Federated Command and Control Infrastructure for Adaptive Computer Network Security

Thomas C. Eskridge | Florida Institute of Technology

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Homeland Security

Science and Technology

Team Profile

Florida Institute of Technology

Harris Institute for Assured Information

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For Academic Years 2014-2019

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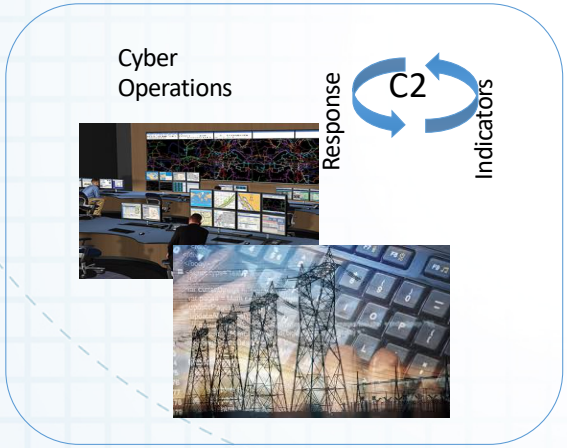
Motivations and Need

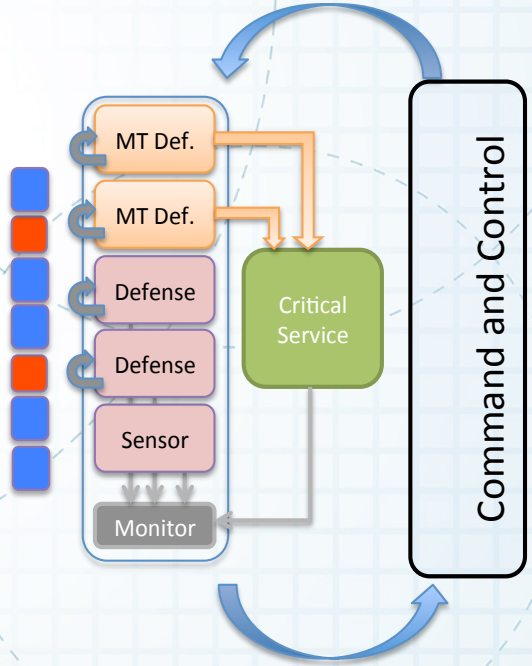
- New **investments and advances** in the design of defensive tools and capabilities for cyber operations
- Increasing adoption of defenses that are significantly more **complex, diverse, and dynamic (e.g. Moving Target Defenses)**
- Increasing acceptance and deployment of **common specifications for automated exchange of threat information**

The FC2 Project addresses the critical need for **Resilient Federated Command and Control Infrastructures** for Cyber Operations and Moving Target Defenses

Project Goal

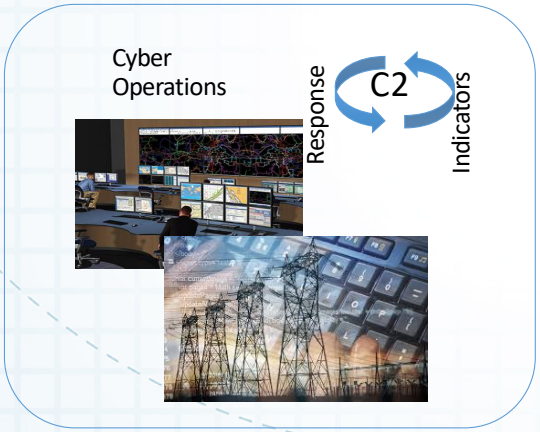
- Enabling Cyber Command and Control
  - Resilient C2 for dynamic and moving target defenses

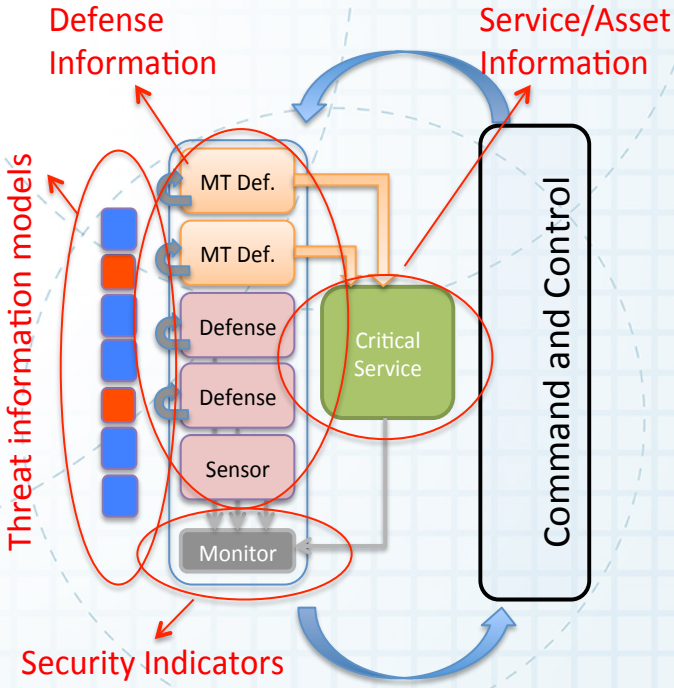




Project Goal

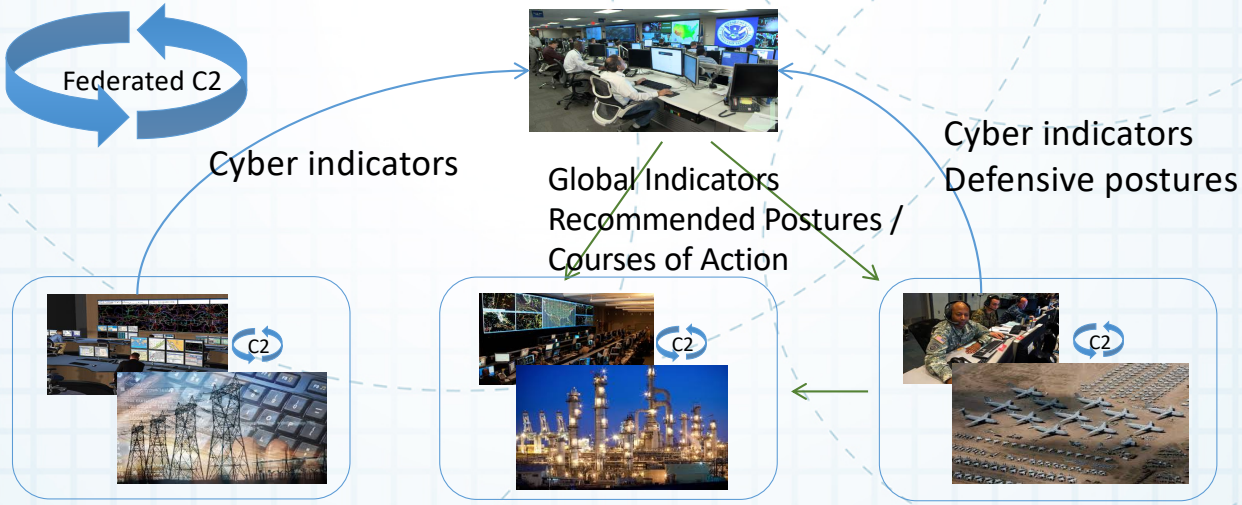
- Enabling Cyber Command and Control
  - Integration, control, and management of third party sensors, defenses, and services





Project Goal

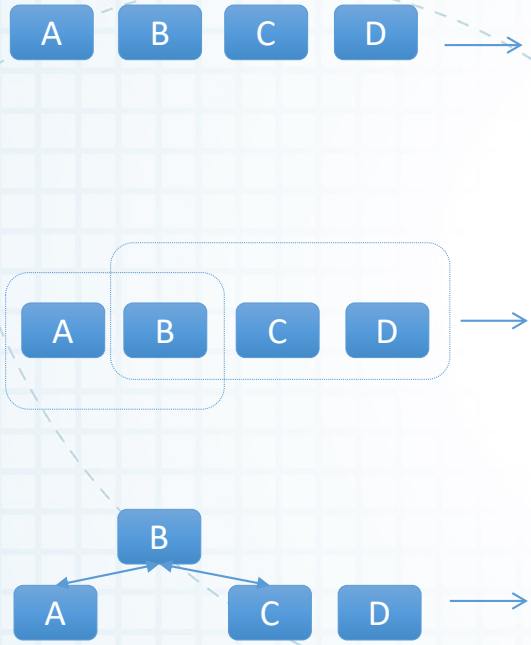
Enable the semi-automated federation of multiple cyber C2 infrastructures to form a Federated Command and Control Infrastructure



FC2 Requirements

- Flexible Structure
  - Overlapping, Hierarchical, etc.
- Scalable
  - From enterprises to commodity routers
- Resilient
  - Able to resist and recover from failures and attacks
- Trusted
  - Policy delegation, authentication
- Extensible
  - External services, enterprises, defenses, and C2 implementations
- Participation models
  - Voluntary participation, incentive models, regulatory models, etc.

Building a Federated C2

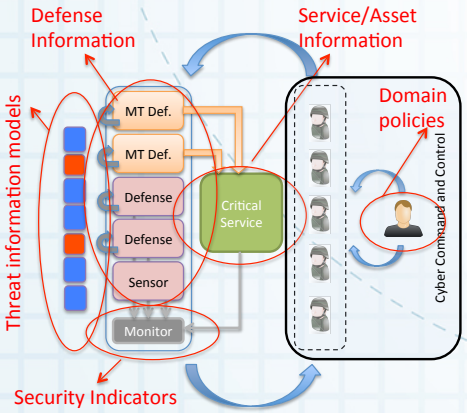


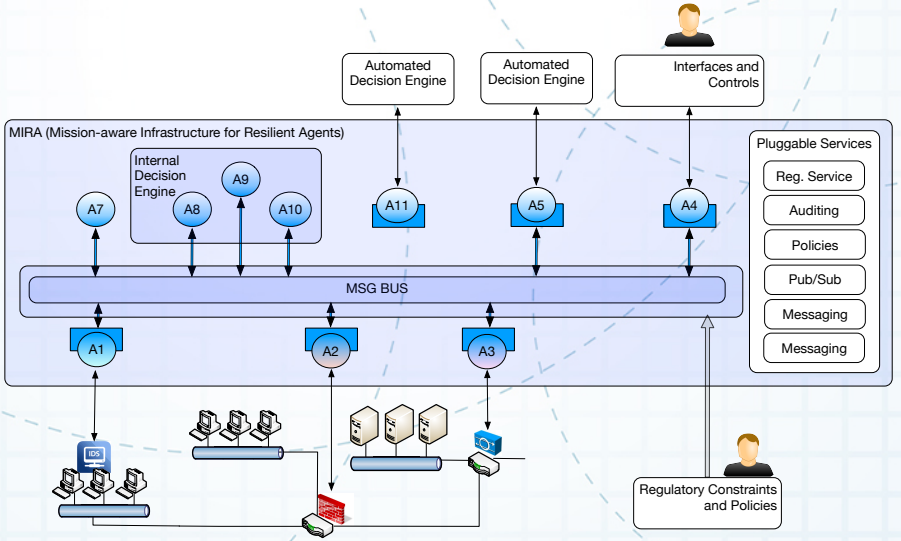
Automating Federation Formation

- **Initial Federation Formation**
  - Policies and mechanisms for federation formation
- **Organization Policies**
  - Defining contexts and information sharing policies
- **Federation Policies**
  - Defining policies for sharing responses amongst federation members, and across federations

Approach

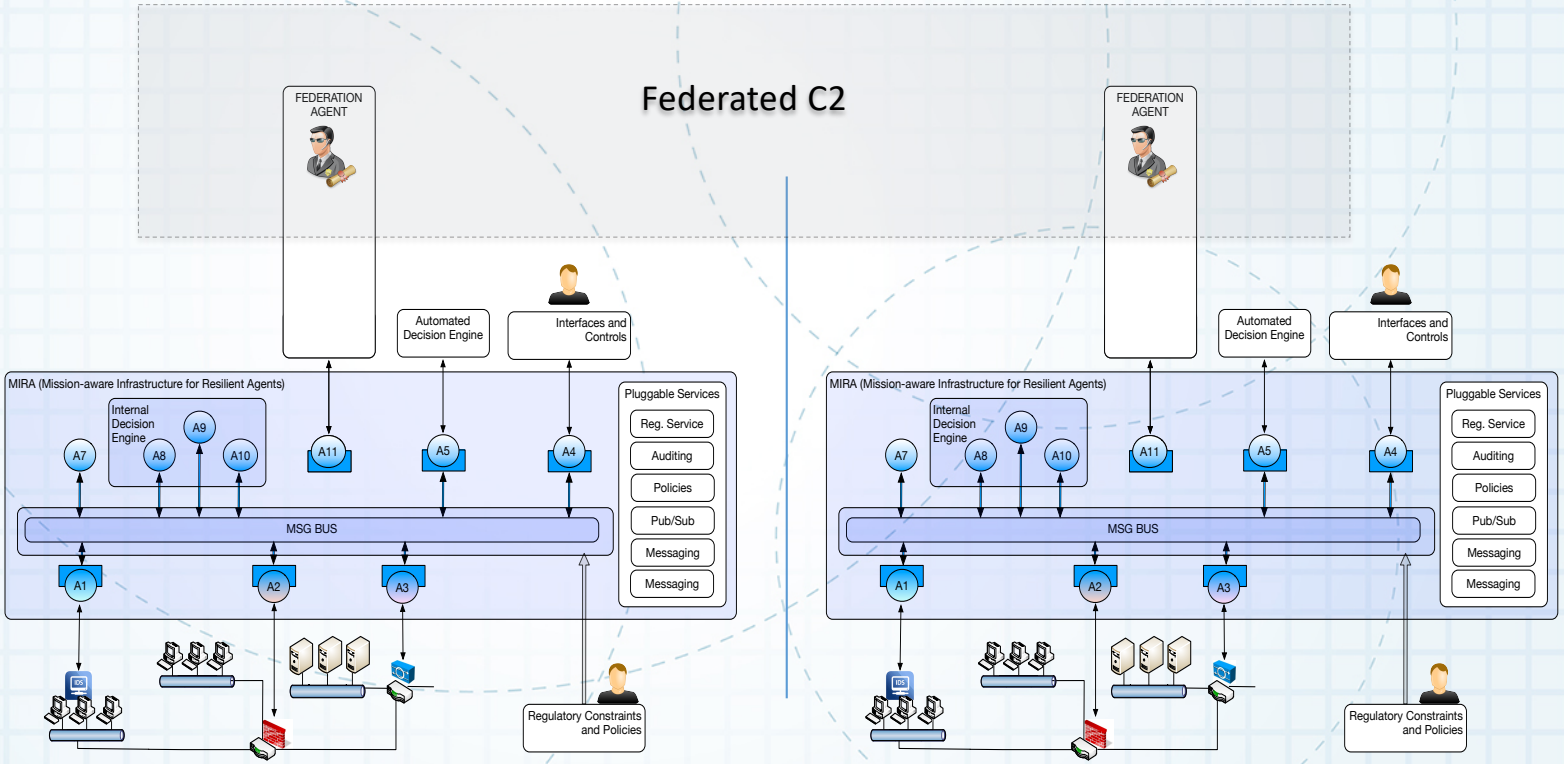
- Building on prior Cyber C2 Frameworks (sponsored by DoD) developed at Florida Tech
- MIRA: Mission-aware Infrastructure for Resilient Agents
  - Human-assisted command and control automation for cyber operations.





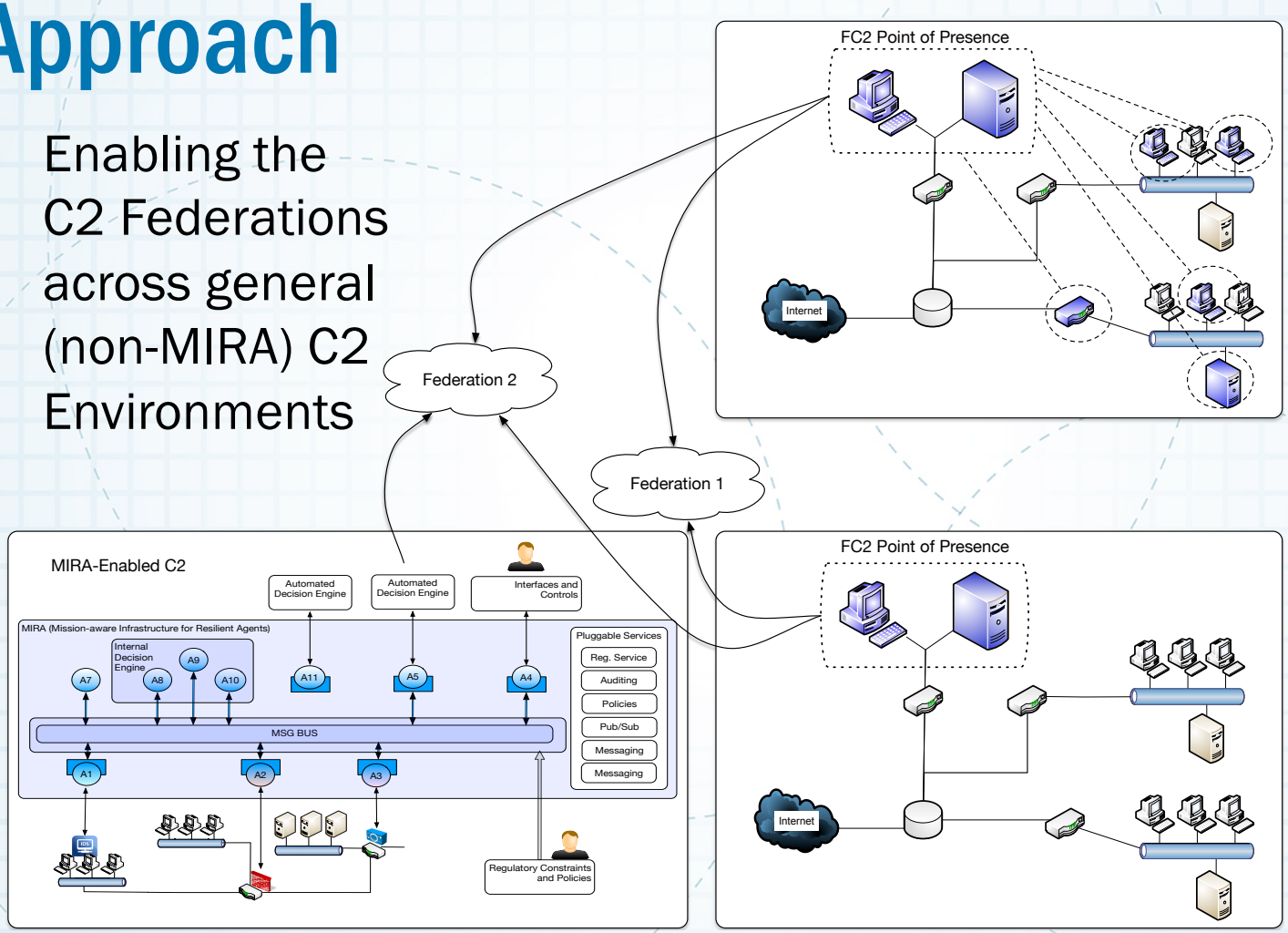
Approach

- Enabling the C2 Federations



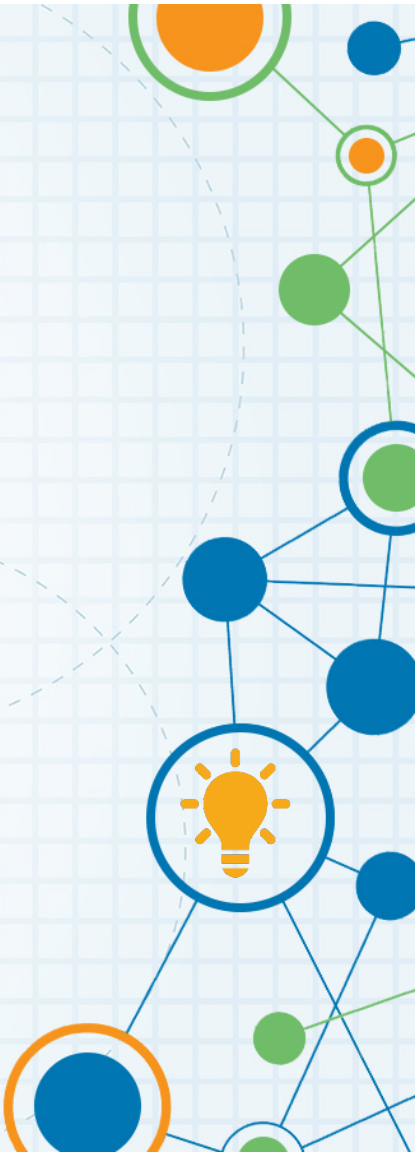
Approach

- Enabling the C2 Federations across general (non-MIRA) C2 Environments



Benefits

- Enabling Federated C2 Operations
  - **Integration of Efforts**: Brings together prior research in the field, *enabling the development of new capabilities through coordination and control*
  - **Context-dependent policies**: *Context changes may trigger new sets of policies* for federation members
  - **Automated process**: *Policy negotiation and enforcement happens automatically*, based on pre-defined preferences from individual members
  - **Maintaining and Leveraging Diversity**: FC2 thrives from the *diverse experiences of member environments*
  - **Multiple participation modes**: *Federation members may define or modify policies at any time*, adjusting their level of involvement in the federation



Competition

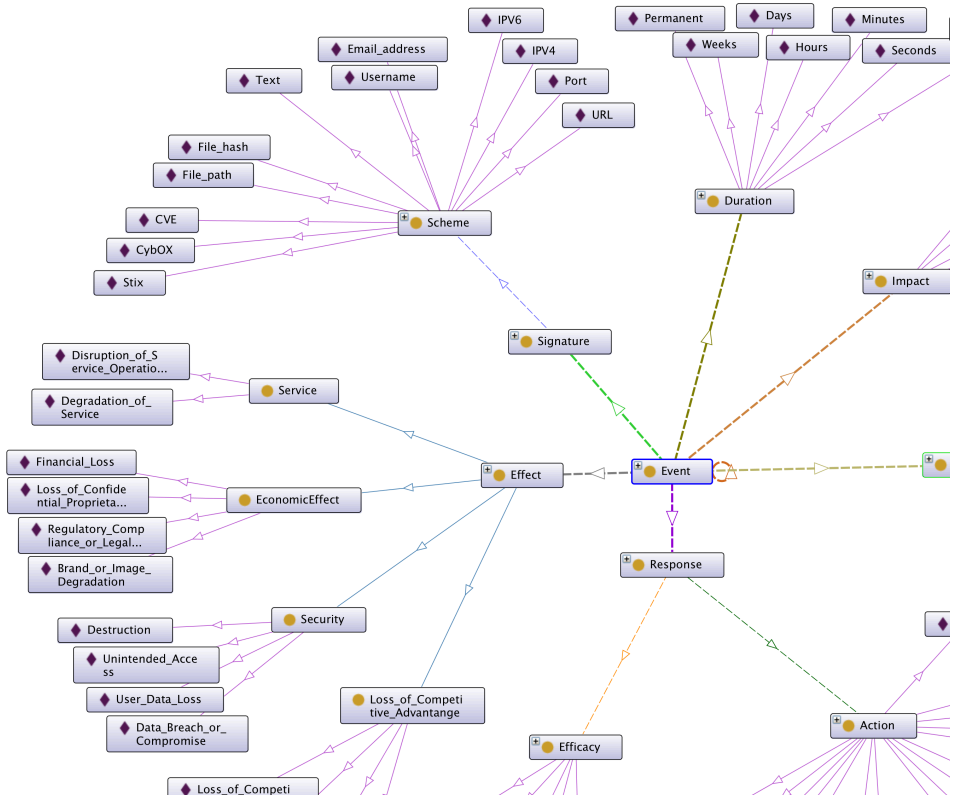
- Other sharing techniques
  - No reasoning component on sharing
  - No generalized connection between response and actuator
- Other orchestration techniques
  - Single vendor
  - Varied assimilation of other sensors and defenses
  - Varied actuation of responses

Current Status

- Created Federation ontology to share information and integrate diverse sensors and defenses
- Federation-wide integration of secure computation method
- Policies for joining, and contributing and acting on federation data
- Integrated third-party command and control
- Demonstrated five enclaves dynamically creating and joining in three different federations
- MIRA C2 integrated control of defenses from six different DHS performers

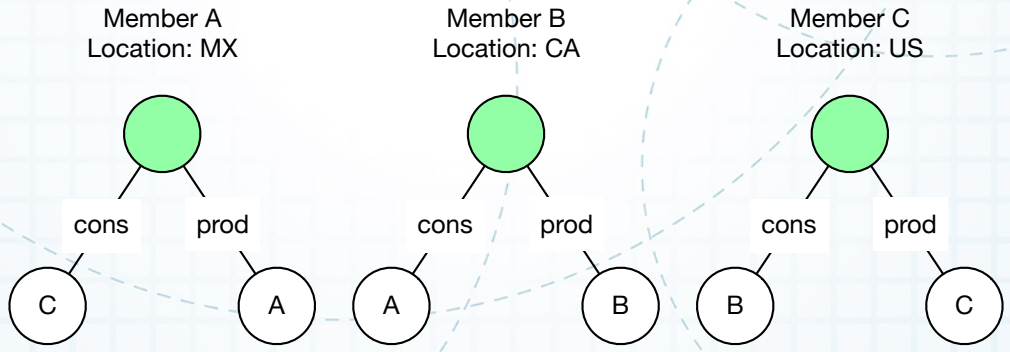
Current Status: Federation Ontology

- High-level concepts describing
  - Signatures
  - Events
  - Responses

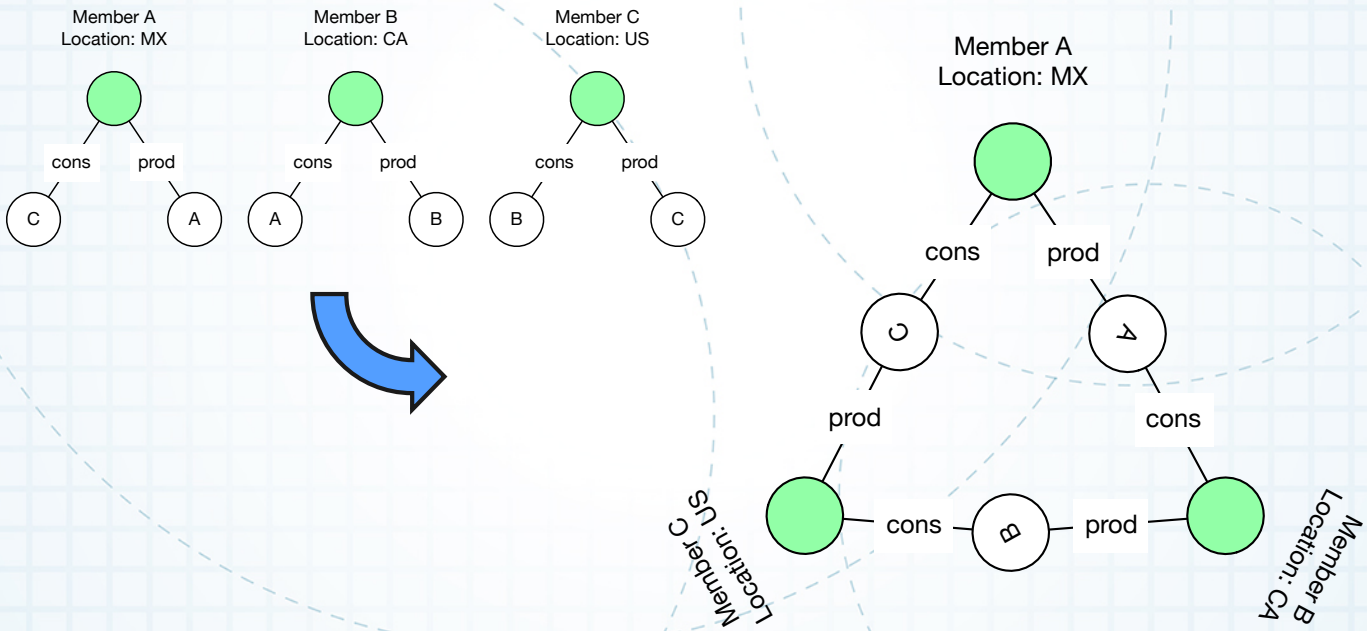


Current Status: Automatic Federations

- Federations are automatically formed and dissolved based on enclave preferences
- Enclaves can conditionalize federation membership based on what other members share

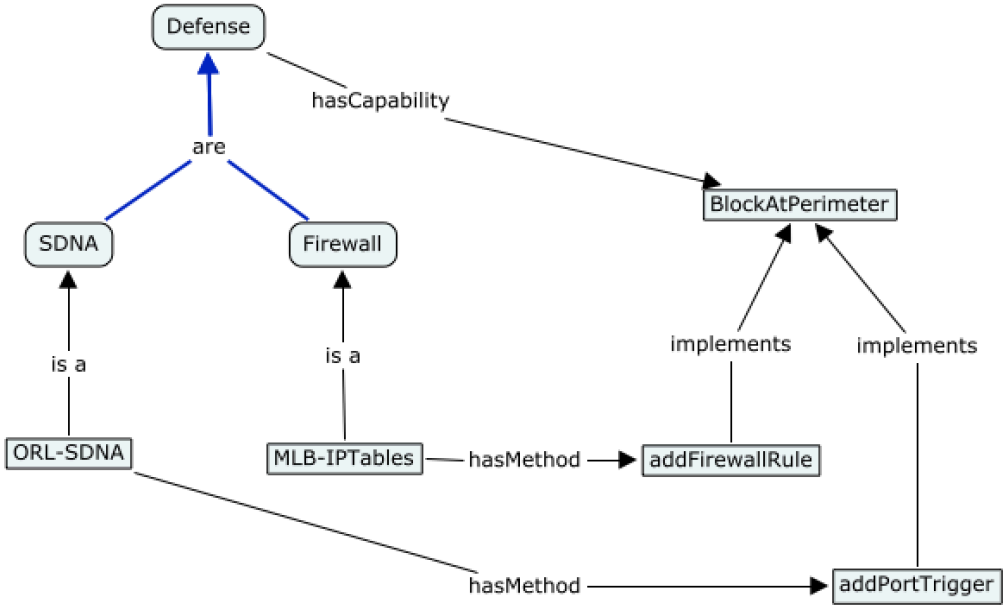


Current Status: Automatic Federations



Current Status: Generalized Control

- Generalized events and controls are shared between enclaves
- Each enclave implements response according to their capabilities



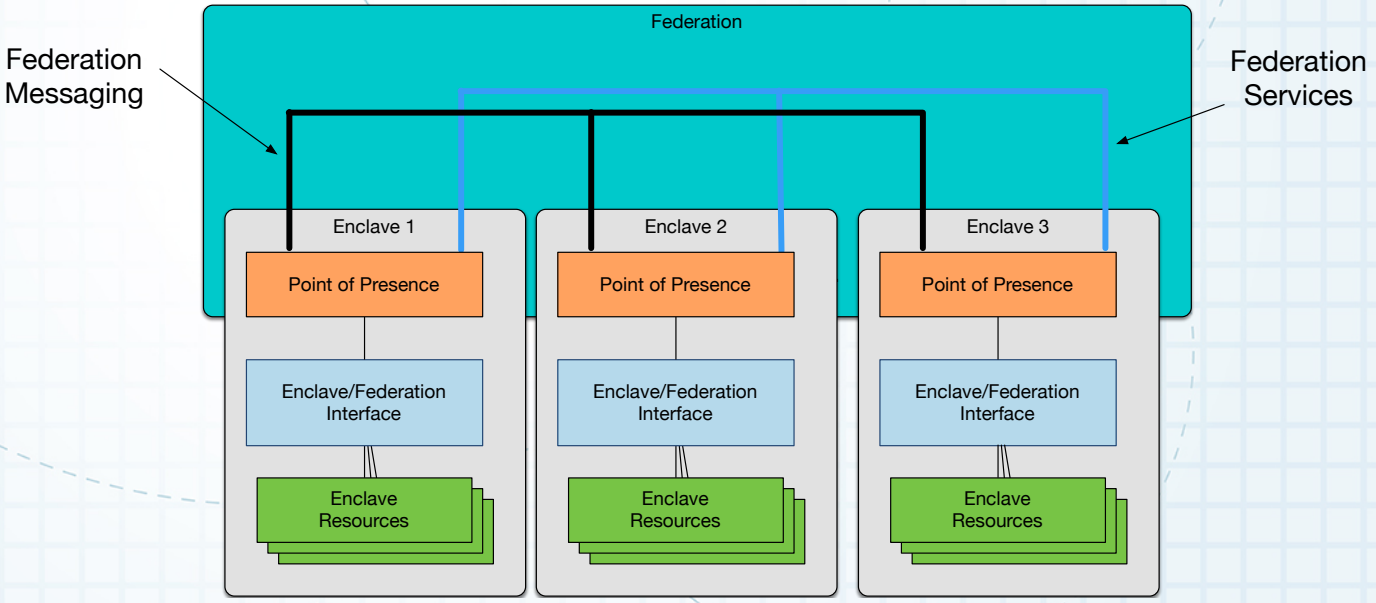
Current Status: Integration with Third-Party Capabilities

- Semantic representation of events and response allows integration of diverse set of capabilities

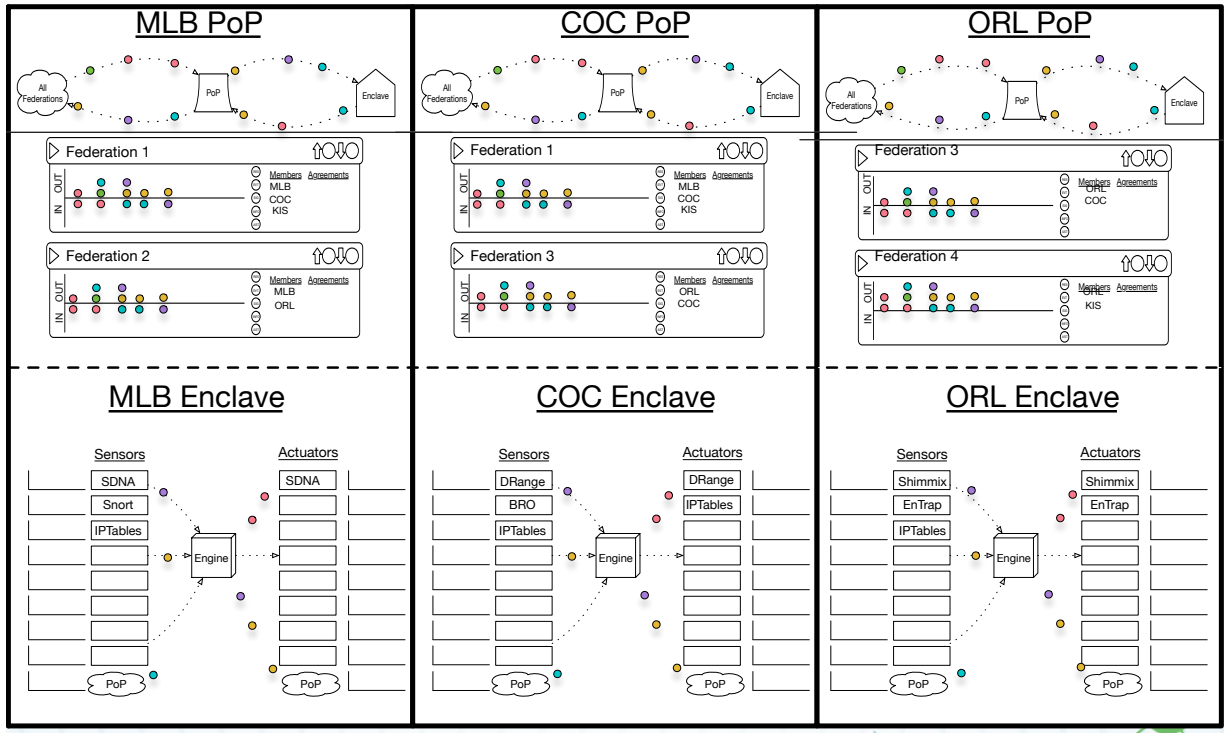
Defense	Services	Command and Control
SDNA – I-A-I Shimmix – Def-Logix Entrap – Def-Logix DRANGE – Sandia National Labs Application Diversity – Florida Tech	Multi-party Computation – MIT/LL	MIRA – Florida Tech Thimblerig - SEI

Current Status: Integration with Third-Party Capabilities

- Federation-level services provide additional capabilities to members

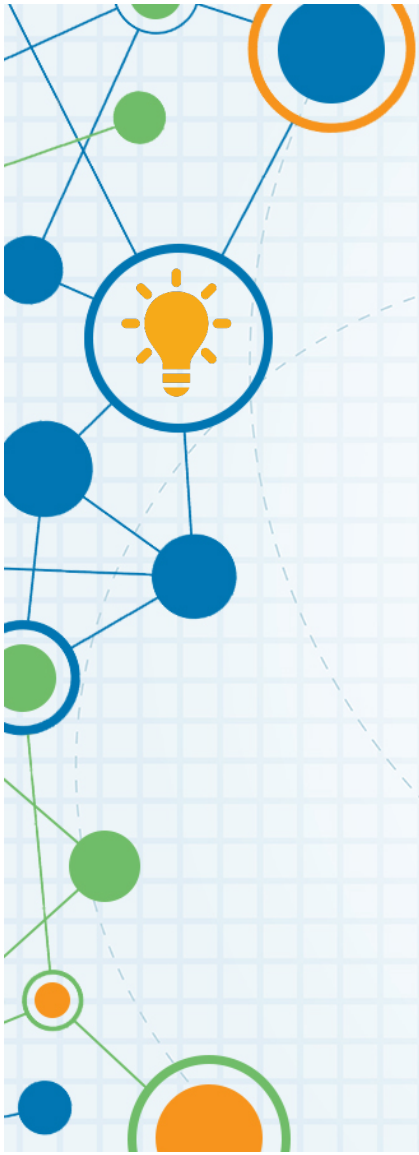


Current Status



Transition/Completion Activities

- Open source efforts
  - In the process of open-sourcing MIRA, the support infrastructure for FC2
- Community development efforts
  - Developing a project website for the distribution of
    - Points of presence and documentation
    - Support infrastructure and communities of interest
- Commercial application efforts
  - Investigating requirements for commercial offering
  - Vertical markets are first target



Lessons Learned

- Communication is key
  - Large group of performers regularly met as a group and often individually to discuss integration and control issues
- A general and extensible representation is useful for integrating a wide range of sensors and defenses
- Even very general contracts between federation members can be very useful

Contact Info

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