Operating As Part of An Interconnected Eco-System

Collect & Transmit (Magnetic or MICS band) devices

Medical practices

Hospitals

Exfiltrate

Insurance companies

Control & disrupt

Implanted devices

Doctors & Nurses

Doctors & Nurses

Infusion pumps & dispensers

Probes & monitors

Advanced scanners
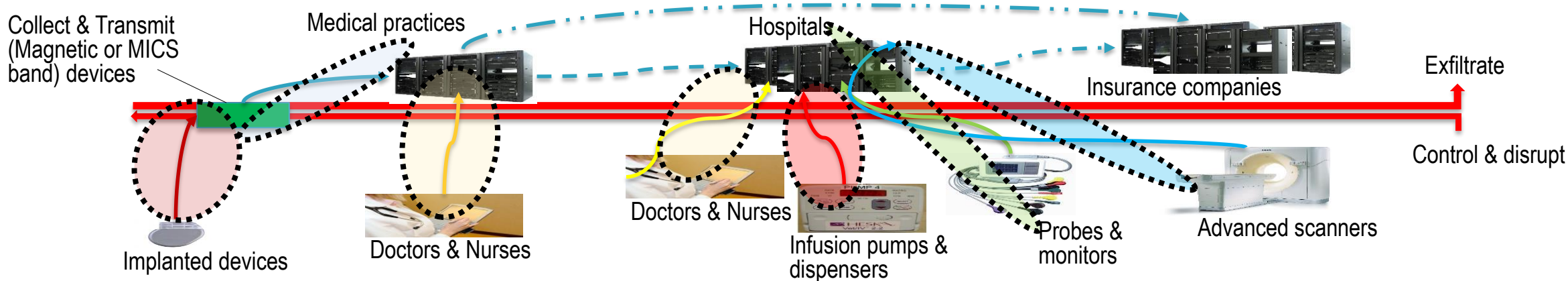
Multifunction Delegates (MDs) mediating between the embedded devices and information systems for both ingress & egress

To Provider's information systems

To Hospital information systems

MD   MD   MD   MD   MD   MD

Implanted devices

Doctors & Nurses

Doctors & Nurses
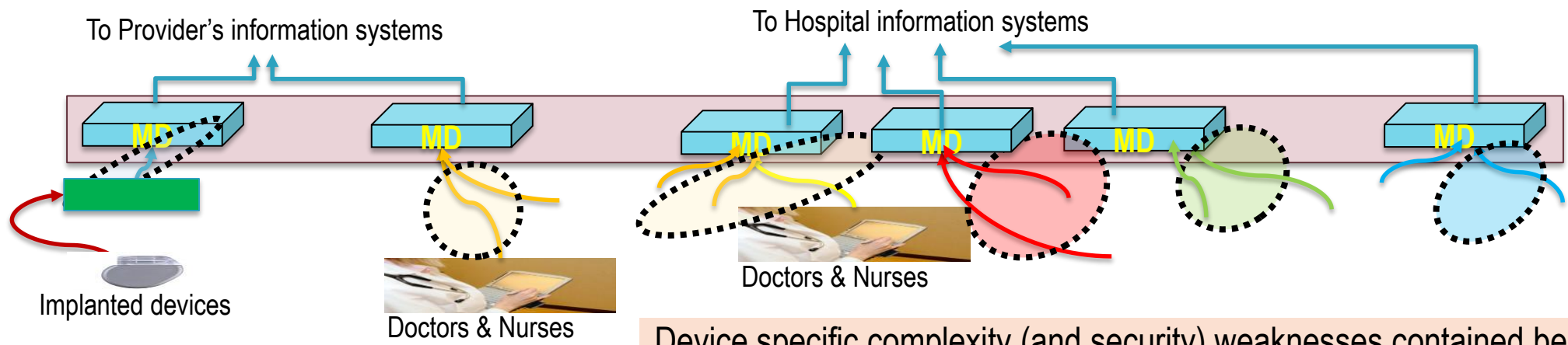
Device specific complexity (and security) weaknesses contained below the mediation layer, making the CPS simpler, more interoperable, secure and privacy preserving

Multifunction Delegates for Secure Medical Cyber-Physical Systems

Dr. Richard Schantz, Dr. Shane Clark, Dr. Partha Pal
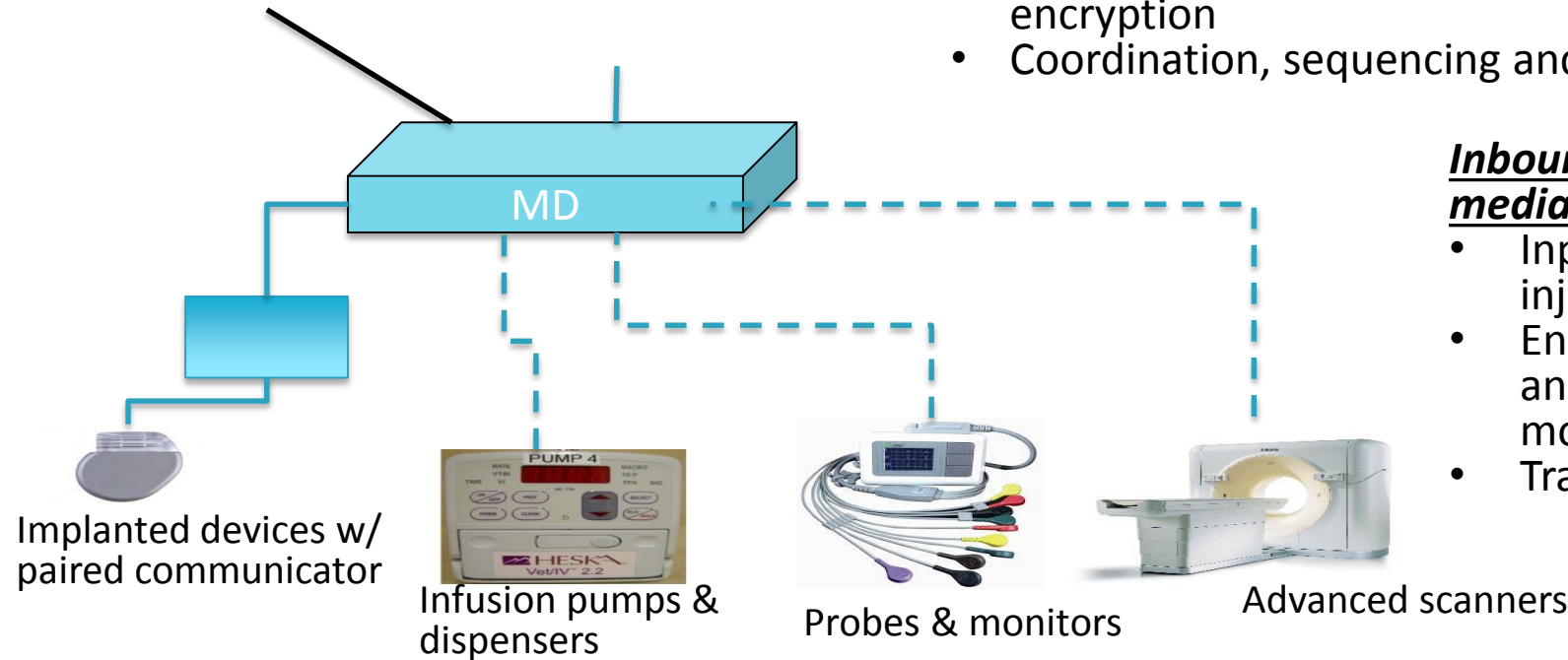
The Multi-function Delegate (MD) Concept

Placed near the embedded devices, MDs mediate all interaction between the devices and the larger CPS in either dedicated or multiplexed manner

Outbound value add of the MD mediation:
- Publish subscribe instead of point to point
- Uniform time stamp and message format
- Publish with encryption (1-1 to the target system)
- Publish with 1-many (attribute and predicate based) encryption
- Coordination, sequencing and adaptation

Inbound value add of the MD mediation:
- Input validation (defend against injection attacks)
- Enforce appropriate access control and authentication without modifying the end devices
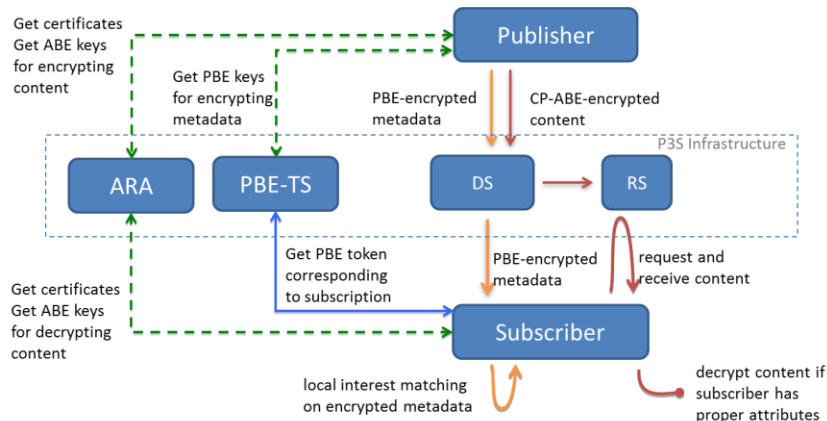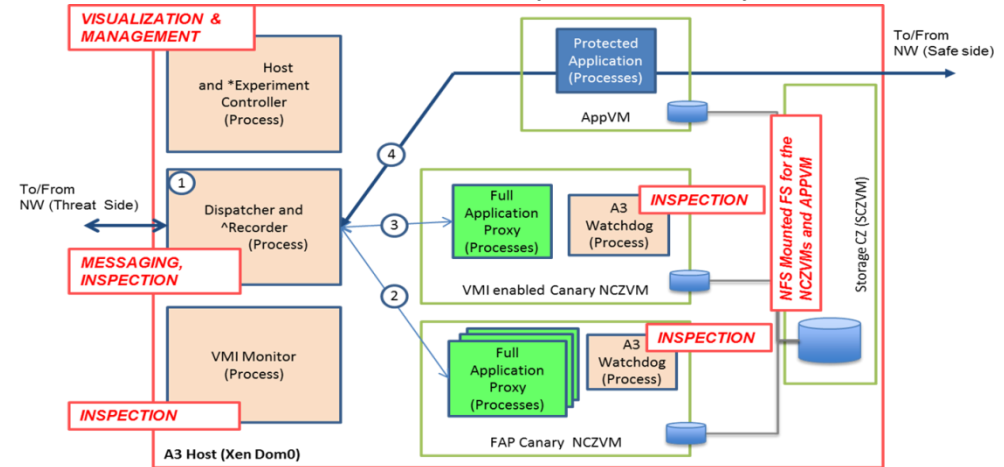- Transformation

MD

Implanted devices w/ paired communicator

Infusion pumps & dispensers

Probes & monitors

Advanced scanners

Dr. Richard Schantz, Dr. Shane Clark, Dr. Partha Pal

Raytheon
BBN Technologies

Some Enablers for Transposing and Extending

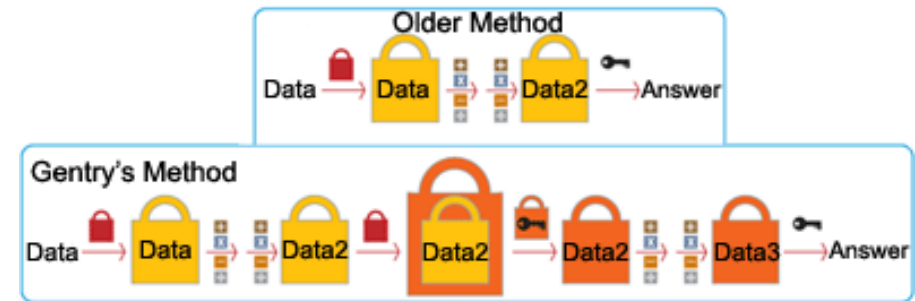## Value added infrastructure services

Total Ship Computing
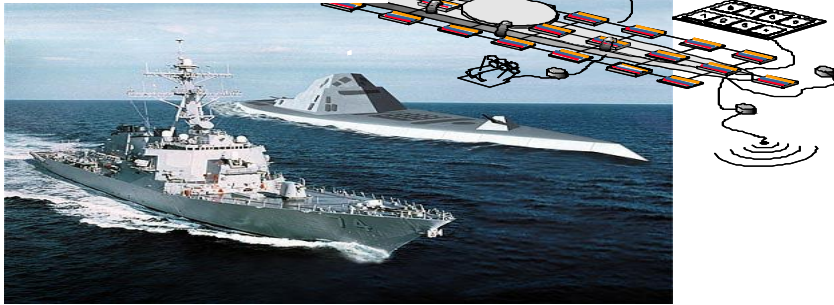
Real-time cyber-security mediation

Interaction privacy

Fully extended privacy: fully homomorphic encryption, metadata protection

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Raytheon BBN Technologies