Extending Service Oriented Architectures to Edge Networks with Active Metadata and Swarming

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Problem Statement

- Creating a service-oriented architecture in an always-on environment has been extensively studied
  - Internet (REST)
  - WSDL/SOAP
Tactical Swarm Networks

- Some tactically important networks cannot use this model for a SOA
  - sparse connectivity
  - mobile nodes
  - limited bandwidth
- “Edge” networks
Solution

- Combine two key APL technologies
  - Active Metadata
  - Swarming
- With some new ideas
  - Create a RESTful metadata network
  - Allow service discovery and activation through the swarm
  - Automatically reconfigure network topology to optimize service response time
Background: AMF 1.0

- The Active Metadata Framework was designed as an alternative SOA methodology
  - Intelligently push metadata to places where it is needed
  - Agent-based
  - Automatically update metadata when needed
Background: Swarming/DCF

- All Decisions Made Locally
- Fast Reactive Decisions - EFFECTIVE
- Each Target Can Accept Direct Control w/o Disrupting the Others - ROBUST

- Each Element Has its Own Knowledge - ROBUST against Loss of Comms
- Multiple Layers of Data Are Fused Seamlessly - EFFECTIVE

- Flat Network – No Central Point of Failure - ROBUST
- Communications Are Less Demanding and Can Hop Across Network, Extending Total Range - EFFECTIVE
Background: REST and Microformats

- Representational State Transfer (REST)
  - “a style of software architecture for distributed hypermedia systems” (Wikipedia)
  - Application state and functionality are divided into resources
  - To manipulate resources, exchange representation (via web pages) using a protocol (HTTP)
- Microformats
  - Provides machine-readable semantics in a web page along with human-readable content.
System Design
TNT Experiment

- Performed at McMillan Field, Camp Roberts CA
- 3xUAVs
  - Hand-launched Procerus Unicorns
- 2xServices (HMMVs)
  - Simulated Chembio detectors -> dB
- 1 Client Node with multiple operators
- Communications limited to ~150m
TNT Experiment
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