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# Agile Integration of Complex Systems

Wayne O'Brien

# Agile Integration of Complex Systems

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**April 26 - 29**

Raimund Merkert, 508.490.2350

Wayne O'Brien, 540.886.2449

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3:00 PM - 3:45 PM

# Outline

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- Background and Problem
- Service Oriented Architecture (SOA) in DoD
- Baseline SOA
- Baseline SOA: Foundation (SOAF)
- Changes for Agile Integration
- Graphically enabled approach
  - SOAF vs. Graphically Enabled Discovery
  - SOAF vs. Graphically Enabled Messaging
  - SOAF vs. Graphically Enabled Mediation
- Summary

# Background and Problem

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- SOA is fundamental to DoD's Net-Centric Vision
- SOA provides a powerful infrastructure for integrating disparate systems and technologies through services
- Current practice relies heavily on human intervention for such integration that leaves little flexibility to the edge user

**Human intervention limits SOA flexibility for edge users**

# Background of Problem

- This presentation describes a graphically enabled method for reducing and simplifying the human intervention
  - Allows edge user to quickly identify non-organic systems and technologies of interest
    - Netted sensors
    - Netted effectors
    - C2
  - Provides agility during mission execution

**Human intervention in using SOA can be reduced**

# SOA in DoD

- DoD has mandated that all systems support the Network-Centric Environment and SOA is fundamental to realizing DoD's Net-Centric Vision (DoDAF 1.5, volume 2, p. xiv and DoDAF 2.0, volume 1, p. 2)
- SOA is mandated by multiple policies, reference architectures and models, and the acquisition process (see notes view)

**SOA is mandated by DoD**

# Baseline SOA

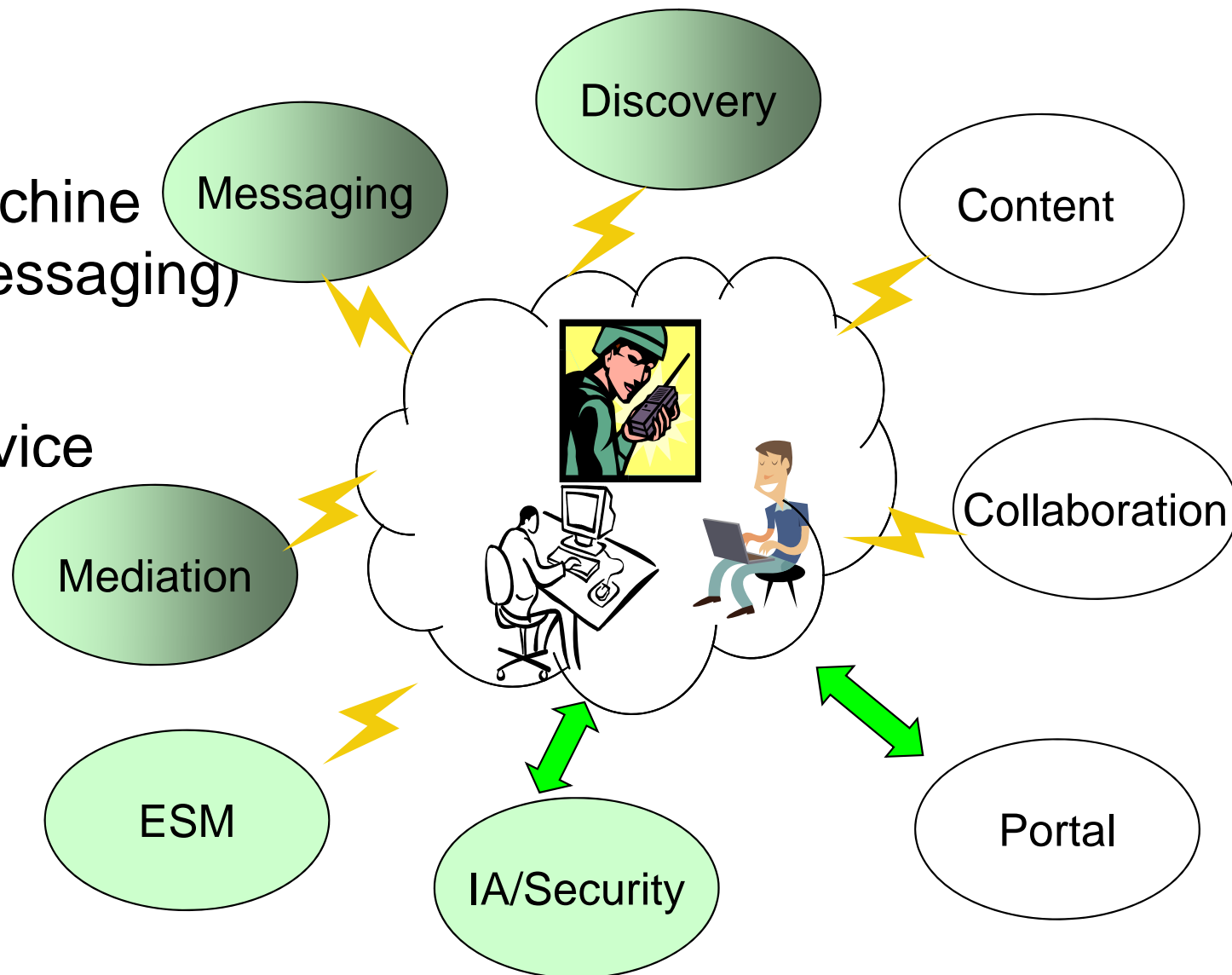
- DISA NCES CDD\*
  - Provides a baseline and taxonomy that are architecture-, technology-, and vendor-neutral
  - Describes Core Enterprise Services
  - Describes SOA Foundation Services within the Core
- Agile Integration is based on graphical enablement of three of the Foundation Services

\*DISA. "Capability Development Document (CDD) for Net-Centric Enterprise Services (NCES)." Increment 1.0, Version 1.0, May 2006

**DISA NCES CDD provides a baseline for SOA**

# Baseline SOA: Foundation (SOAF)

- Discovery
- Machine to Machine Messaging (Messaging)
- Mediation
- Enterprise Service Management
- IA/Security



**Foundation services provide net-centric infrastructure**



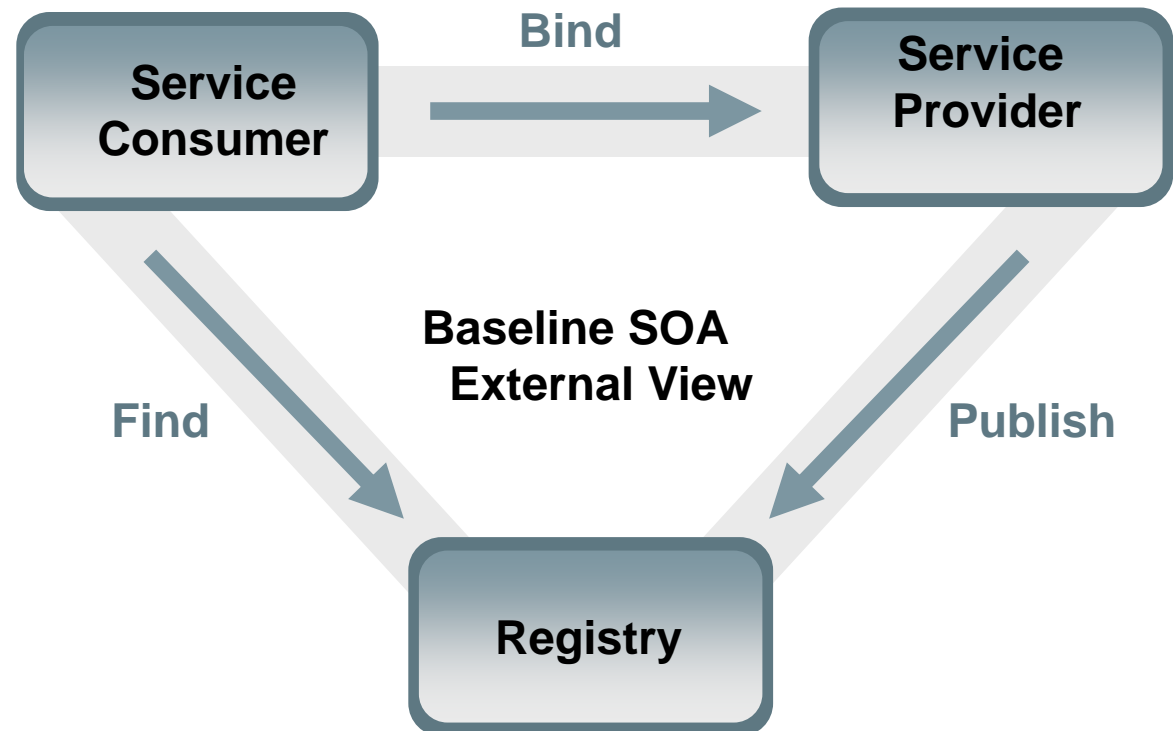
# Changes for Agile Integration

- SOAF Service Discovery Service
  - Change how provider registers
  - Change how consumer finds and binds
- SOAF Messaging Service
  - Change subscription flow
  - Change alert flow
  - Change notification flow
- SOAF Mediation Service
  - Create workflow during mission execution
  - Preprovision
    - Adaptors
    - Translators

**Changed three SOAF services**

# SOAF Service Discovery Service

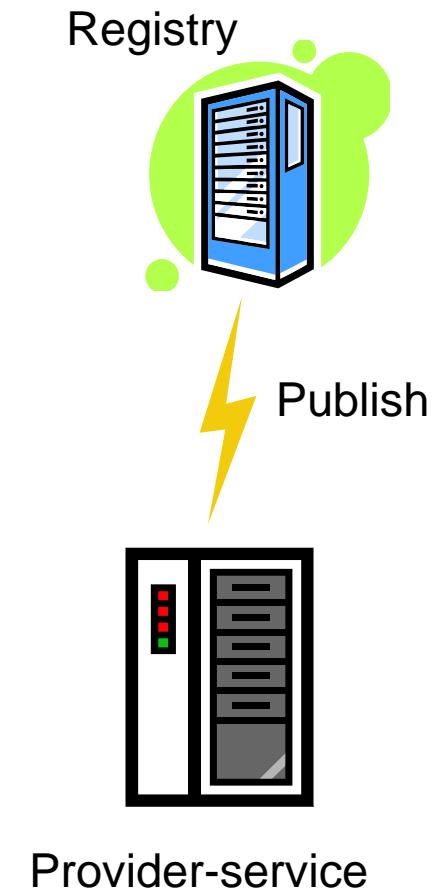
- Registries
- Consumers
- Providers
- Publish
- Find
- Bind (assign)



**Discovery needed to link decoupled providers and consumers**

# SOAF Service Discovery – Provider

- Publish endpoints and metadata
  - Obtain certification to publish to registry
  - Use general registries
    - Service
    - Metadata
  - Publicize locations
    - Locations widely distributed
    - Available through internet searches
    - Open to large populations
    - Consumer not known in advance
    - Time of access not known in advance



**Large open registries with unanticipated users**

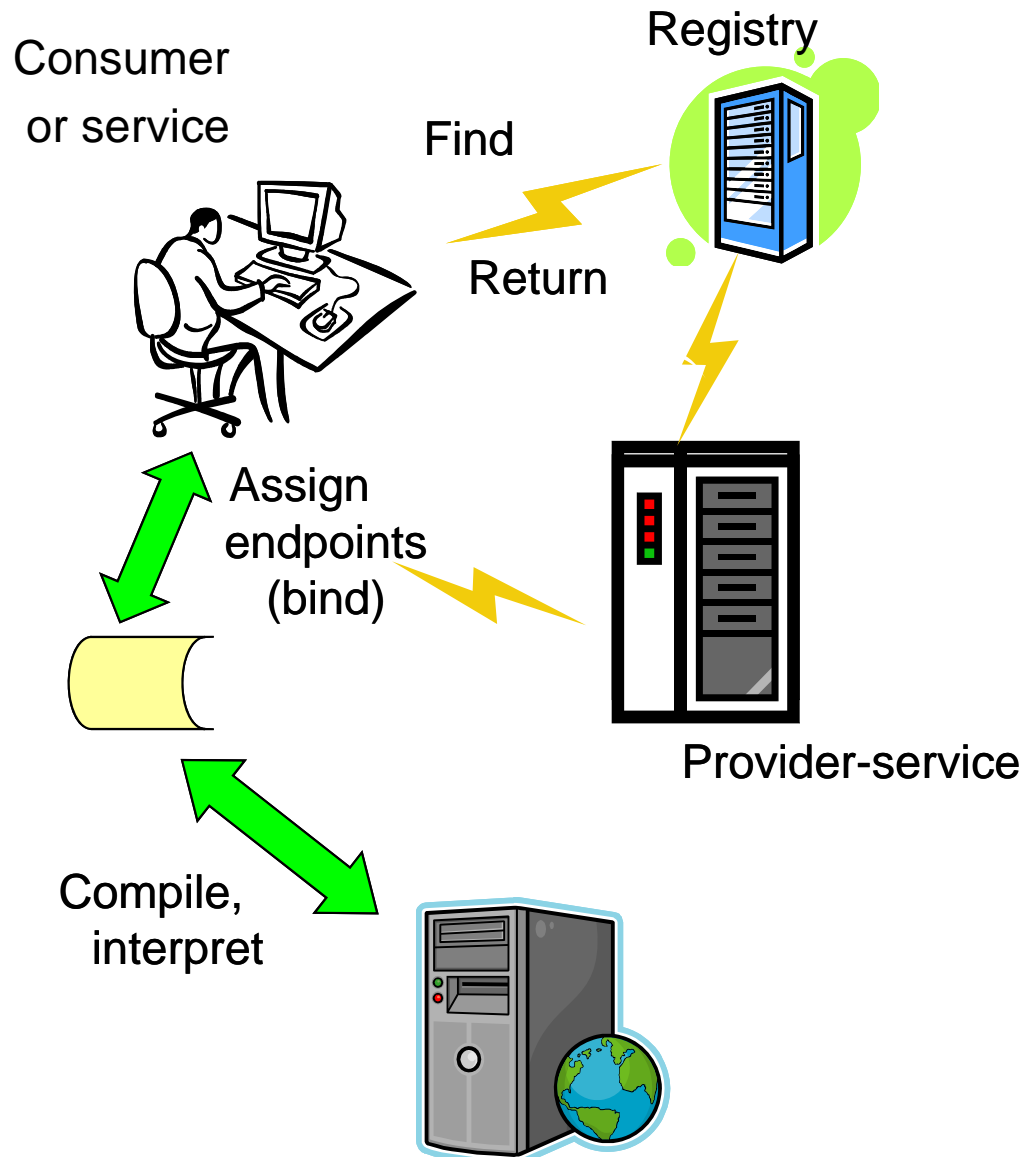
# SOAF Service Discovery – Consumer

## ■ Design time

- Search registries manually
- Find required services
- Assign endpoints in code and compile (bind)
- Human intervention

## ■ Runtime

- Find services dynamically (service)
- Latency
- Uncertainty



**Human intervention or latency, uncertainty**

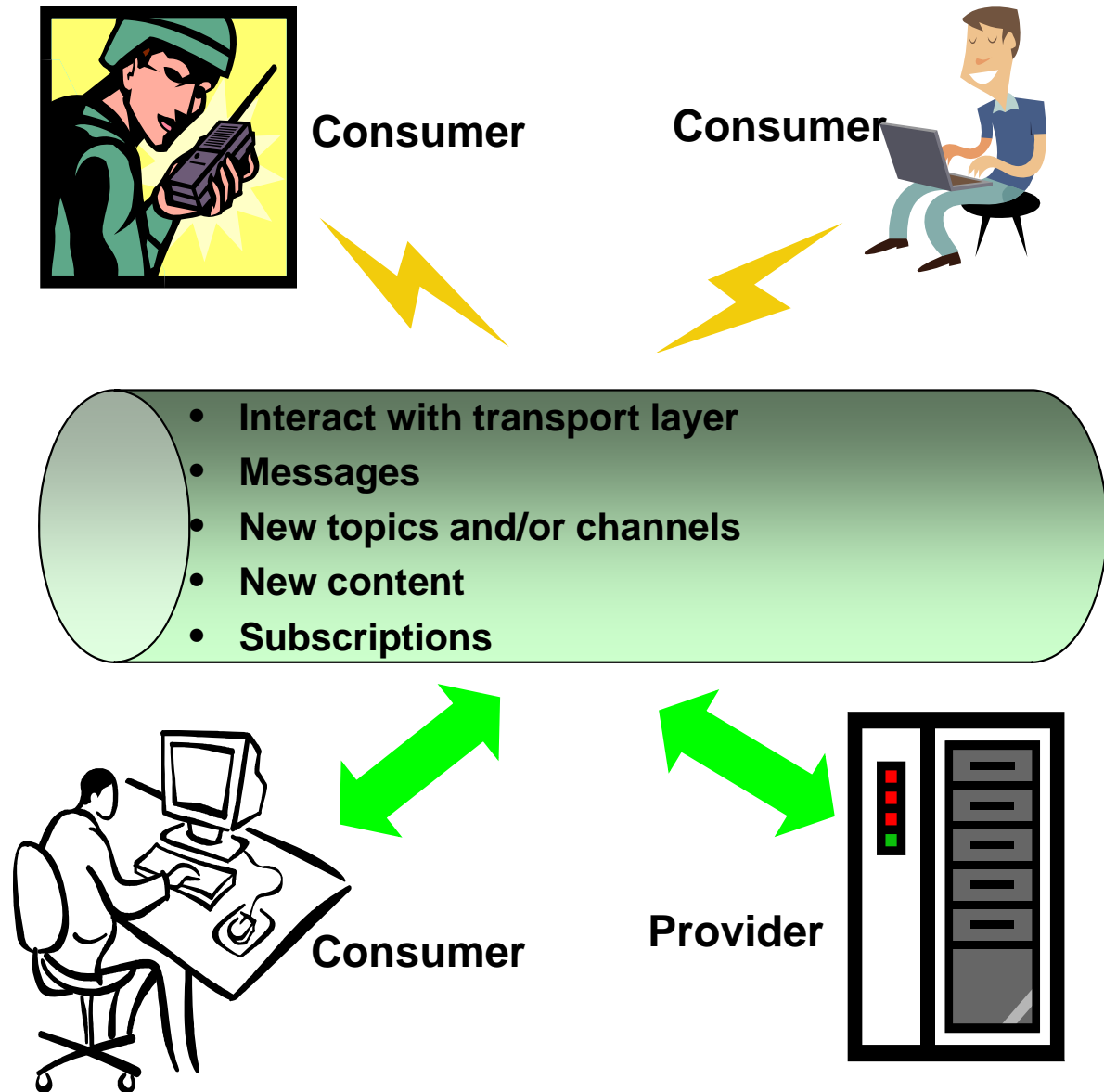
# Graphically Enabled Discovery

- Functions reduced to enabling selection of displayed services
  - General purpose registries not used
  - Based on Community of Action (CoA) registry (slide 16)
- Whatever is placed on the edge-user's display is available for the mission
- Edge user finds a service by selecting a displayed icon
- Edge user binds the service by dragging it and dropping it on an orchestrate icon (slide 22)

**Discovery simplified and made visual**

# SOAF Messaging Service

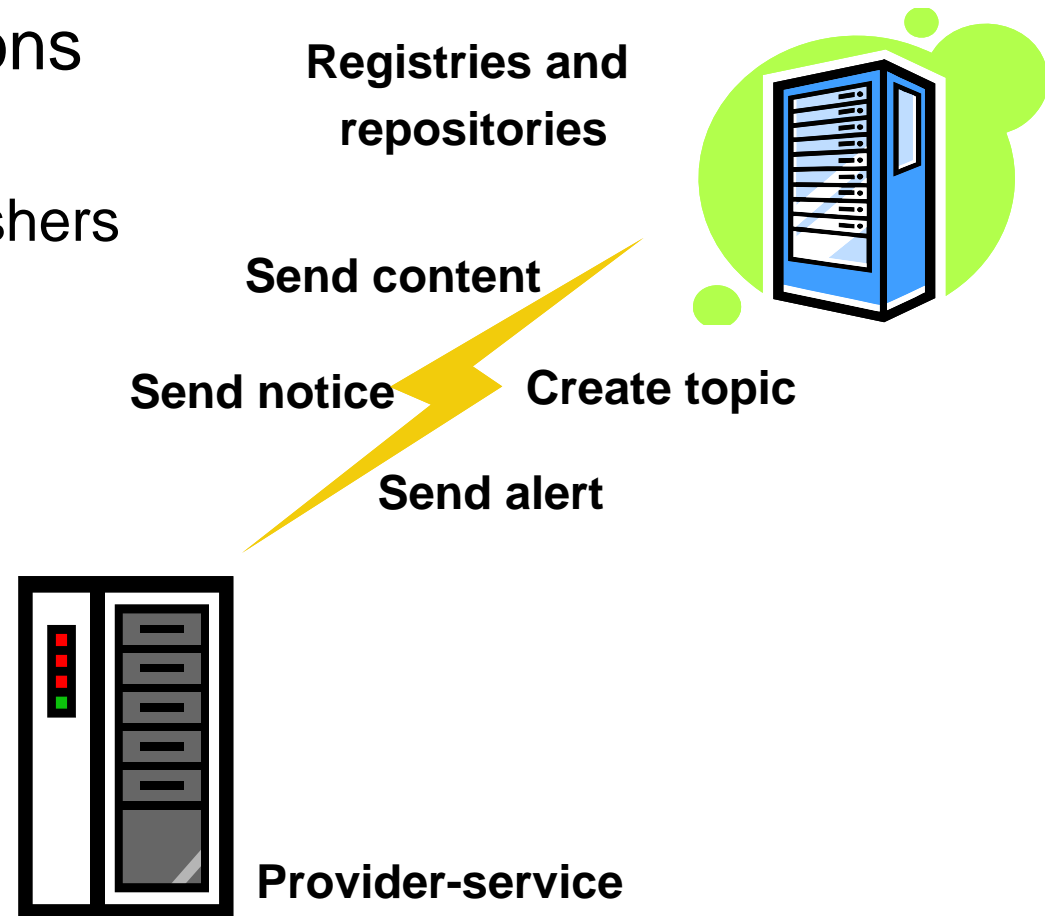
- Transport
- Receive, route, queue, and deliver messages
- Create new topics and/or channels
- Transmit new content
- Process subscriptions
  - New
  - Results
  - Alerts
  - Notices



**Messaging is more than a data bus**

# SOAF Messaging – Provider

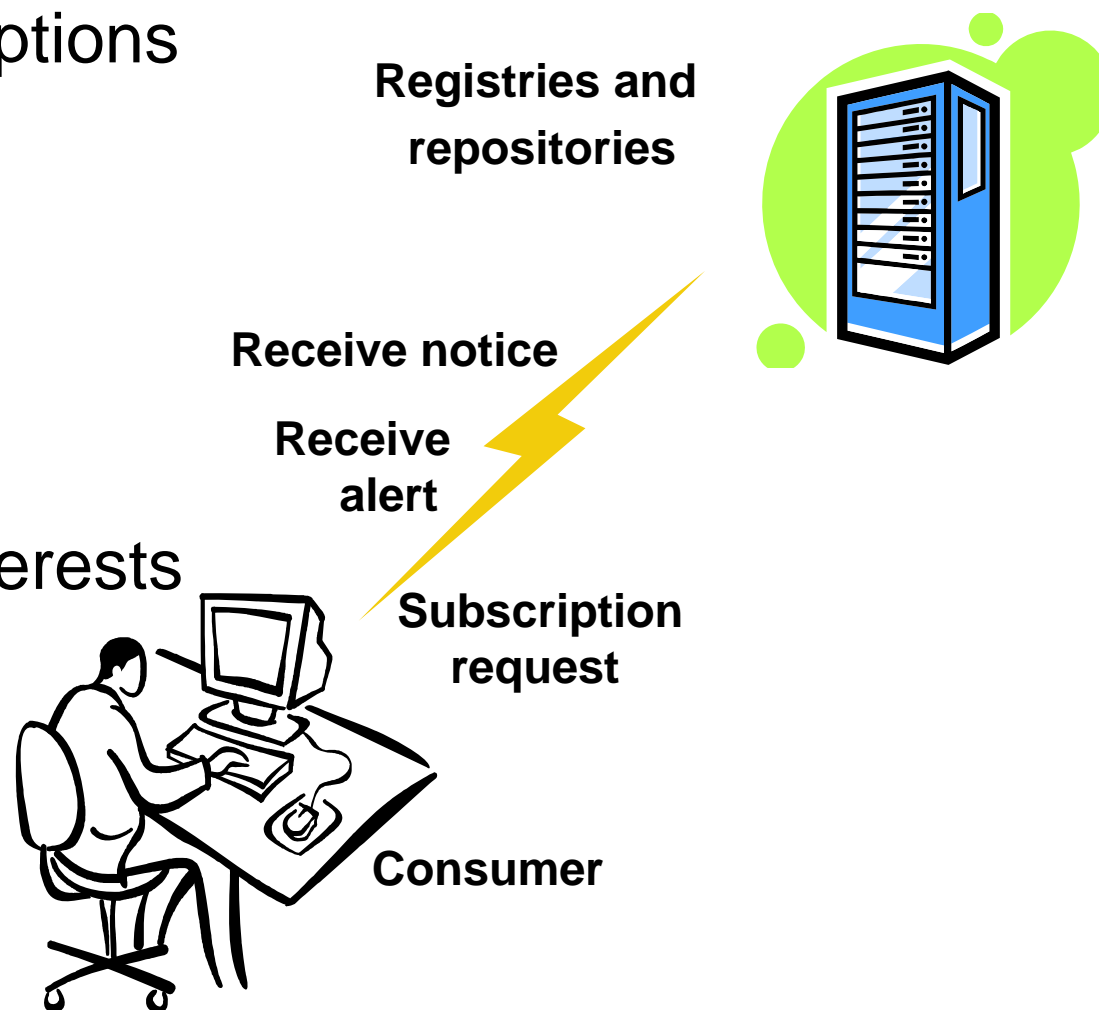
- Respond to new publications
  - Create new topic or channel
  - Send new content from publishers



**Messaging is in background**

# SOAF Messaging – Consumer

- Respond to new subscriptions
  - Topic or channel
  - Interests or preferences for content
- Send alerts for topics or channels
- Send notifications for interests or preferences (content available)



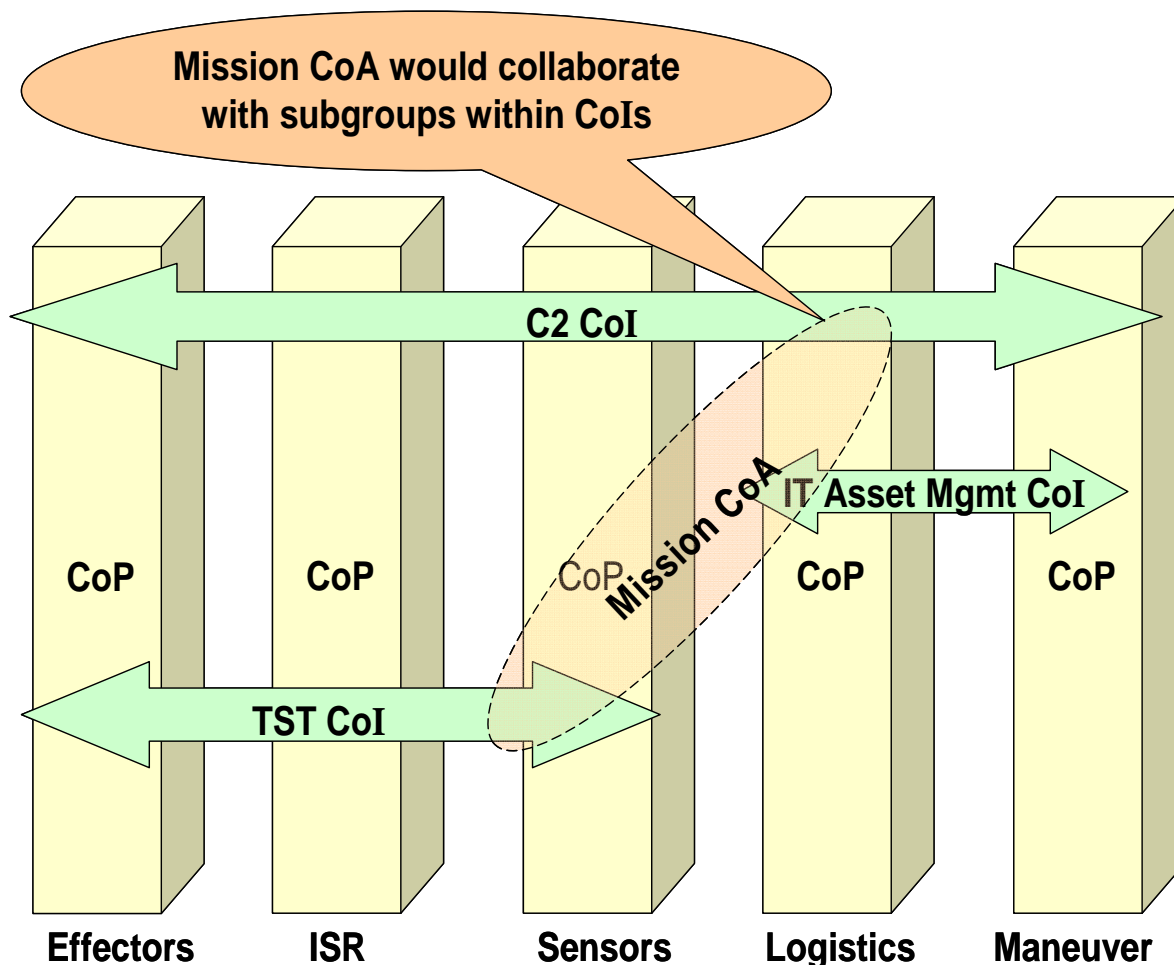
**Messaging is in background**



# Graphically Enabled Messaging

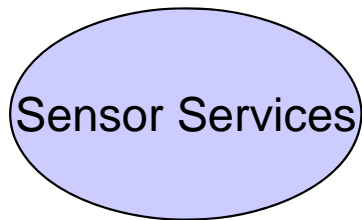
- Registry based on CoA
  - Providers and services
  - Consumers and interests
  - Details for mediation

- Consumer entry effectively subscribes consumer to all of the services included with the consumer interests

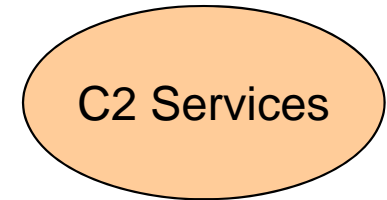


**Mission-limited registry**

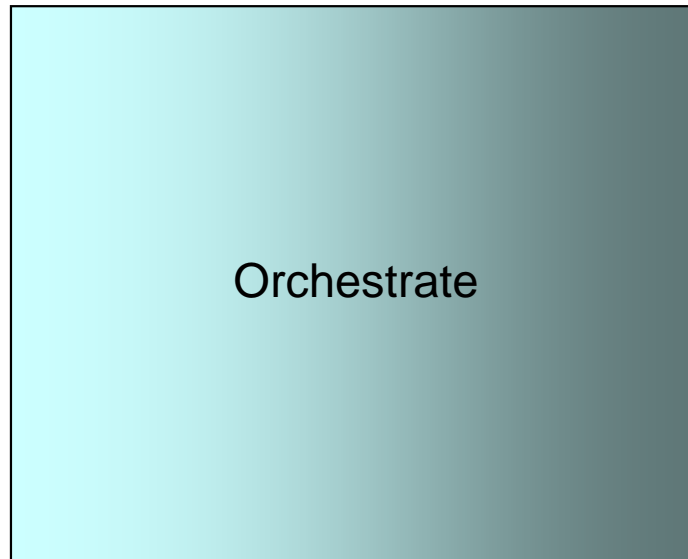
# Graphically Enabled Messaging



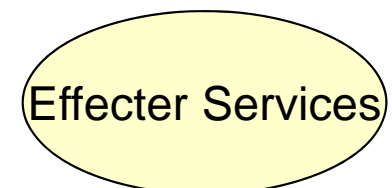
Event service responds to new entries in CoA registry



Alert provided when display service displays icon for new service on all CoA displays



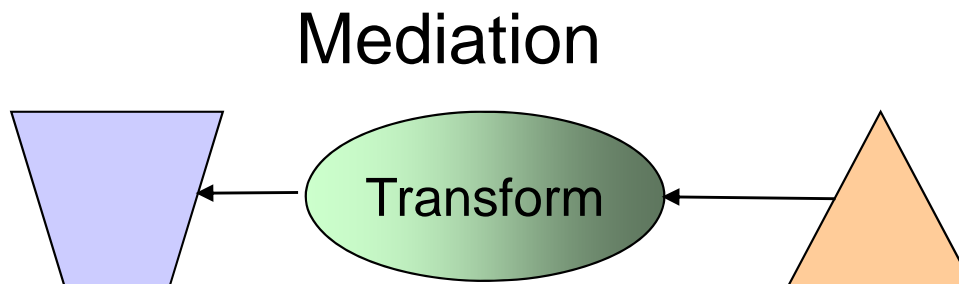
Consumers implicitly subscribe to services when they register in CoA registry



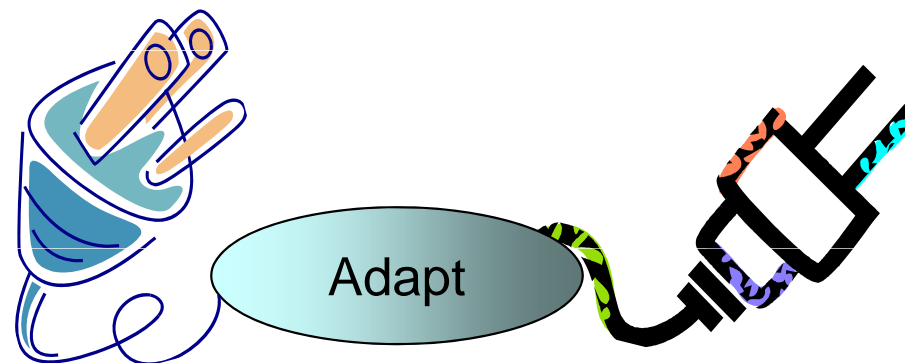
**Messaging is in foreground**

# SOAF Mediation Service

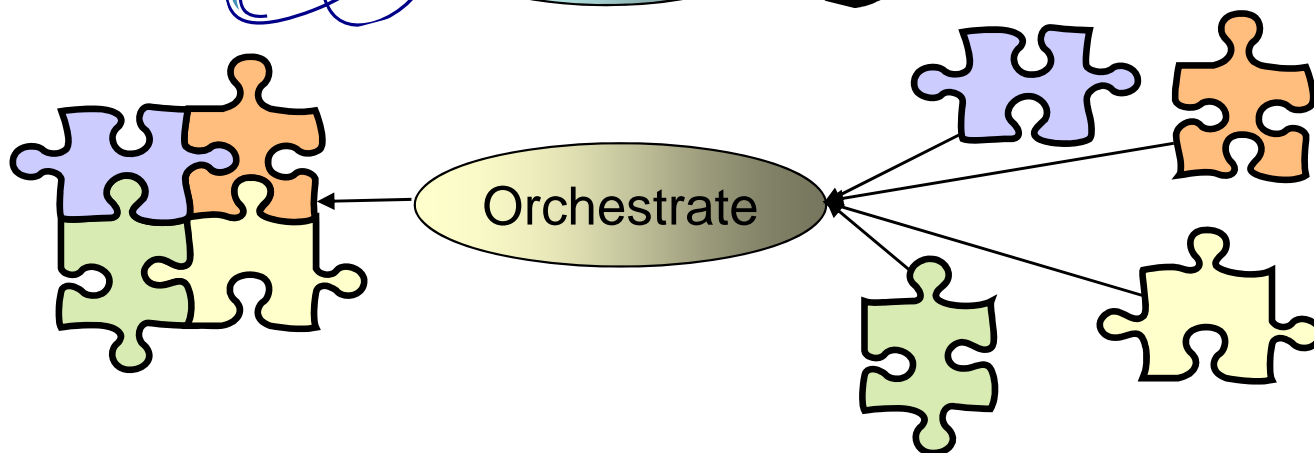
- Transformation



- Adaptation



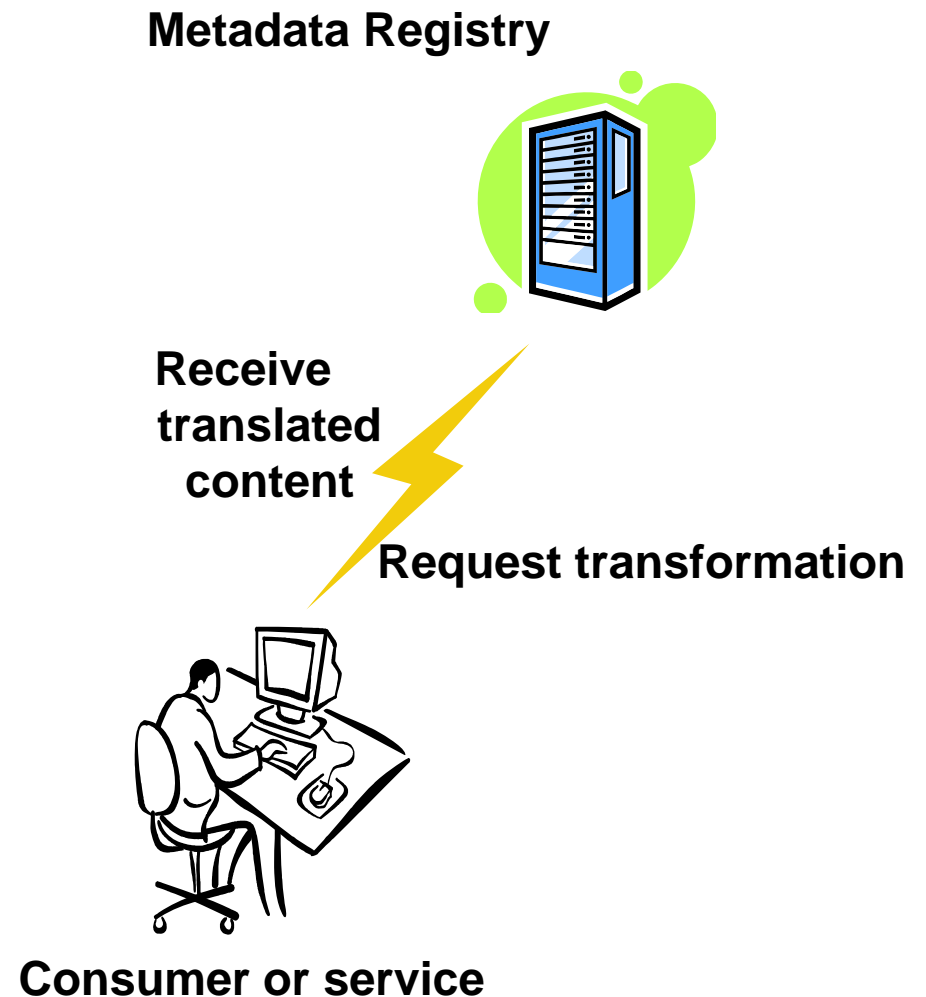
- Orchestration



**Mediation enables integration of services from disparate systems**

# SOAF Mediation – Transformation

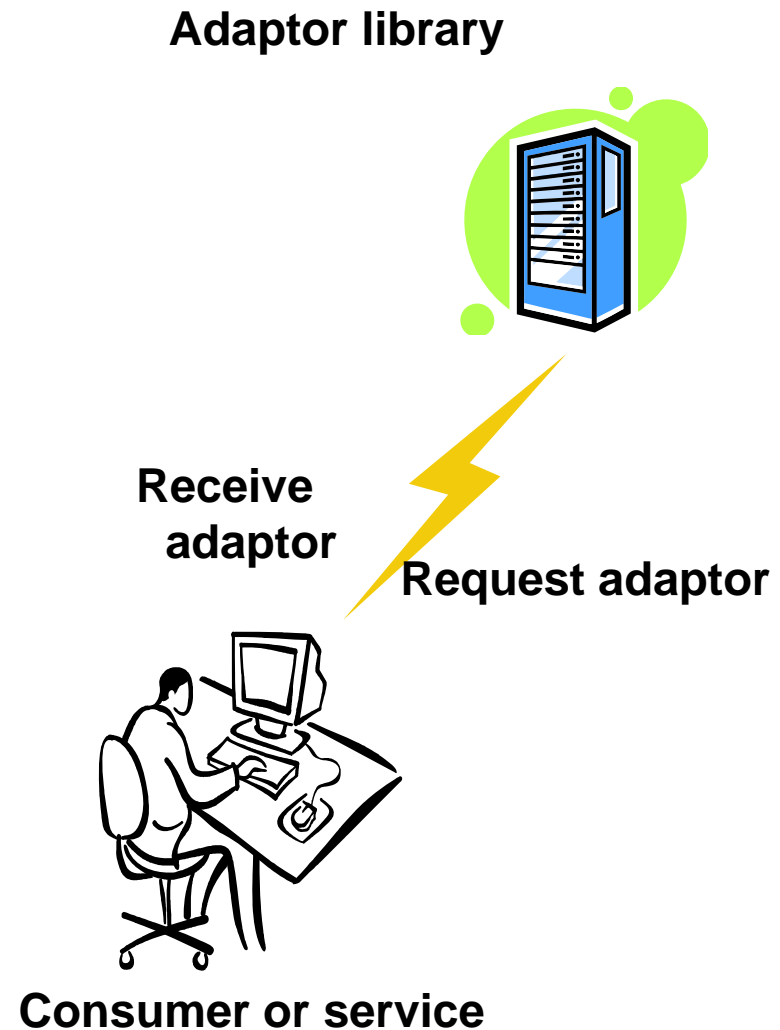
- Respond to requests for format translation for content
- Find transformation, e.g., relevant schemas
- Translate content, e.g., from one XML schema to another for consumer



**Transformation explicitly requested**

# SOAF Mediation – Adaptation

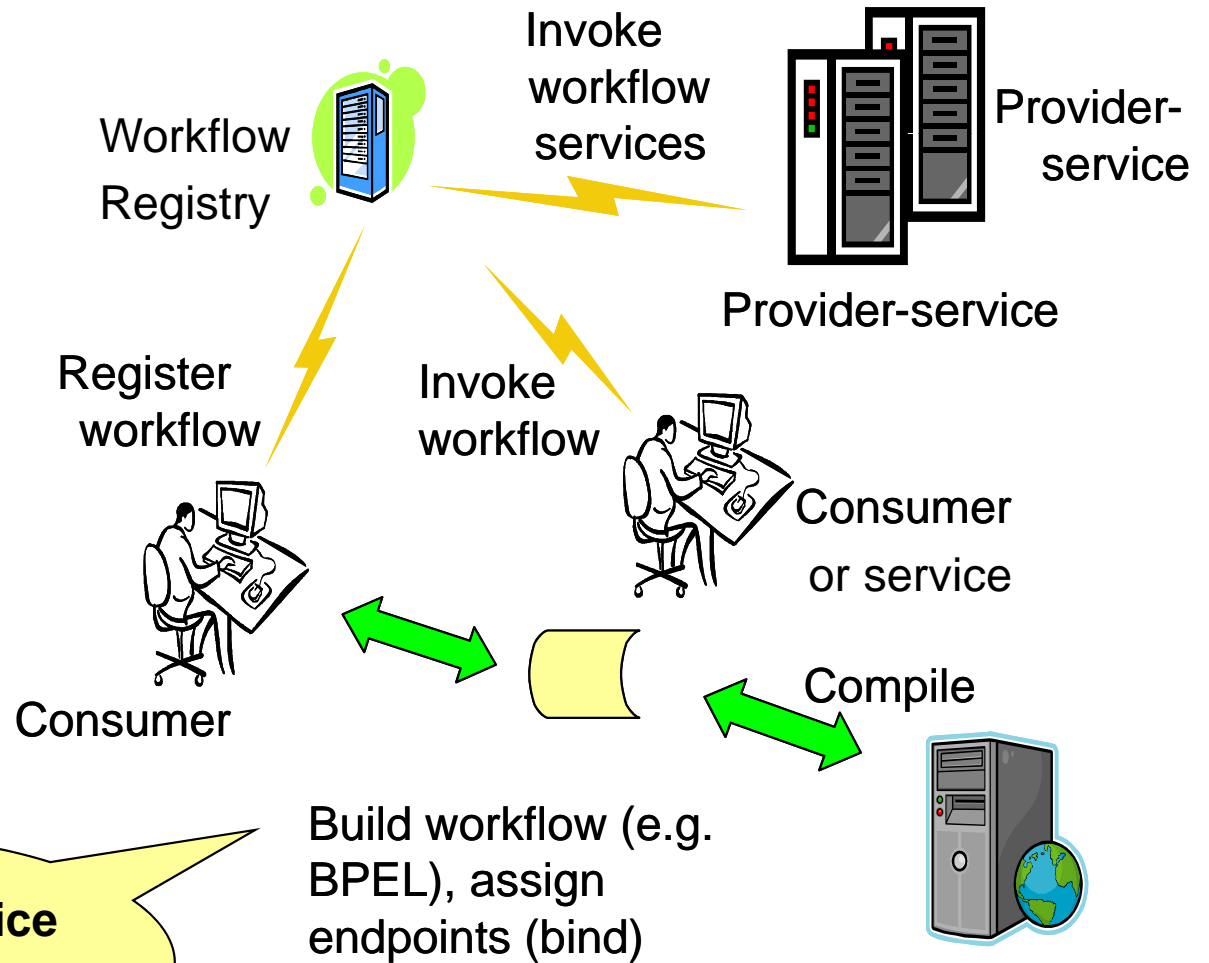
- Respond to requests for protocol adaptor
- Find adaptor
- Return adaptor to consumer



**Adaptation explicitly requested**

# SOAF Mediation – Orchestration

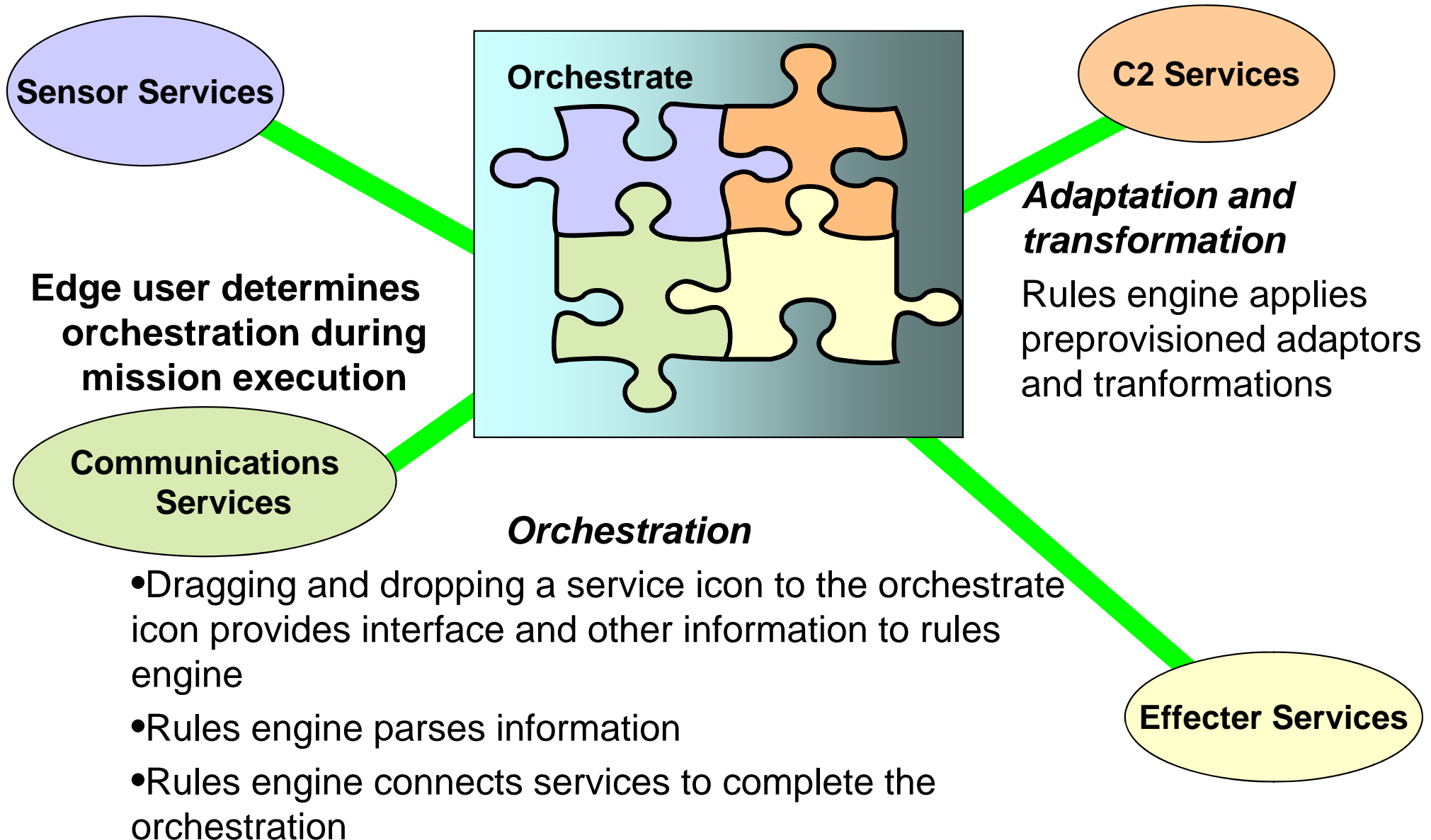
- Create and register workflow script
- Retrieve workflow script (for same or different consumer)
- Execute workflow script (services from one or more providers)



**May require service discovery for endpoints**

**Orchestrate at design and plan time**

# Graphically Enabled Mediation



**Orchestrate during mission execution**

# Summary

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- Four fundamental differences run across all three graphically enabled services
  - Graphically displayed registry
  - Mission-limited registry
  - Consumers register, but don't subscribe explicitly
  - Registry-driven
- Agile Integration provides the edge-user increased flexibility during mission execution
- Agile integration combines aspects of corresponding SOAF services as part of specializing them



# Summary

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- There are extensions to what was demonstrated that would be worth investigating and potentially developing
  - Creating contingency pools for resources through real-time resource management
  - Including interfaces between resource management and the CoA registry
- There are implications for doctrine and training to maximize the agility and related benefits

# Acronyms

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- BPEL: Business Process Execution Language
- CDD: Capability Development Document
- CoA: Community of Action
- CoI: Community of Interest
- CoP: Community of Practice
- DoDAF: DoD Architecture Framework
- ESB: Enterprise Service Bus
- ESM: Enterprise Service Management
- IA: Information Assurance
- JCIDS: Joint Capabilities Development System
- NCES: Net-Centric Enterprise Services
- SOA: Service Oriented Architecture
- SOAF: SOA Foundation
- UDDI: Universal Description, Discovery, and Integration Services
- WSDL: Web Service Definition Language
- XML: eXtensible Markup Language