
# OPENC2: PROTECTING OUR FUTURE AT MACHINE SPEED

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# Agenda



- Background
- Design Philosophy/ Principles
- OpenC2 Syntax
- OASIS Transition
- Current Plan
- Call for Participation

# Background: The Motivation and Vision

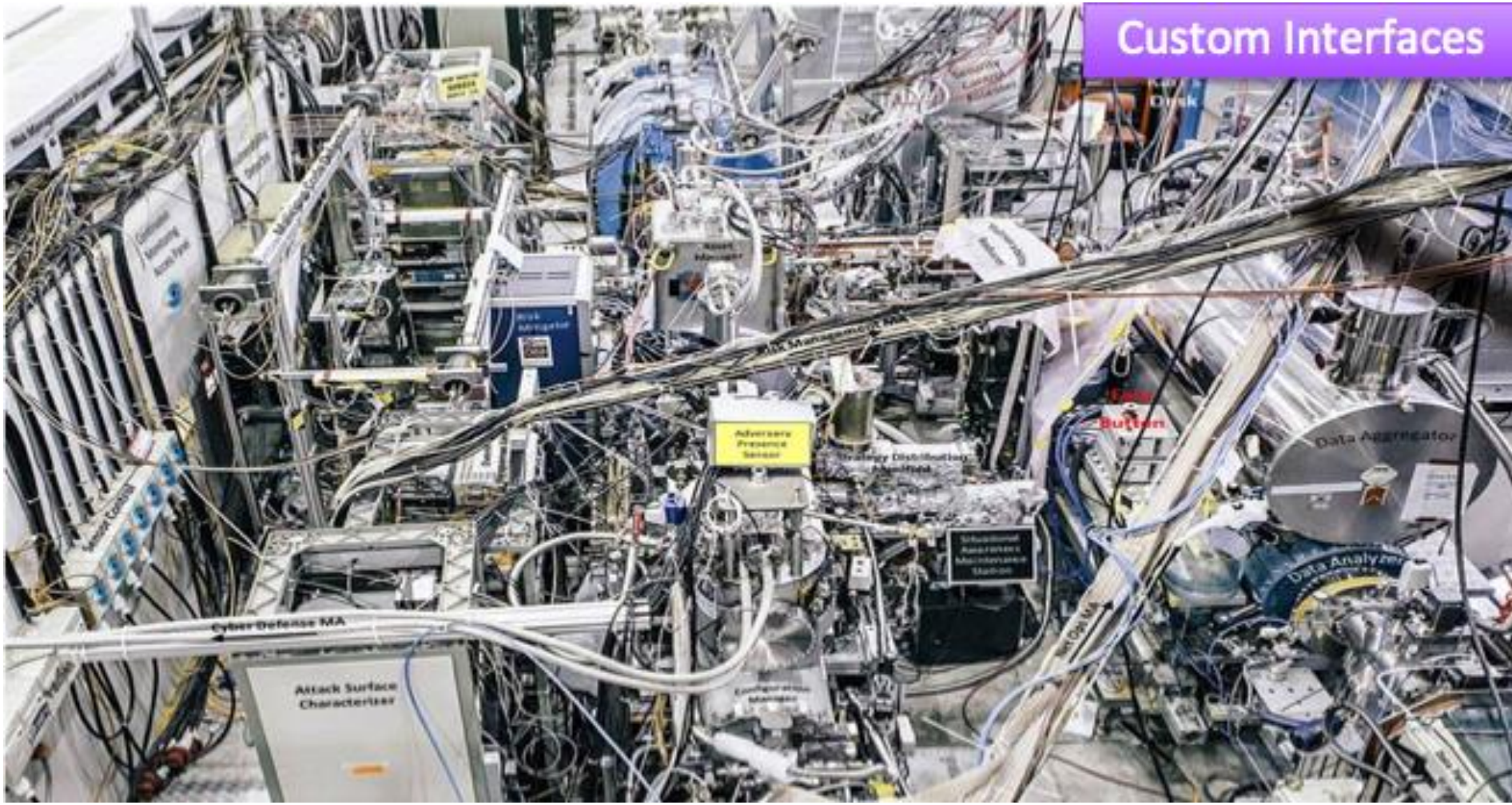


- Challenge
  - Coordinated Defense in Cyber Relevant Time
- Vision: Future Cyber Defense Tactics
  - Sharing of indicators
  - Coordination of response actions
  - Automated, multi-part actions at machine speed
- Strategy
  - Decouple Functional Blocks and Standardize Interfaces
  - Identify and fill gaps as they pertain to Cyber Threat Indicator Sharing and Response
  - Participate in a diverse and collaborative environment

**Standardization is a Key Enabler for Automation**

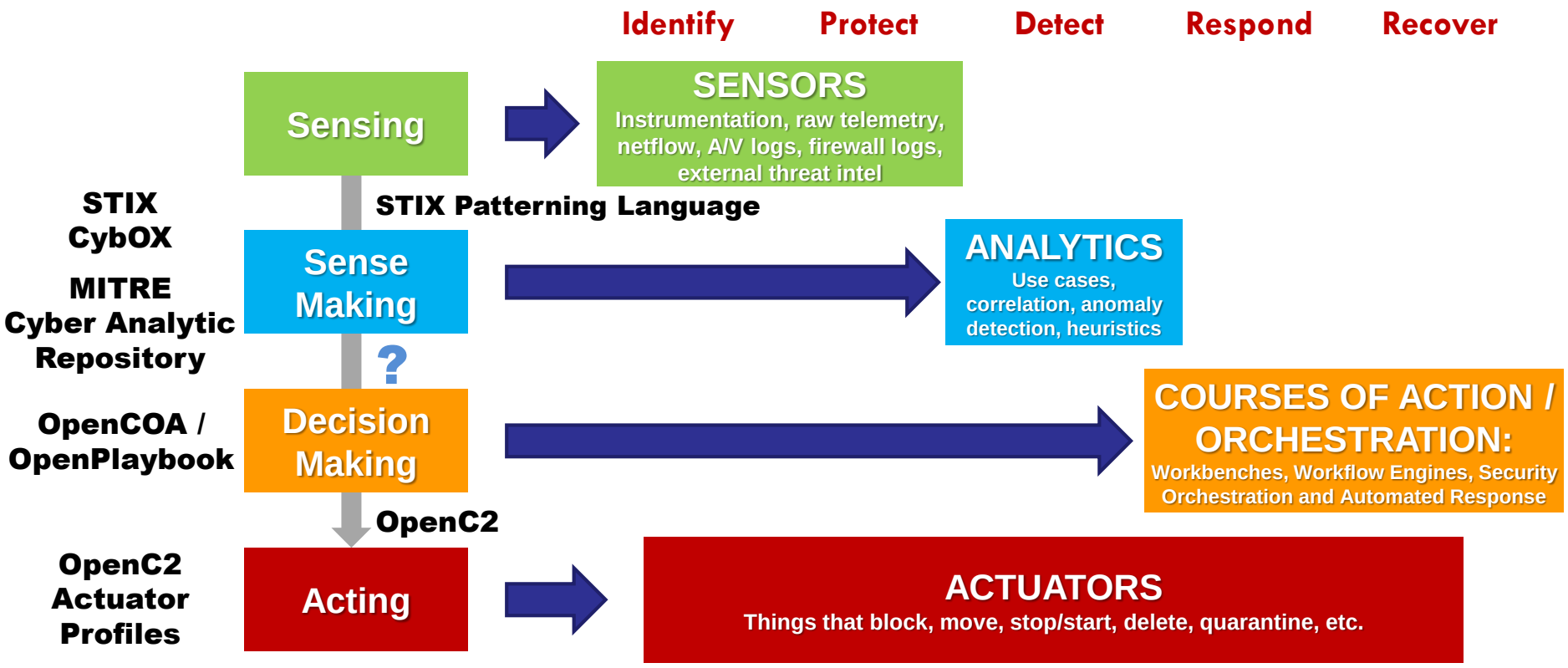
# Integration in the Absence of Standards





# Decoupled Security Stack: Making Security More Manageable (& interchangeable)





# OpenC2 at a glance



- Unambiguous Machine-to-Machine Communication
- Simplicity
  - Low overhead on sensor and actuator
- Focuses on 'Acting' portion of cyber defense
- OpenC2 assumes the following has been done:
  - Sensing; 'What' triggers the action
  - Analytics; 'Why'
  - Decision; 'Which' action
- OpenC2 will leverage pre-existing protocols and efforts

# OpenC2 Focuses on 'Acting'




- STIX
  - Standard Threat INTEL object
  - Supports Analysis


- TAXII
  - Standard Transport protocol
  - Supports Secure Exchange


- OpenC2
  - Standard Command Language
  - Supports Automated Response

OpenC2 is part of a Suite of OASIS Standards

# OpenC2 Design Principles



- Lightweight
  - Efficient machine-to-machine communications
- Abstract
  - Focuses on ‘What’ to do versus “Device Specific”
- Extensible
  - Extensions enable additional precision and flexibility
- Agnostic
  - Transport, authentication, integrity controls etc.
  - Enables flexibility with respect to implementation

Enable Unambiguous Machine-to-Machine Command and Control Messages

# OpenC2 Assumptions



- Basic Assumptions
  - The analytics have been done
  - The decision to respond has been made
  - The Transmitting and Receiving entities are authorized to do so
  - Assured transport

# OpenC2 Parameters



- The Lexicon Decouples the aspects of the commands
  - ACTION: What is to be done
  - TARGET:  What you are doing it to
  - ACTUATOR: Who is performing the command
- Extensions permit additional precision to the commands
  - SPECIFIER: Identifies general to specific targets or actuators
  - OPTIONS: Provide additional details for the command, target, actuator
- Benefits of decoupling
  - Facilitates integration of new technologies
  - Supports high level effects based AND device specific use case

# Example Actions / Targets



## Actions

- scan
- locate
- create/query/set/delete
- report
- notify
- deny/contain/allow
- start/stop/restart
- pause/resume
- detonate
- redirect
- update
- save
- …

## Targets

- device
- directory
- domain_name
- email_addr
- email_message
- file
- ipv4_addr/ipv6_addr
- mac_addr
- ip_connection
- process
- url
- user_account
- …

# Example OpenC2 Command



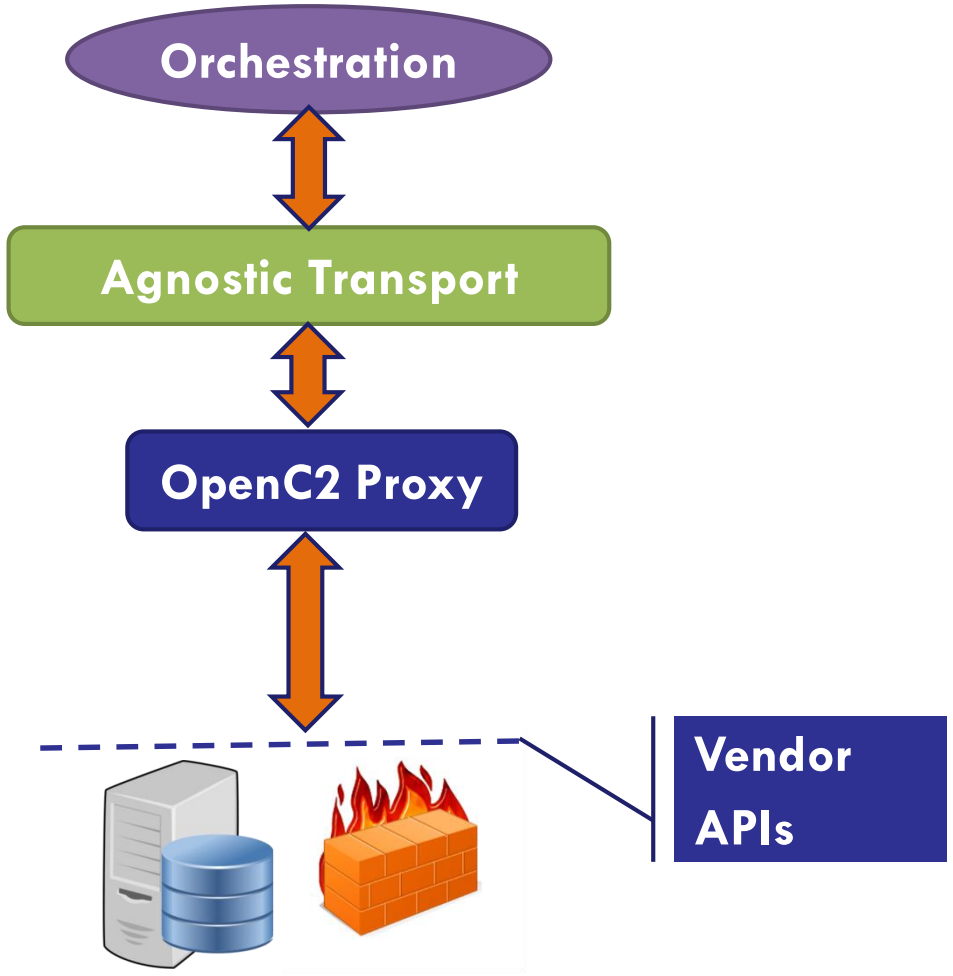
*# Block all ftp data transfers from hosts and request ack. Note that the five-tuple is incomplete*

```
{“action”: “deny”,
 “target”: {
      “type”: “openc2:five-tuple”,
      “specifiers”: {
           “Layer4Protocol”: “TCP”,
           “src-port”: 21
      }
 }
 “actuator”: {
      “type”: “openc2:firewall”,
      “specifiers”: {endpoint},
      “options”:{ openc2: drop}
 },
 “command-options”: {
      {“id”:“UUID=123e4567-e89b-12d3-a456-426655440000”}
      {response=TRUE}
}
```

# OpenC2 Use Case



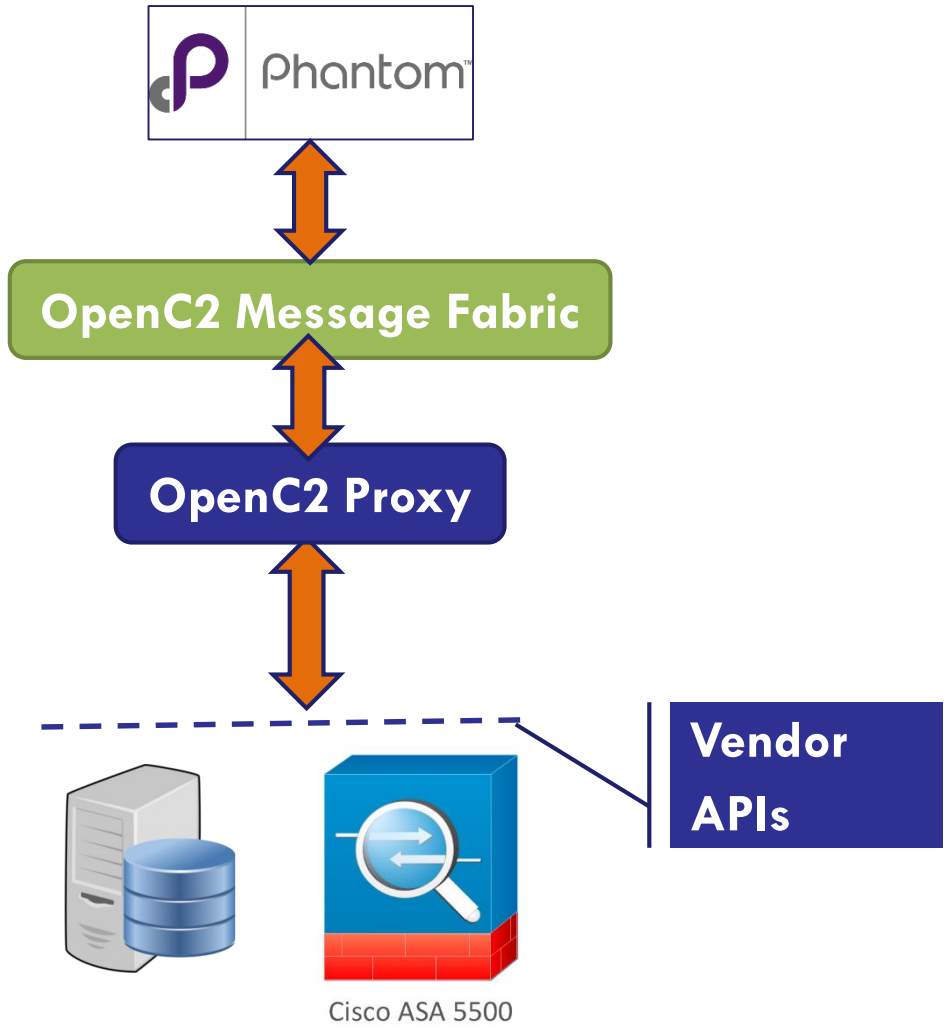
- Abstract Use Case
  - Mitigate Evil Domain
  - Local Orchestrator
    - Deny Evil Domain
    - Scan evil.pdf
    - Contain Infected WS
  - Actuator executes command
- Implement across Agnostic Transport Mechanism



# Prototype Implementation



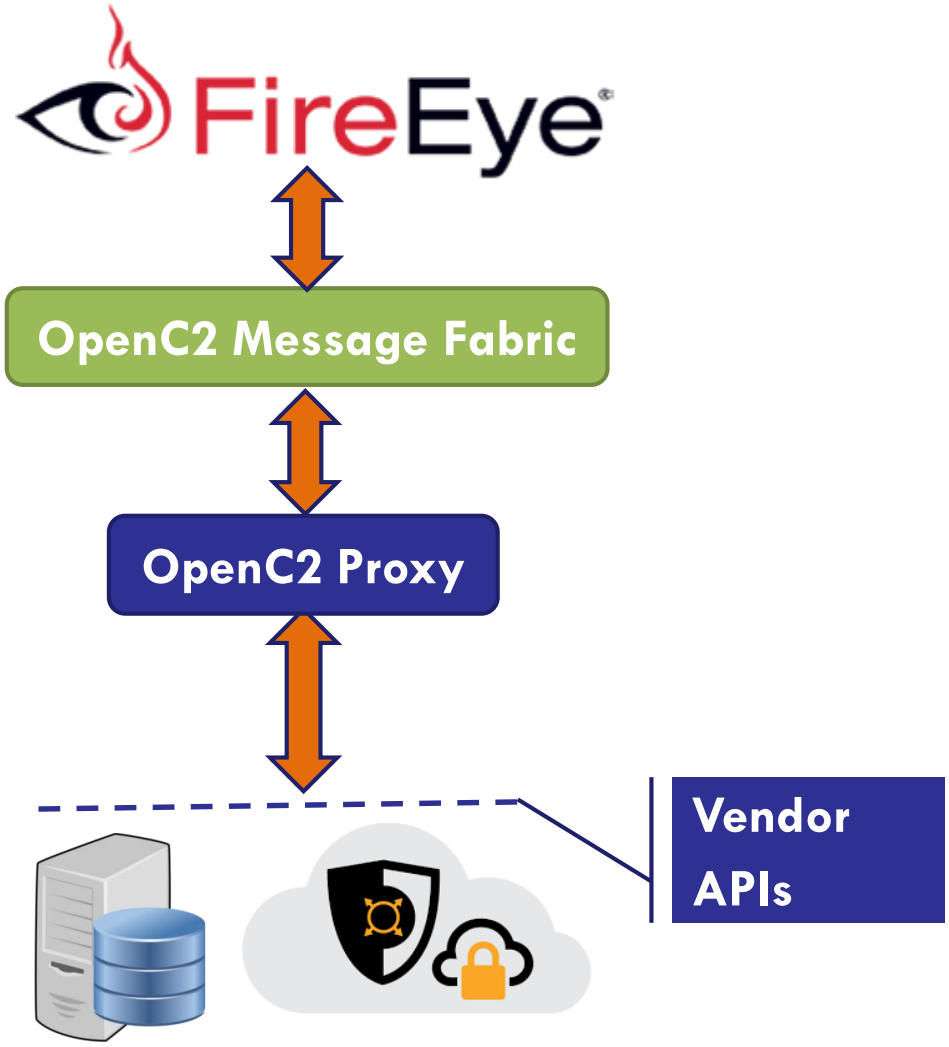
- Orchestrators and Actuators converge on the OpenC2 message fabric
- OpenC2 'Proxy' maps to hardware API
- Converging on Message Fabric facilitates implementation



# Demonstrate Vendor Agnostic



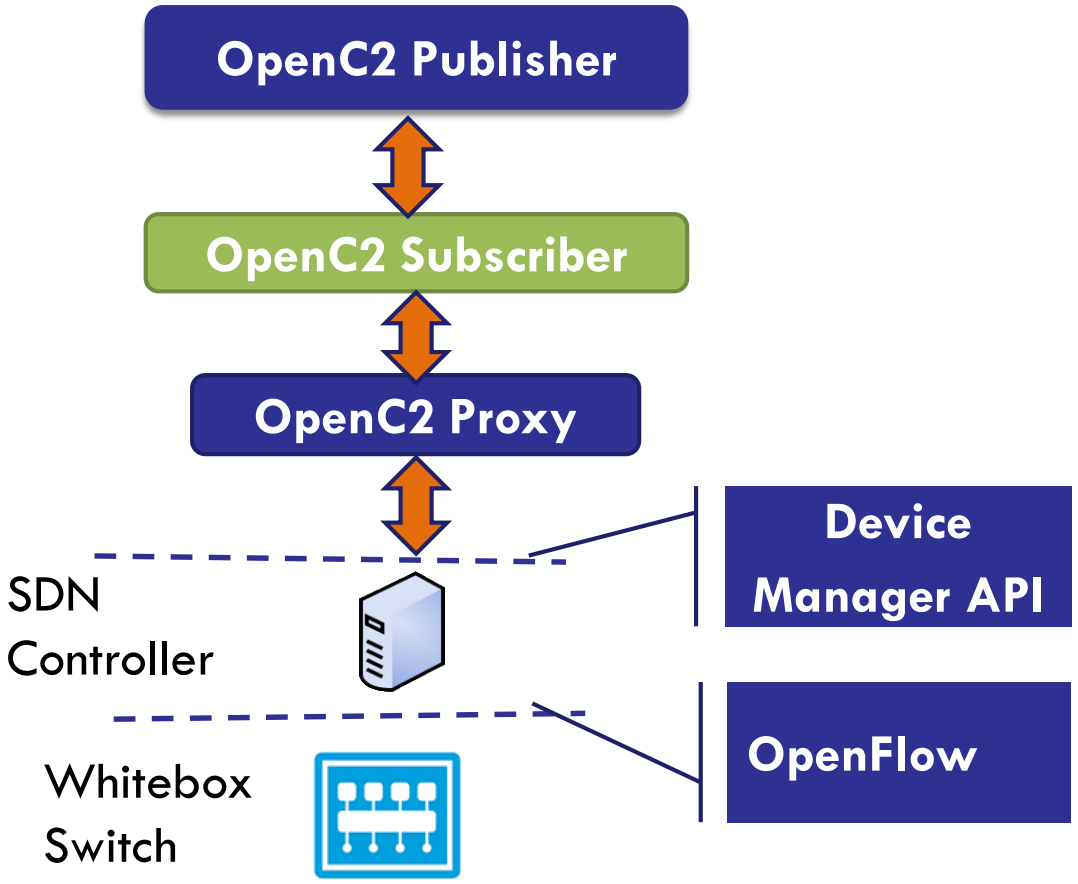
- Allows corporate wide sharing of cyber defense tactics
- Minimizes impact when changing components



# Demonstrates Architecture & Technology Agnostic



- Deny Command is executed REGARDLESS of product
- Simplifies integration of new technologies that achieve similar actions
- Unified tactical approach independent of equipment set



# OpenC2 Documentation Approach



- Core Language Specification
  - Actions
  - Default target namespace
  - Semantics, syntax
  - Profile framework
  - Minimum to implement
- Actuator Profiles
  - Scope and applicability
  - Required and optional actions and nuances in the context of the actuator
  - Applicable targets
  - Specifiers and options for a class of actuators
- Implementation Guides

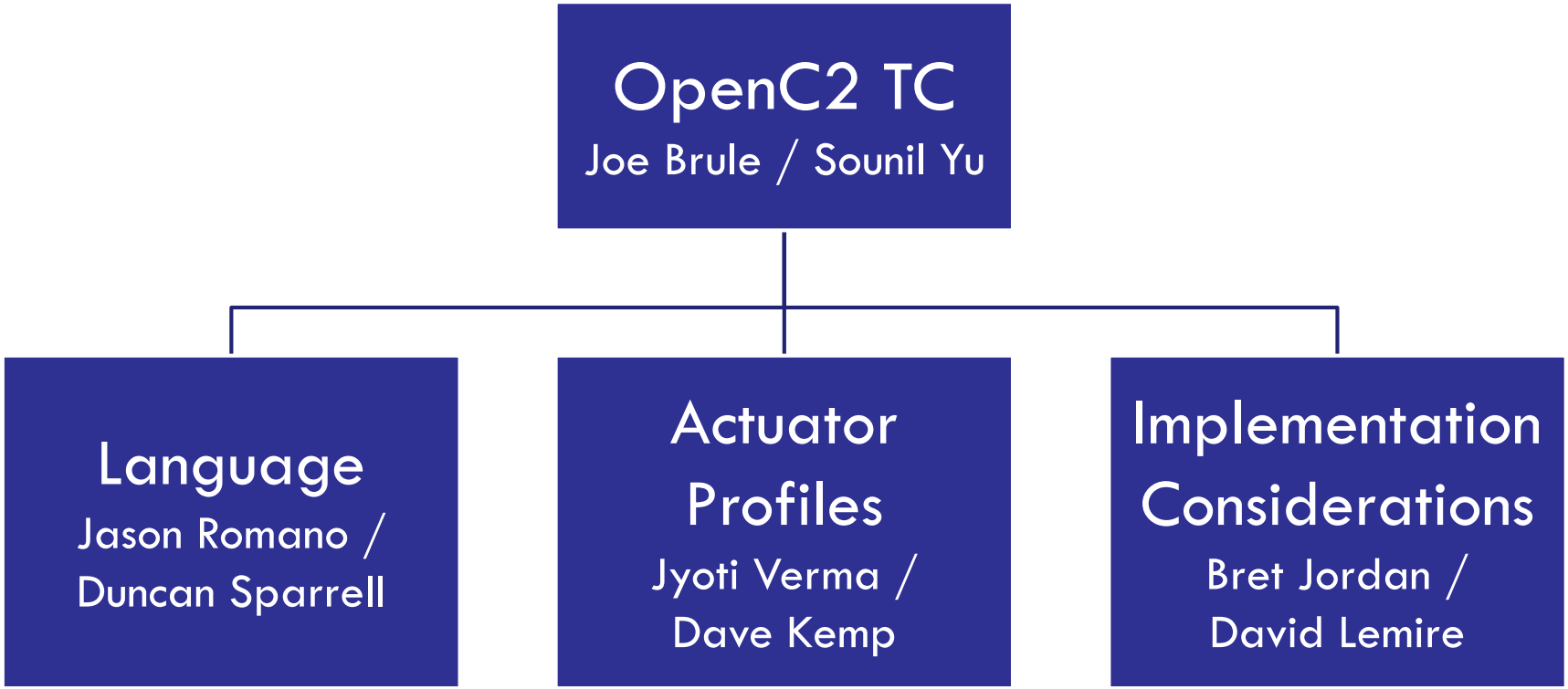
# Transition to OASIS



- OASIS Kickoff meeting on June 7, 2017
- OASIS Technical Committee
  - Monthly Meetings
- OpenC2 Sub-committees
  - Language SC meets weekly
    - Specification of syntax, actions and targets
    - Actuator Profile SC meets biweekly
    - Gathering of ‘frenemies’
  - Implementation Considerations SC meets monthly
    - External dependencies such as IA, Transport etc.

# OASIS Technical Committee Organization





# Language: Proposed Work Plan



- Sequence of Committee Specification Drafts (CSDs)
  - November TC CSD version 0.1.0 (approved on 11/14/2017)
    - Document layout
    - Actions
  - January TC CSD version 0.2.0
    - Targets
    - Mandatory-to-Implement (MTI) Encoding (JSON) structure agreed to
  - February TC CSD version 0.3.0
    - Responses, Alerts and Modifiers
    - Address unresolved details from 0.1 and 0.2
  - March TC Committee Specification Version 1.0.0
    - Actuator Information

# Profile Development Approaches



- Bottom-up
  - Start with full list of 30-40 actuator functions, then factor out common functionality into a higher-level profile (2nd level Endpoint / Network / Manager, or top level Generic)
- Top-down
  - Start with 2nd level profiles
  - Split off more granular profiles as necessary
- Actuator SC will pursue both approaches
  - List of specialized actuator functions under development
  - 2nd level profiles also being considered
  - “Meet in the Middle”

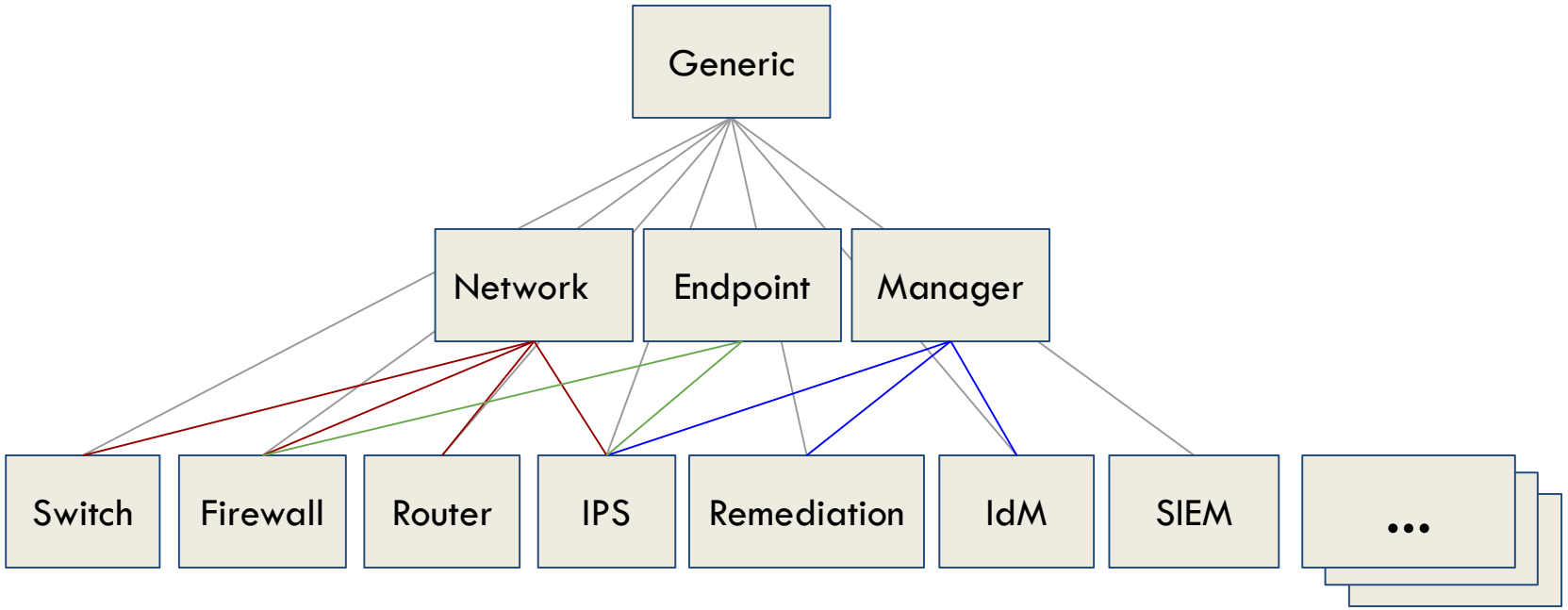
# Actuator Profile Granularity



Roadmap / lists of potential profiles:

https://docs.google.com/document/d/1nlXzQOD0xT-SMp4vfFIELvmV8AiWhmXwn8PoEjMEe3g

Successive refinement:



# Implementation Considerations



- Subcommittee focuses on interoperability
  - OpenC2 Ecosystem
  - Message Transfer Mechanisms
  - Information Assurance Features
- Primarily guidance (non-normative) products
- Tracking and complementing Language and Actuator SCs

# Request of the Cybersecurity Stakeholders



- Use Cases
  - Exercise the Language & Identify Gaps
- Actuator Profile Data Call
  - Which Actions from the Language Specification will be used?
  - Which Targets from the Language Specification do you act upon?
  - What Specifiers do you need?
  - What Options are available in your product?

# We Welcome Your Support



- Please show your support on https://wiki.oasis-open.org/openc2/UsersSupportingOpenC2
- Ask your vendors to show their intentions on https://wiki.oasis-open.org/openc2/ProductsWithOpenC2

# Questions? Comments? Complaints?



- OpenC2 Leadership
  - Joe Brule (Co-chair)
  - Sounil Yu (Co-chair)
  - Joyce Fai (Executive Secretary)
  - Duncan Sparrell (Language Subcommittee)
  - Jason Romano (Language Subcommittee)
  - Dave Kemp (Actuator Profile)
  - Jyoti Verma (Actuator Profile)
  - Dave Lemire (Implementation Considerations)
  - Bret Jordan (Implementation Considerations)
- Contact us at openc2-chair@lists.oasis-open.org

# Backups

# Observations

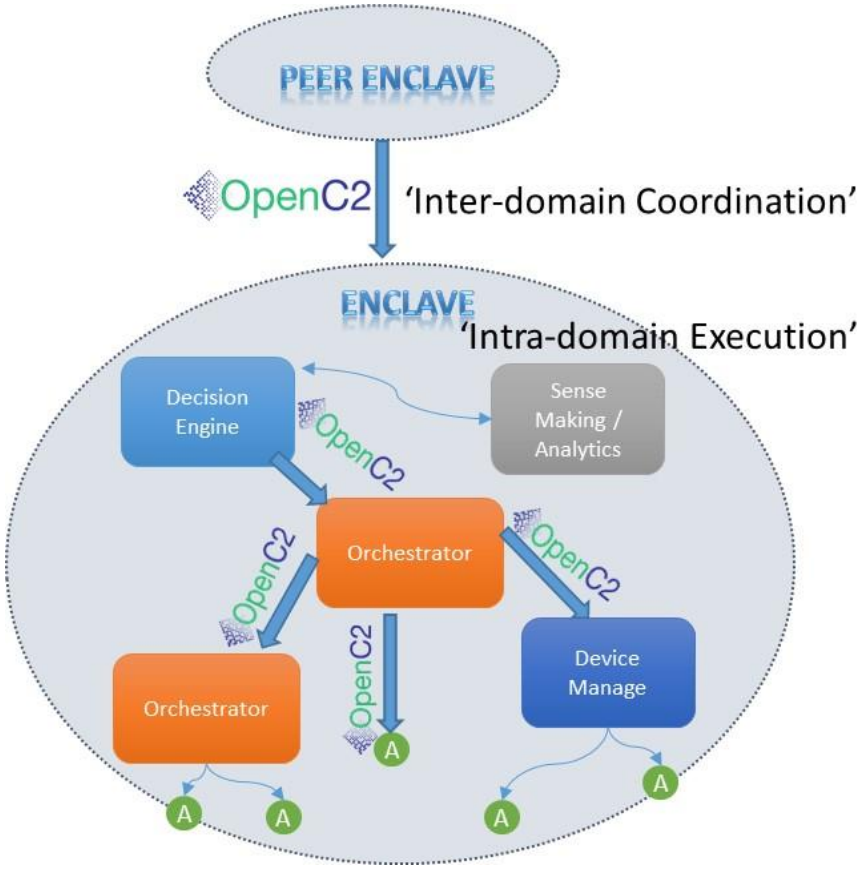


- Actuator profiles are the mechanism by which industry-specific knowledge is incorporated into the OpenC2 standard
  - Industry participation will enable success
  - Industry collaboration will define the distinction between the standard and product differentiators
- Actuators to be defined by capabilities
  - 'Hardware' based approach is redundant and does not support NFV
  - Multiple 'profiles' may be required
  - 'Foundational' profile?

# OpenC2 External Dependencies



- OpenC2 is necessary but insufficient
- OpenC2 Assumes
  - Decision has been made
  - Action is warranted
  - The command can get there intact and securely.
  - Recipient is authenticated and authorized.
- OpenC2 Focuses on the ACTING portion of cyber defense



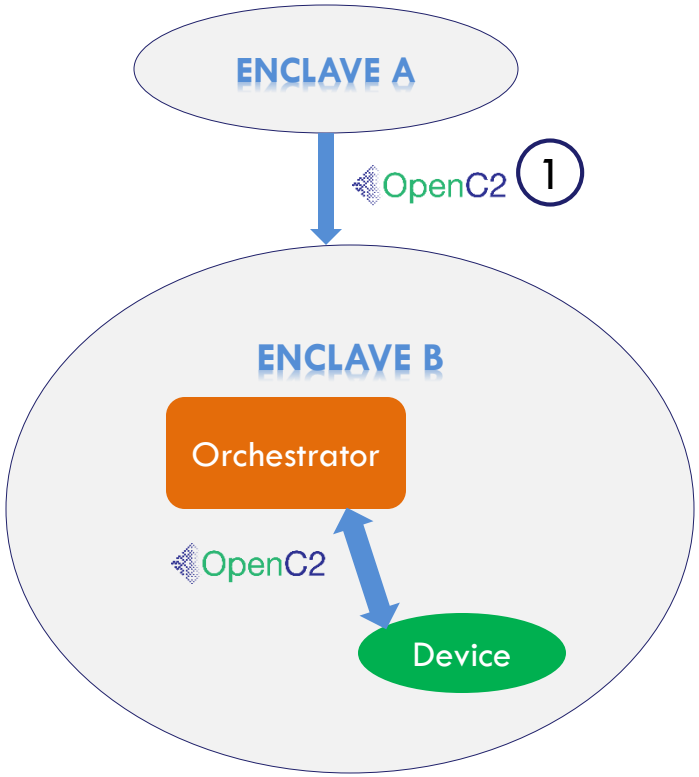

OpenC2 Implementations will FAIL without a robust means to convey commands!

# OpenC2 Assurance Threats - 1



① Threats against Inter-enclave C2 – an actor may:

- alter C2 message to degrade or halt defensive responses,
- send spoofed commands to open up enclave B to attack,
- view C2 traffic to gain warning of defensive responses,
- Disrupt network services to prevent delivery of C2 messages.

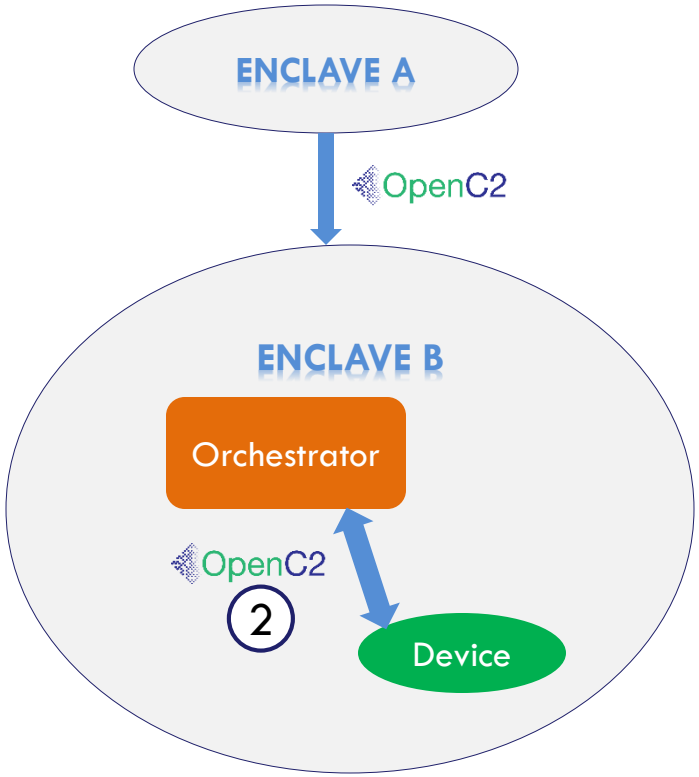


# OpenC2 Assurance Threats - 2



② Threats against intra-enclave C2 – an actor may:

- alter C2 messages to degrade or halt defensive responses,
- send false commands to open up an enclave for attack,
- Spoof C2 replies to disrupt defense or confuse defenders,
- Flood devices to prevent delivery of C2 messages.



# OpenC2 Derived Security Requirements



To combat or mitigate threats against inter- and intra-enclave cases, OpenC2 may need:

- **Confidentiality** – ability to control visibility of OpenC2 messages to only authorized recipients.
- **Integrity** – assurance that OpenC2 message sent is the message received
- **Authorization** – limit sending and receiving to authorized parties only
- **Authentication/Proof-of-Origin** – ability for all recipients to know the source of a message or identify of the sender
- **Availability** – assurance that messages can always be sent
- **Reliability** – assurance that messages are delivered to all intended recipients

# Prototypes Posted on Github



- Yuuki
  - University of Maryland
  - Implements OpenC2 as multiple dispatch on type
  - Actuators are dynamically created and hot swappable
- OrchID
  - Zepko
  - OpenC2 proxy built in Django
- OCAS
  - S-fractal
  - OpenC2 API Proxy written in ERLANG
- Pub-sub on bsd
  - G2
  - Implementation of OpenC2 on open source firewall written in C

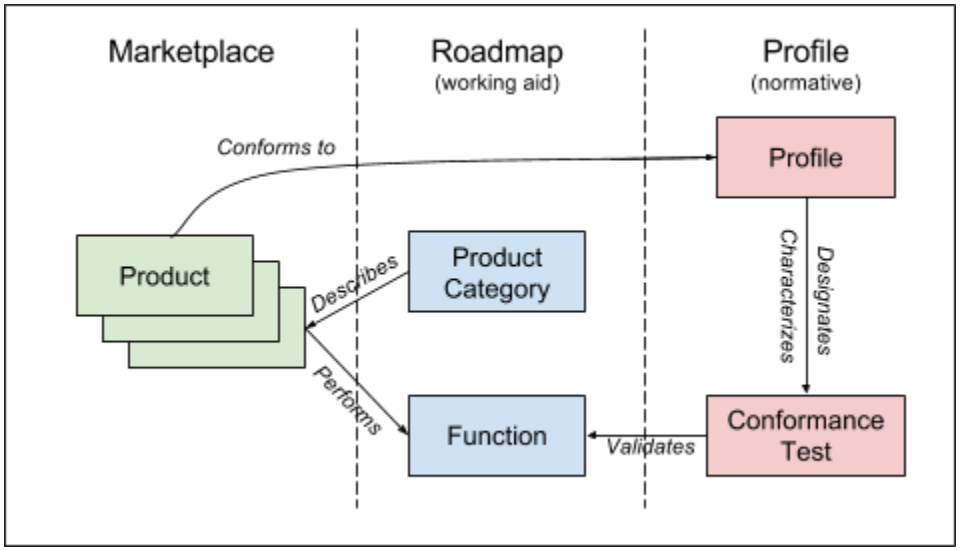
# Additional Prototype Efforts



- OpenDXL Message Fabric
  - Joint INTEL/ G2
- Cisco ASA Prototype Implementation
  - Orchestrator issues DENY and ALLOW to Cisco ASA based on CTIA update
- Reactor Master/ Reactor Relay
  - Zepko
  - Use of OpenC2 in inter-domain commanding use case
- IACD Course of Action Implementation
  - JHU/APL on behalf of NSA
  - 15 OpenC2 Actions issued to Nine actuators
  - Implemented in Java

# Actuator Roadmap






- Goals
  - Define initial set of cyber defense functions
  - Identify initial set of profiles to be developed
- Approach
  - Identify Product Categories & perform Market Survey
  - Identify the sent of functions/ features common across the category
  - Define conformance tests
  - Create Profile

# OpenC2 as a Concept



# At the Language Description Level



# OpenC2 at the Actuator Profile Level



- End Notes
  - Contribution: Status and Way Forward Brief by Joe Brule, Executive Director, OpenC2
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