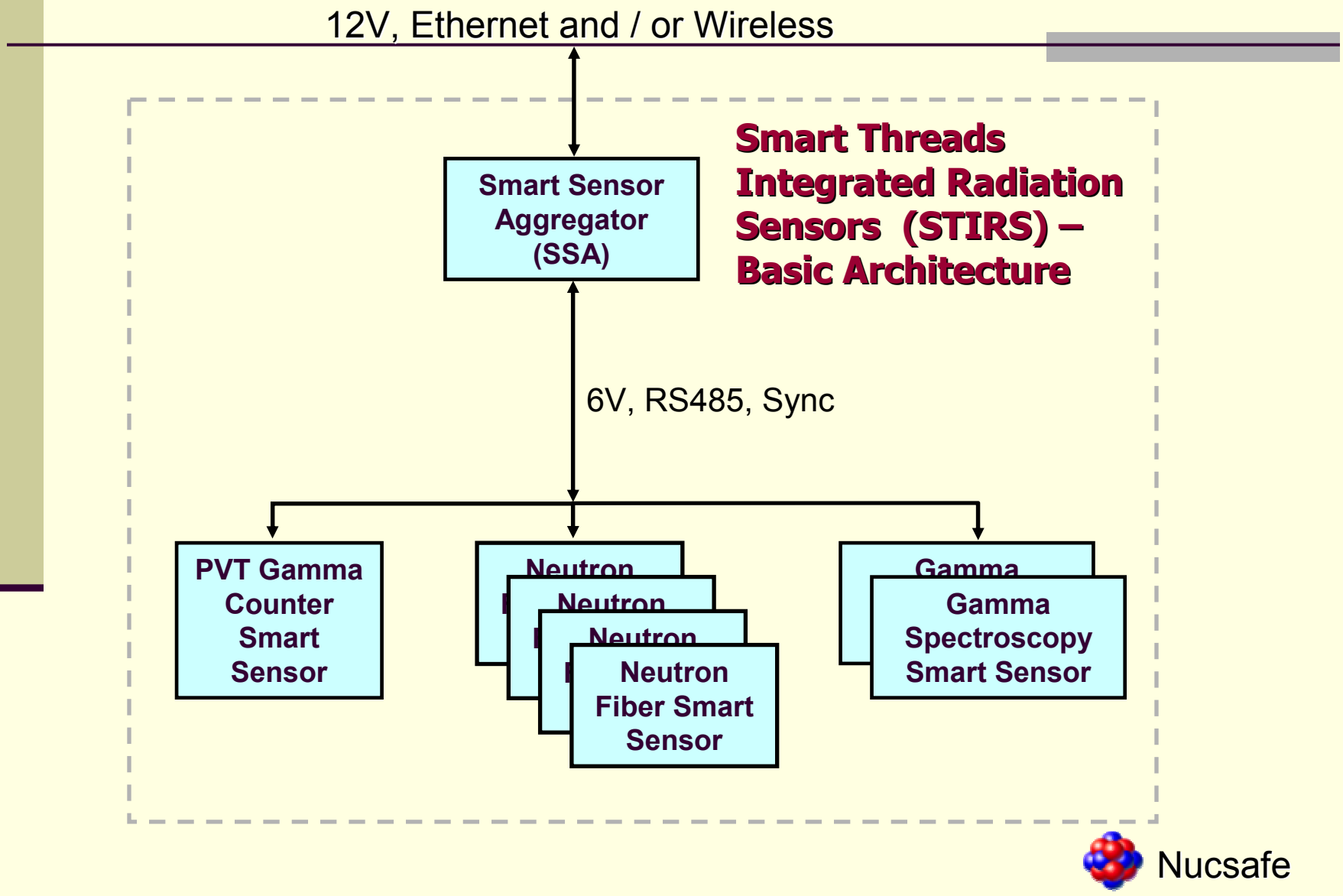
Smart Threads Components *(cont'd.)*

- **Firmware:**
  - Common protocol and interconnection concept
  - Modular platform for all types of CBRN detectors
  - Data processing within each Smart Sensor
    - Radiation Smart Sensors report 'counts' *per* time
    - Perform statistical calculations
    - Processing sets the bandwidth on the RS485 comm bus
    - Sensor 'State-of-Health' parameters tracked



Nucsafe

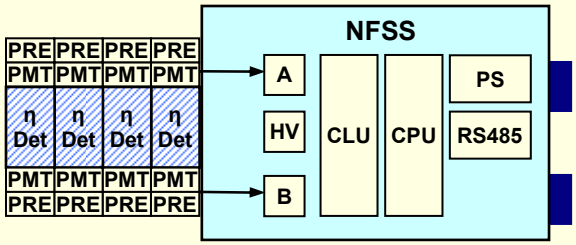
STIRS – Basic Platform Architecture

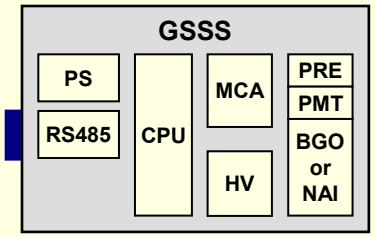


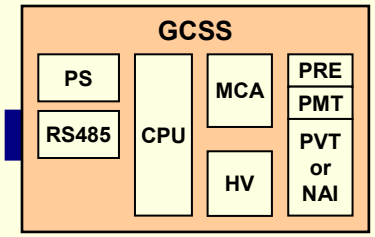
Nucsafe

STIRS Platform Architecture

Modular Configurations for Specific Missions

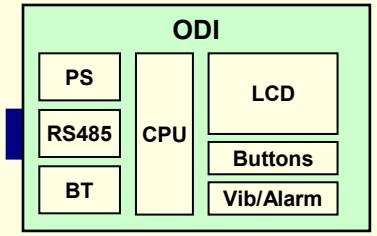


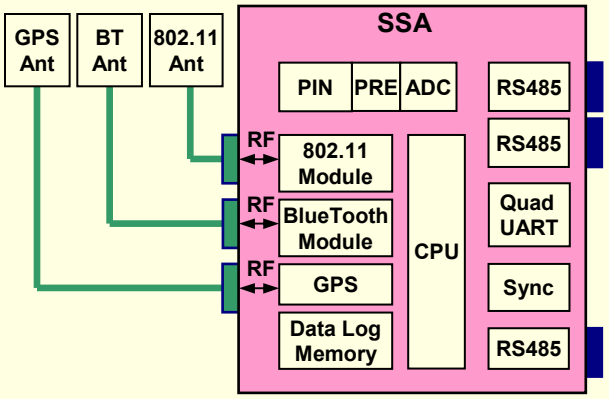


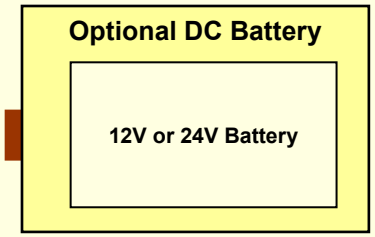


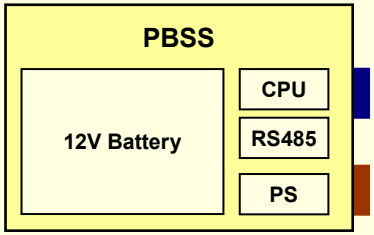
Smart Sensors

- A modular architecture for portable, transportable, and large STIRS systems.
- Utilize 'standard' building blocks; *e.g.,*
  - Power – Line or Battery
  - HV Supply
- Communications protocols are standardized
  - Ethernet
  - Wireless protocols



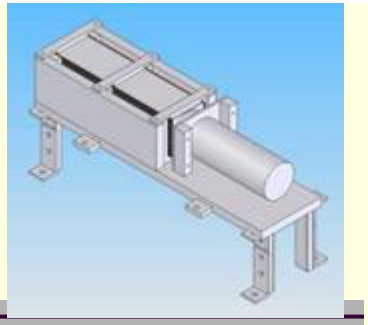


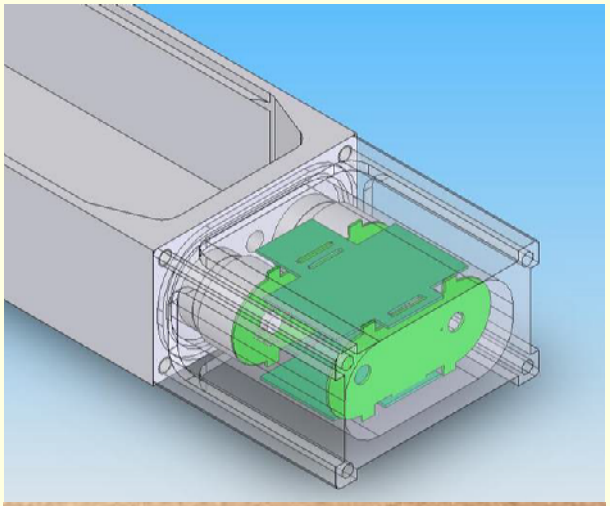


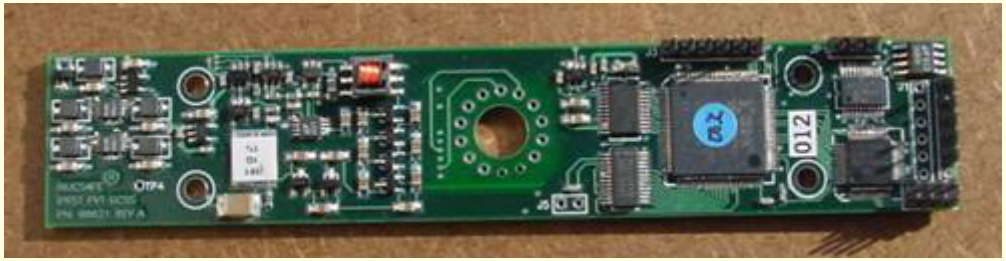


Nucsafe

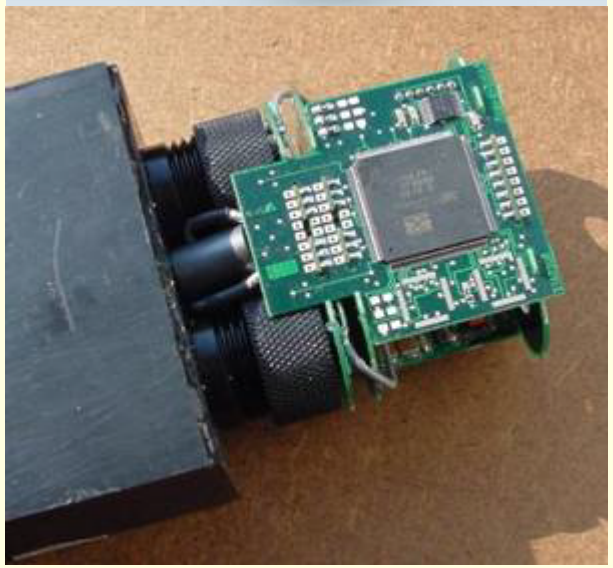
Hardware
STIRS Smart Sensors



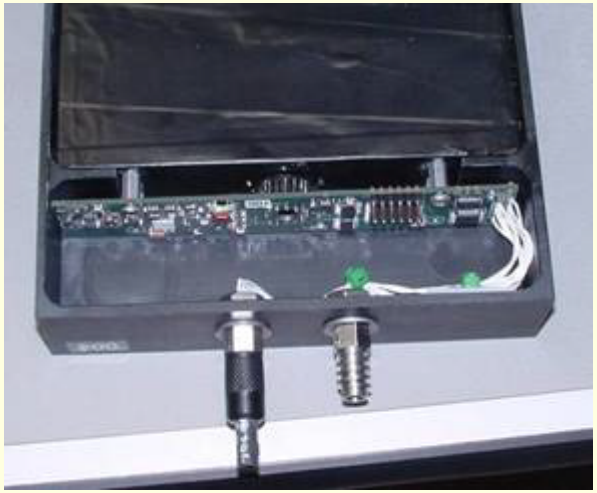




Each STIRS Smart Sensor contains a radiation detector, HV supply, signal processing electronics, and microprocessor(s)



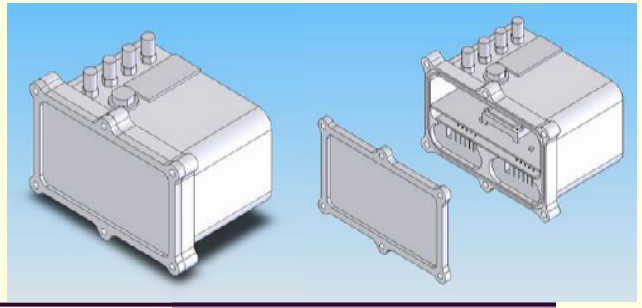
^{6}Li Silicate Fiber Neutron Smart Sensor



PVT Gamma Ray Smart Sensor

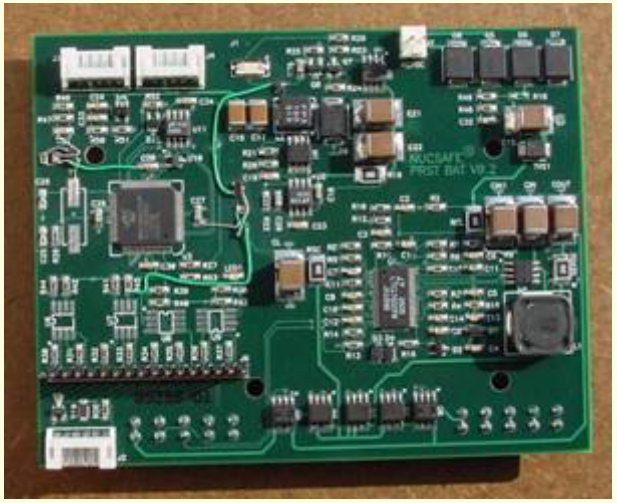
Nucsafe

Hardware
Smart Sensor Aggregator (SSA)



- SSA and Power Supply Module
  - Collects data packets from sensors
  - Calculates alarm information
  - Drives packets to the Operator Display
  - Integrates GPS, BlueTooth, 802.11b modules
  - Power Supply reports status of batteries to SSA
  - Power Supply recharges batteries

Smart Sensor Aggregator (SSA) Board

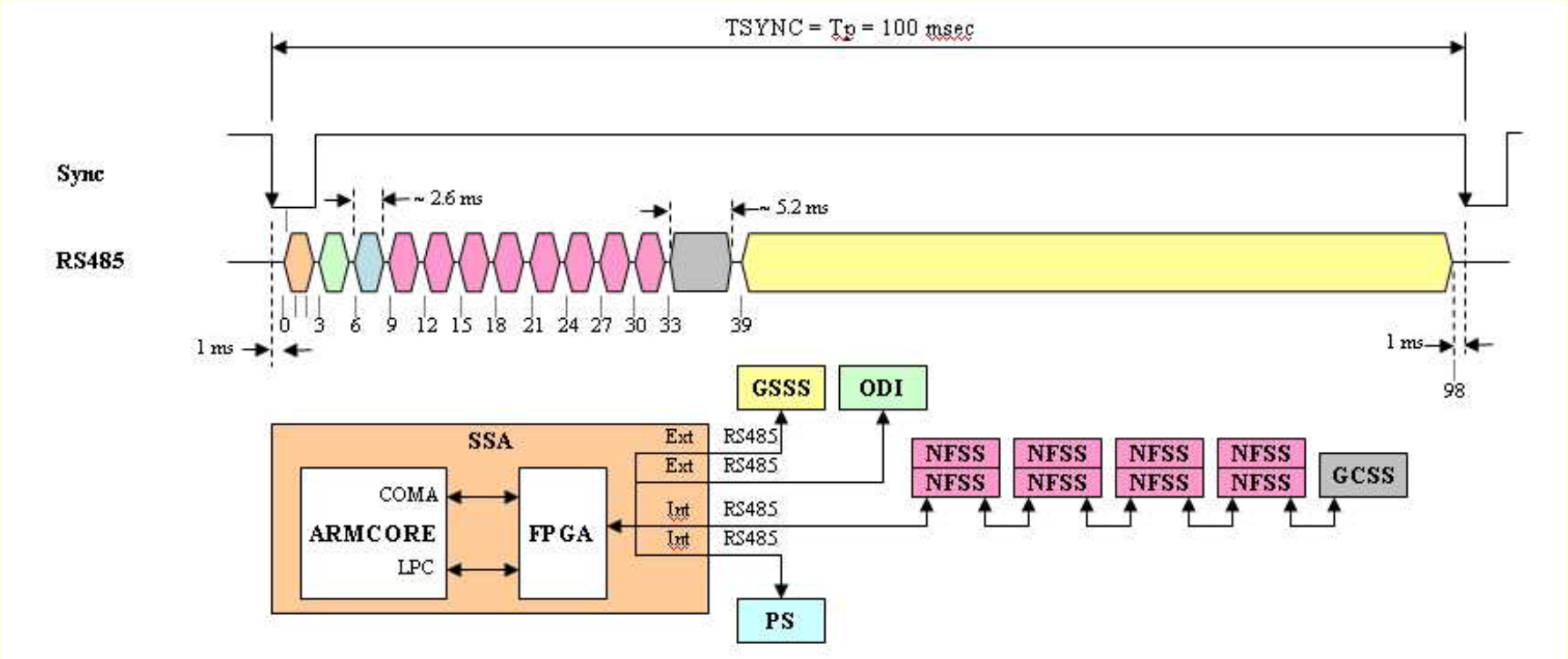


Power Supply and Power Conditioning Board

Nucsafe

Hardware / Firmware
STIRS Smart Sensors – RS485 System Bus

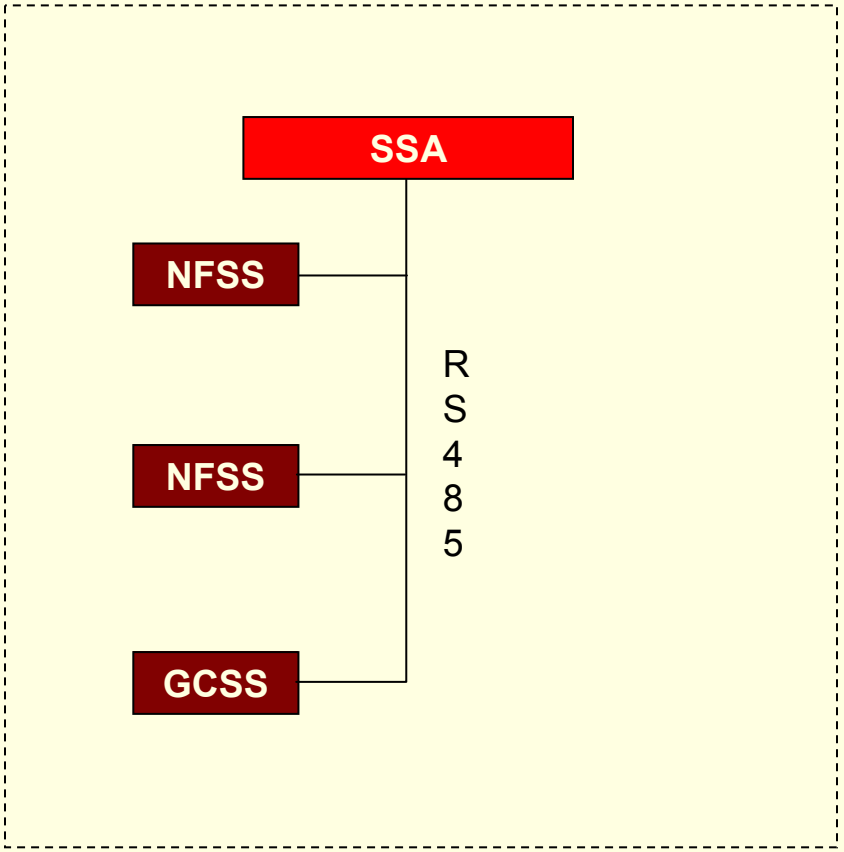
Smart Sensor RS485 Communications and Data Packet Concept



Nucsafe

STIRS - Example 1
Portable Radiation Search Tools (PRST)

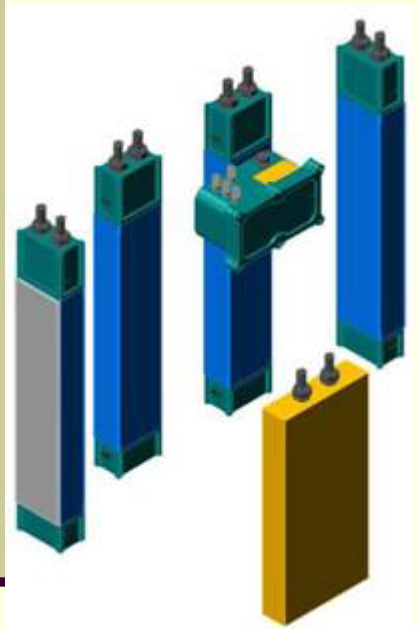
- Using any permutation of Smart Sensors, connected to a Smart Sensor Aggregator (SSA), any STIRS system can be easily configured.
- Example – Portable Radiation Search Tools (PRST)

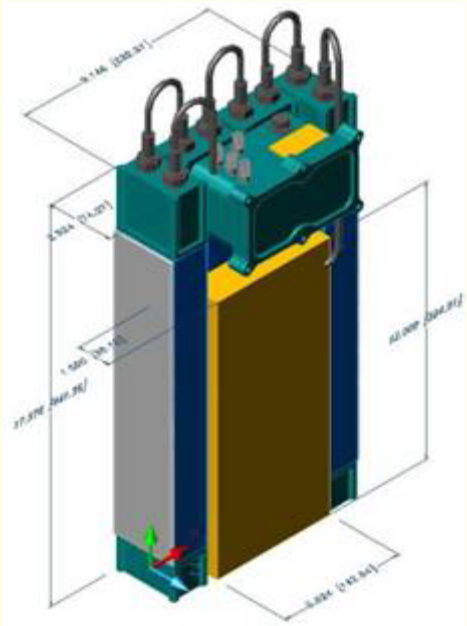


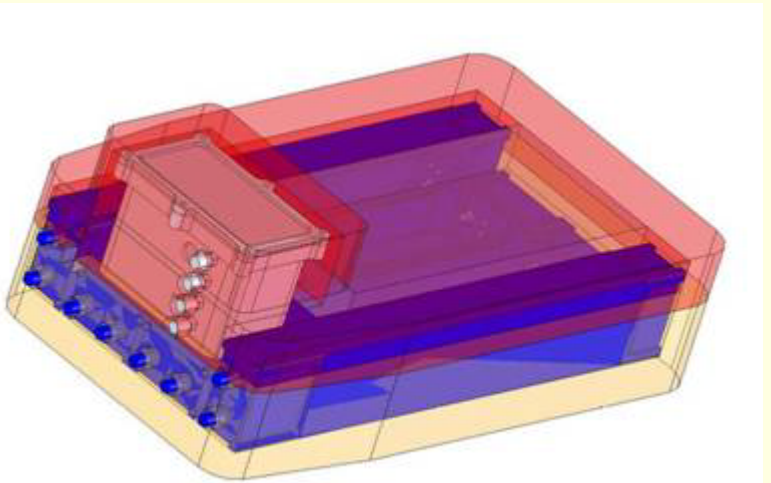
Nucsafe

PRST Systems
Backpacks, Vests, Briefcases

- NucSafe PRST Models





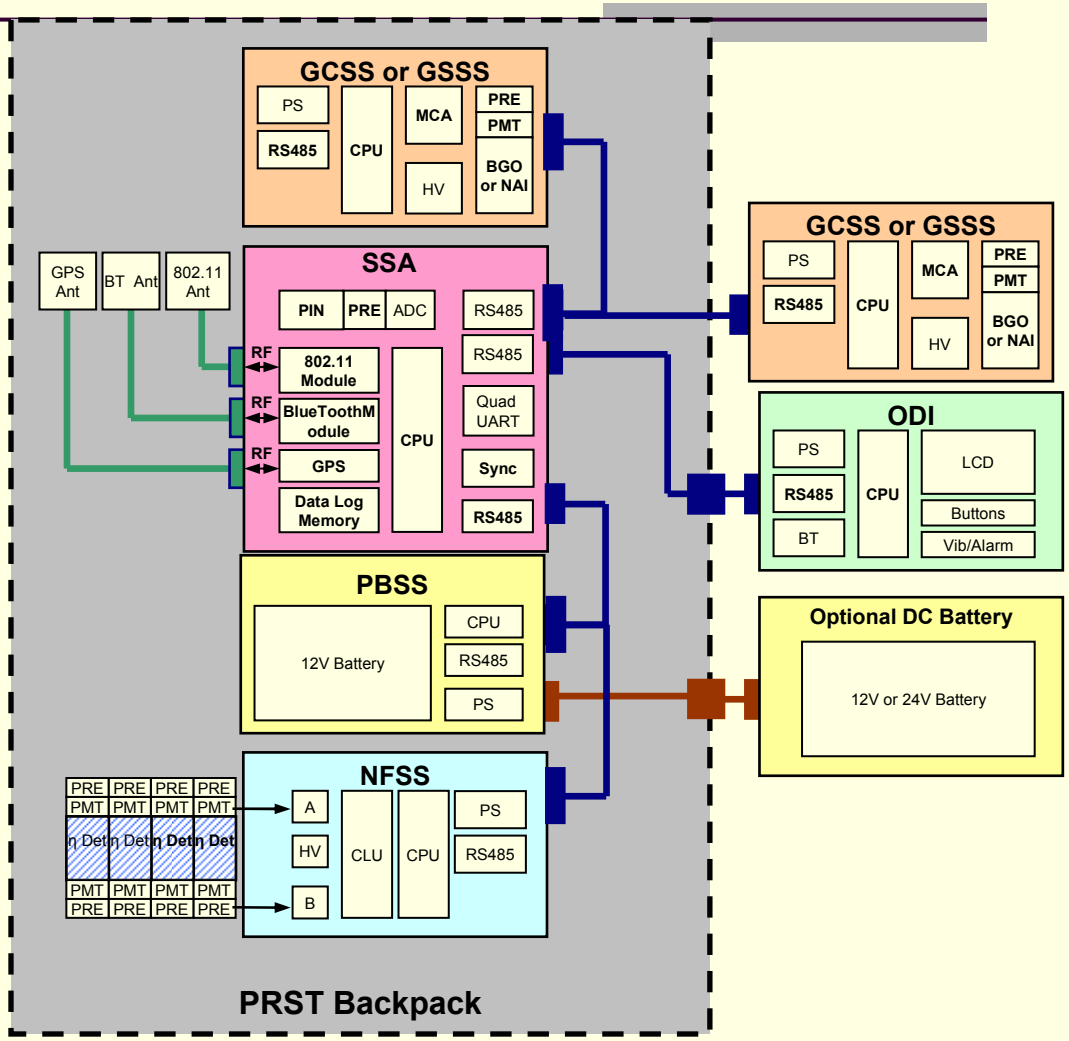


Orthographic Projection – DTRA 3G PRST

Nucsafe

Example of 'Build Your Own' PRST (Portable Radiation Search Tool)

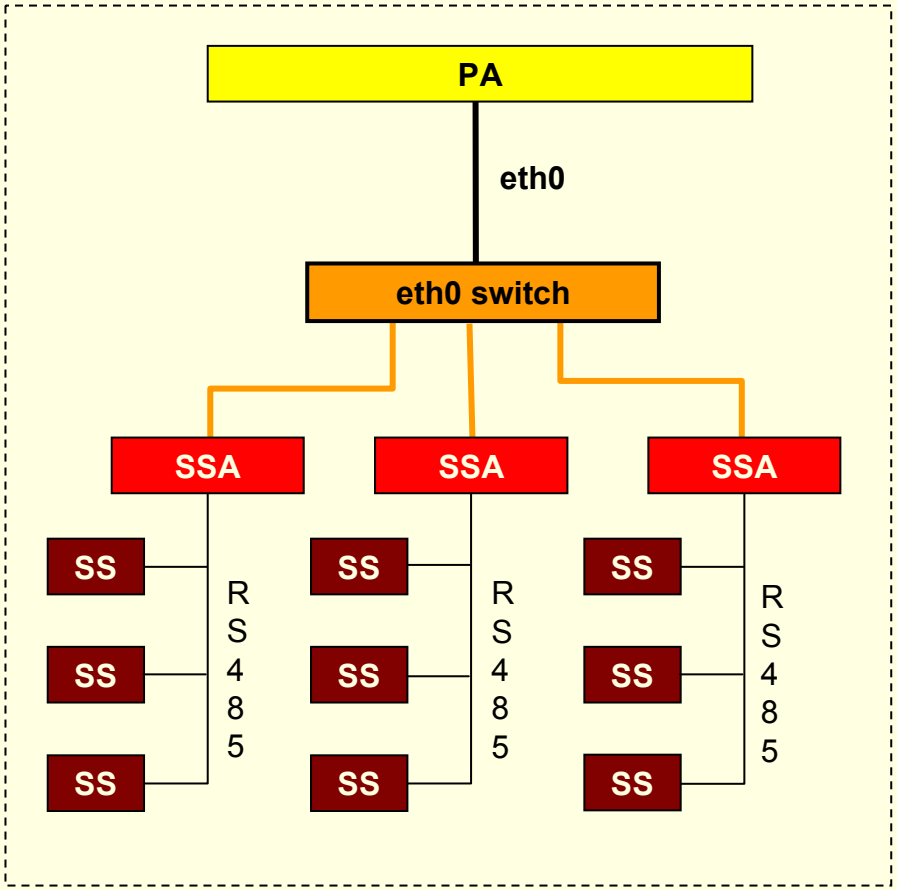
- Radiation Threat – Need a mission specific Portable Radiation Search Tool
  - Select STIRS Smart Sensors for mission
  - Connect to Smart Sensor Aggregator (SSA)
  - Configure for Deployment
  - Architecture allows:
    - Choice of CBRN Detectors
    - Operator Display
    - Add-on functions
    - Multiple Wireless Protocols
    - External battery



Nucsafe

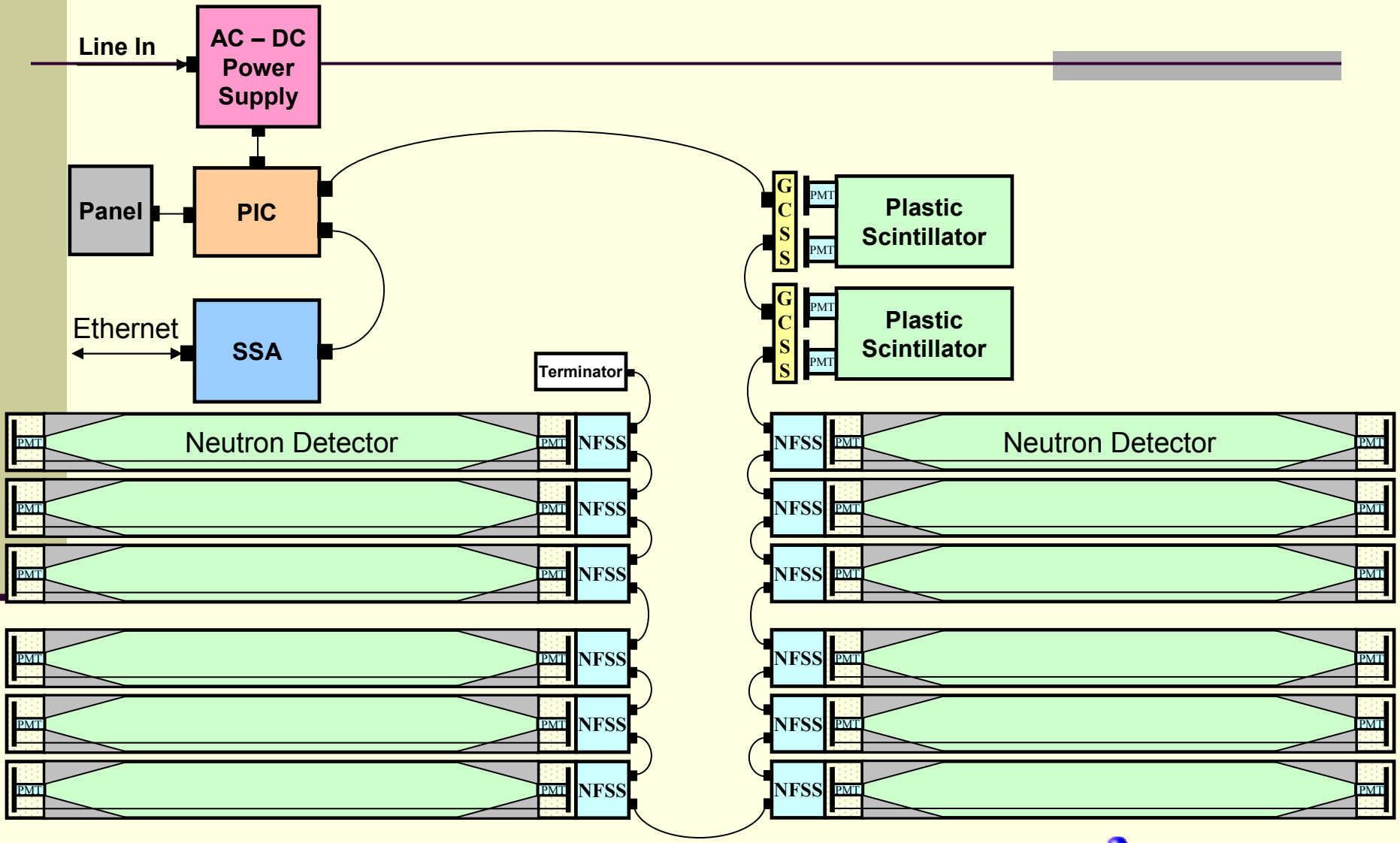
STIRS Example 2
Mobile System Schematic

- Larger and/or more numerous STIRS Smart Sensor components can be easily configured
- By use of an Ethernet switch, systems like SPARTAN can be configured.



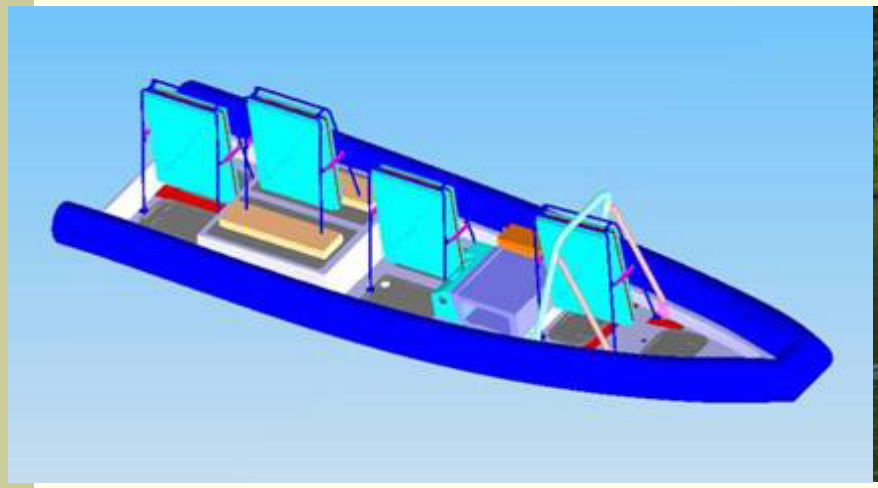
Nucsafe

Mobile STIRS Example – SPARTAN USV



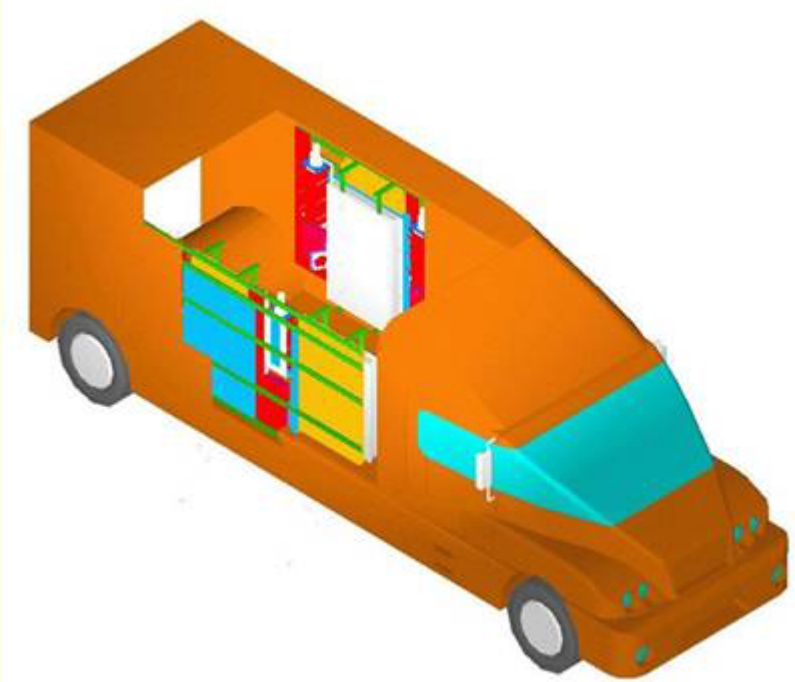
Nucsafe

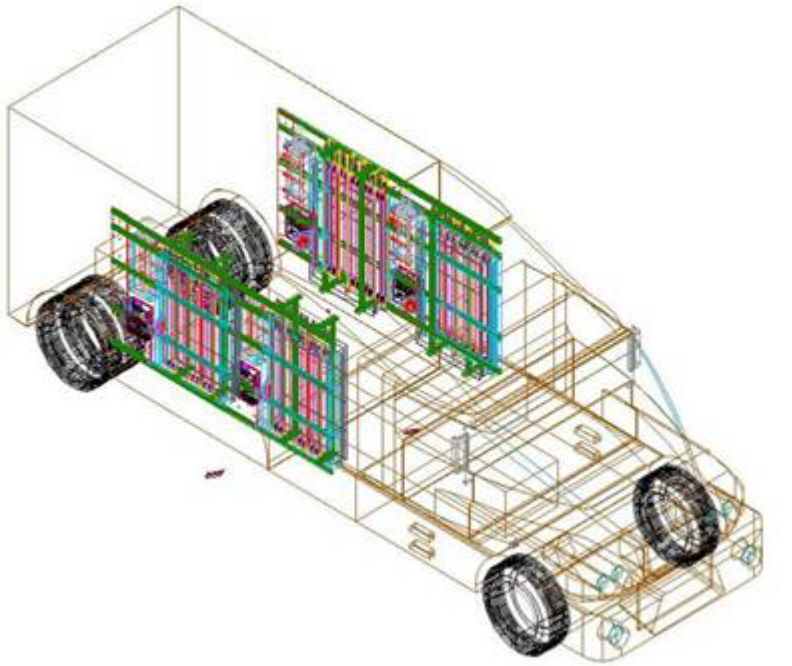
SPARTAN Mobile System - USV



Nucsafe

Van Mounted Mobile STIRS System





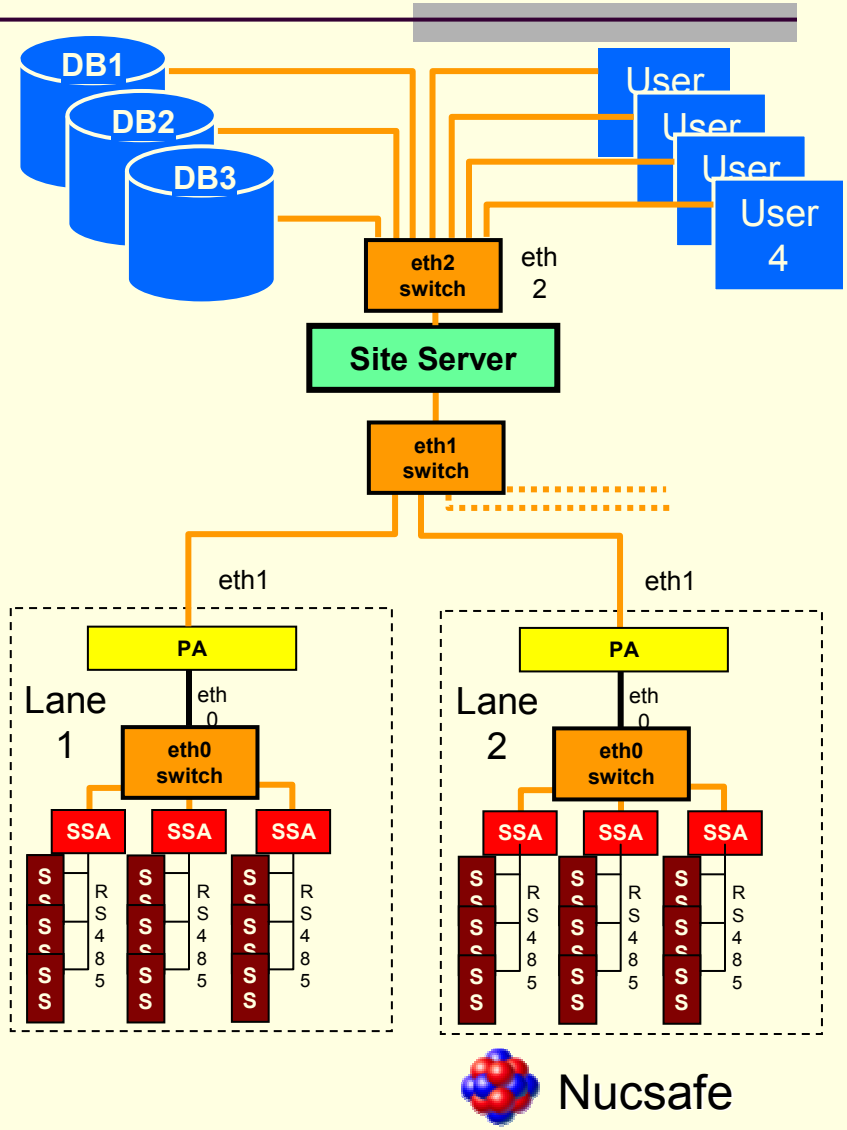
Van, SUV, and Patrol Cruiser
Mobile Systems

Nucsafe

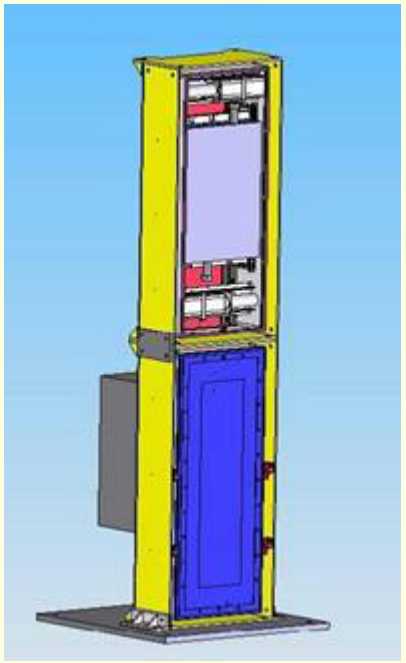
STIRS Example 3

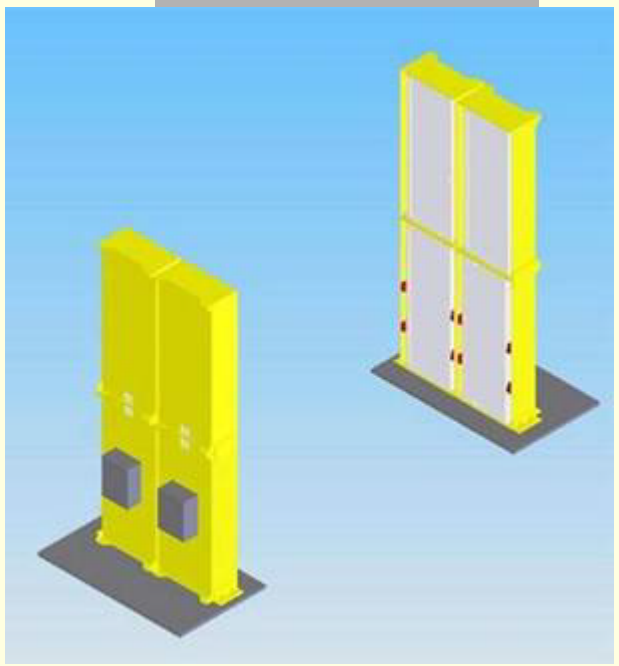
Multi-lane Vehicle Portal Radiation Monitors

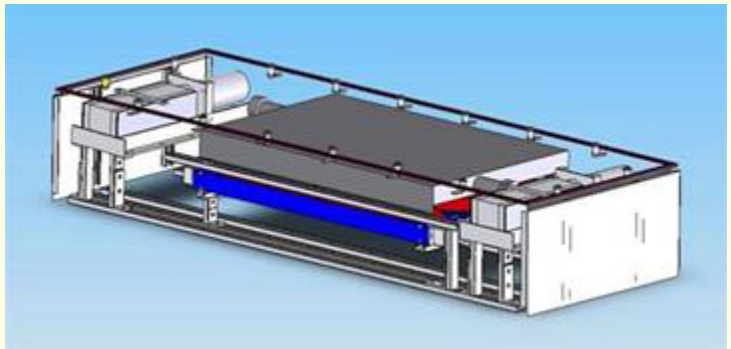
- More complex systems are assembled by connecting groups of STIRS ‘panels’
- Panels are connected to a ‘Panel Aggregator’ computer that monitors a fully integrated STIRS system.
- Multiple STIRS systems may be linked *via* Site Servers – data is made available to multiple users and stored to databases as desired.

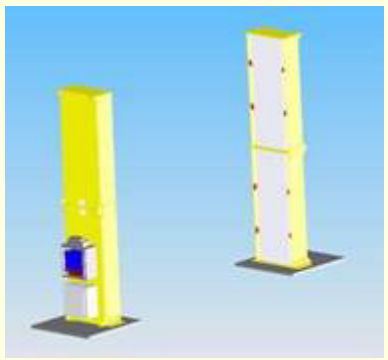


Radiation Portal Monitoring Systems



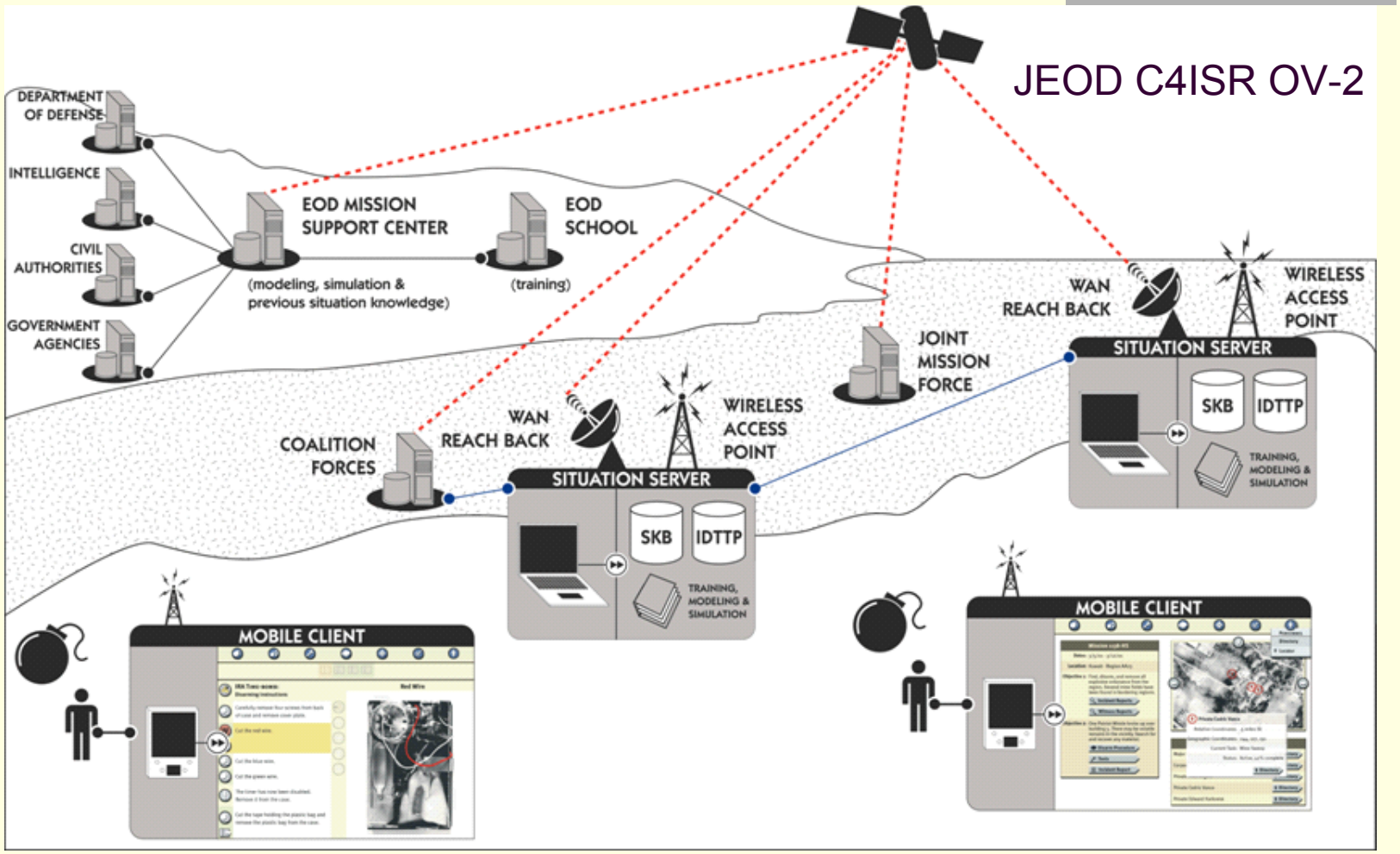






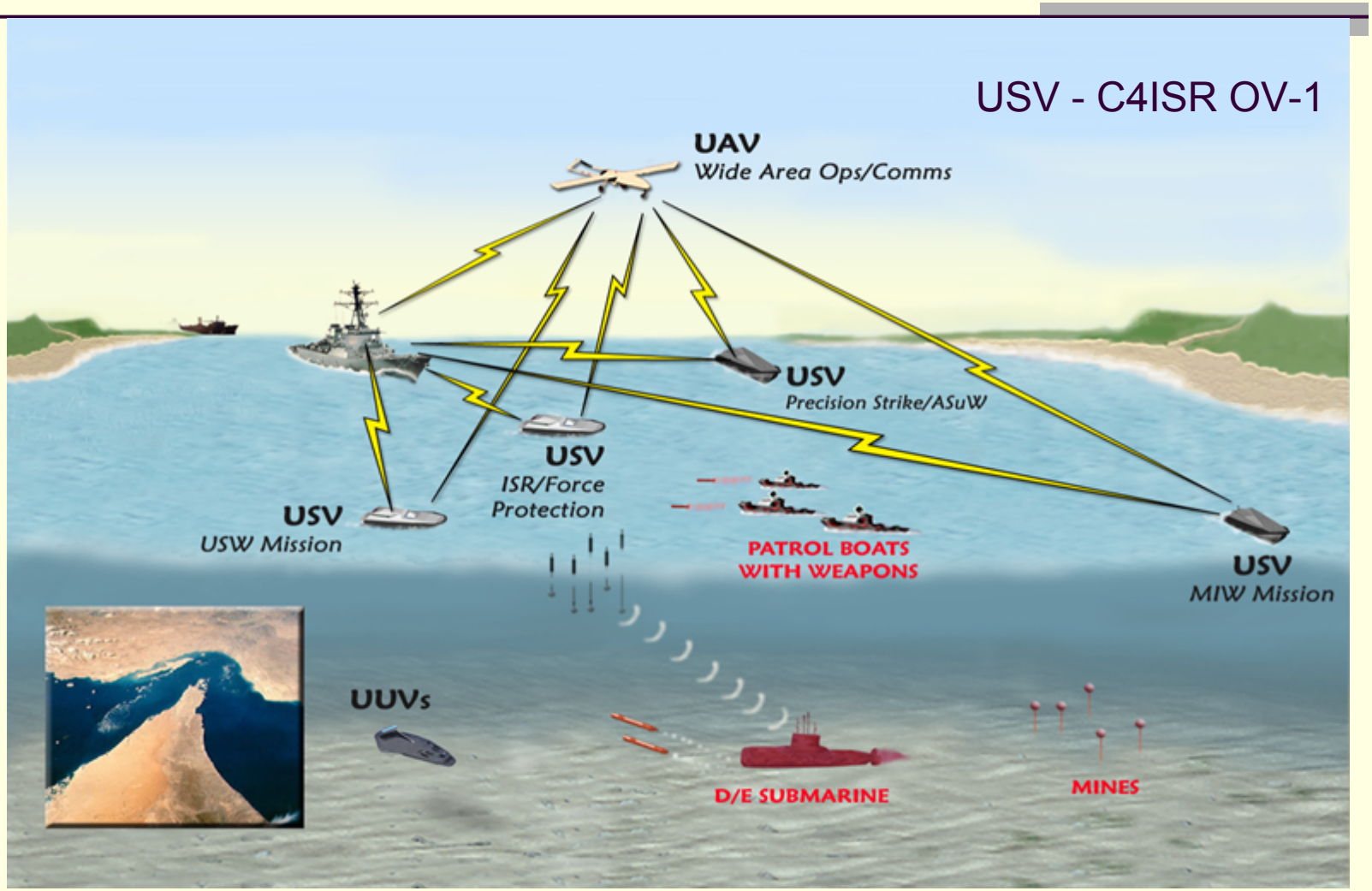
Nucsafe

Communications and Reach-back



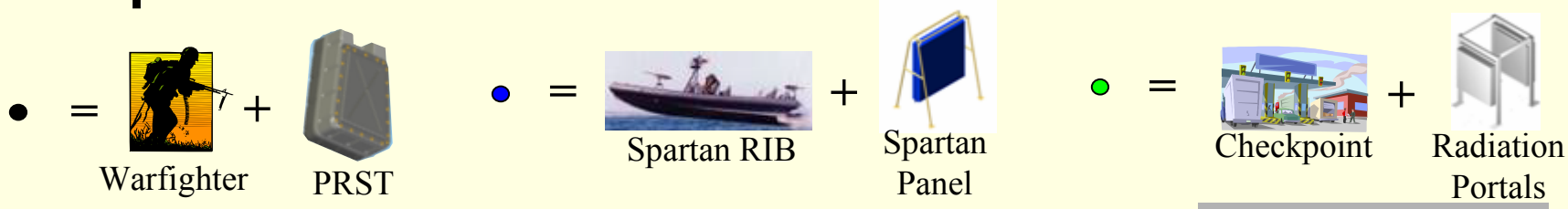
Nucsafe

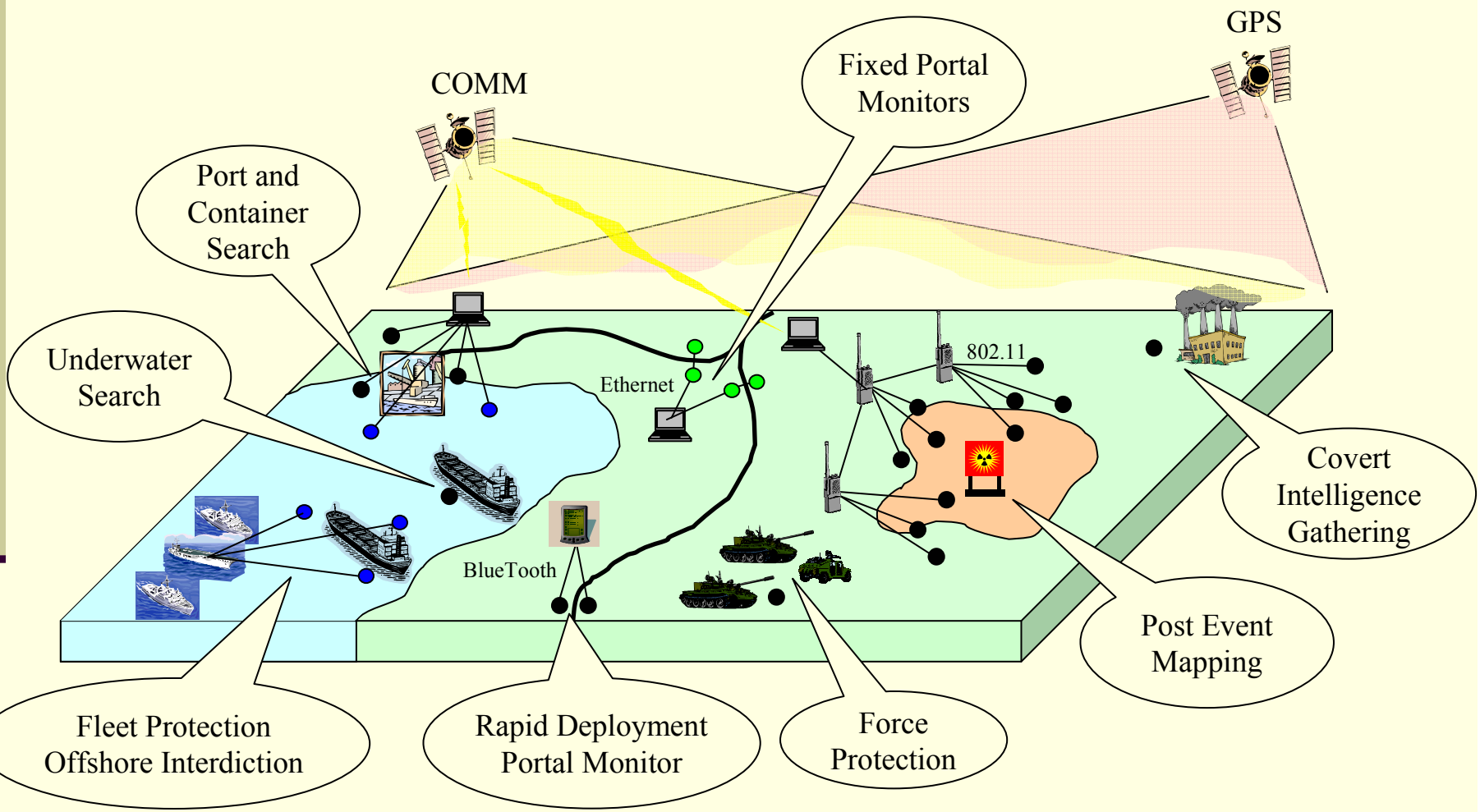
Communications and Reach-back



Nucsafe

Operational View C4ISR OV-1 - Nucsafe STIRS





Nucsafe

Synopsis

- Smart Threads is a modular architecture for CBRN detector systems
  - Self-configuring platform
  - Dynamic
  - Easily expandable
  - ‘Scaleable’ – Portable to Very Large Systems
- Smart Threads Integrated Radiation Sensors (STIRS) were discussed in this presentation
- Smart Threads can include numerous CBRN sensor systems

Questions & Discussion, Acknowledgments

NTS April 1953
'Badger'
300 Foot Tower
23 Kilotons

Threat Analog:

IND on Elevated
Floor of High Rise

Funding for the majority of this research has been provided by the U. S. Defense Threat Reduction Agency (DTRA), DoD, Contracts HDTRA01-04-C-0008 and HDTRA-05-D-0004.

Nucsafe