Near Real-Time Multi-Source Flow Data Correlation

Carter Bullard
QoSient, LLC

carter@qosient.com

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Problem Statement

- Cyber incident attribution and forensics, is a complex process.
- To assist in security incident response, recognizable hostile activity needs to be associated with other information system behavior in order to understand the complete cyber security incident life cycle
  - SSH flow is used to log in as root, and run a rogue program to exfiltrate data from the enterprise.
- Flow status information provides great transactional network traffic audit data
- How to correlate flow data to provide extended situational awareness to address complex cyber security events.

Data Correlation

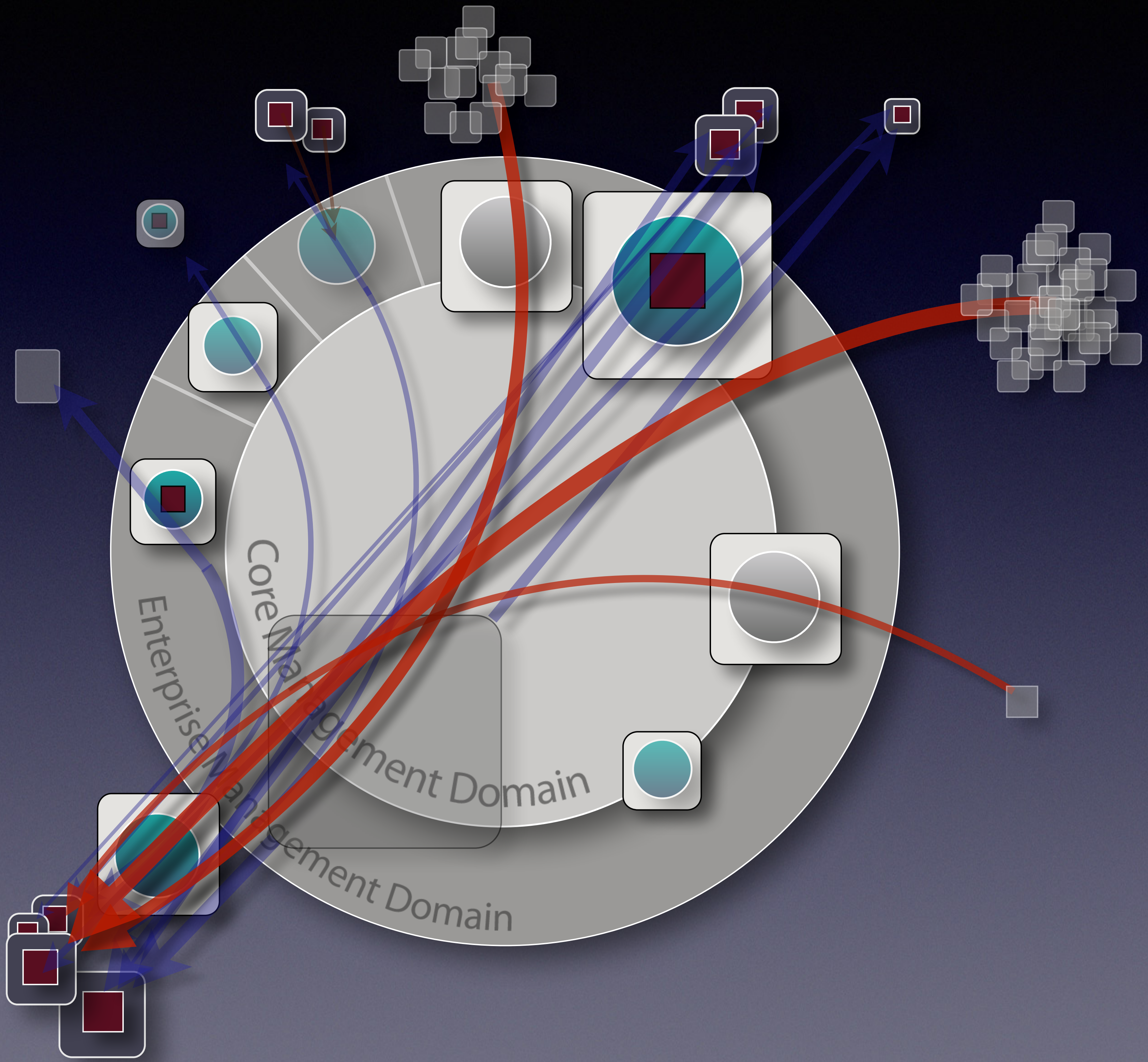
- Semantic Enhancement
  - Classification Information
    - Geospatial - Geolocation information
    - Netspatial - Virtual positioning information
    - Community of Interest
    - Application
  - Origination information
    - User / Machine
- State based alerting / alarming
  - Intrusion detection

Data Correlation Strategies

- Flow Attribute Matching
  - Flow Identifiers
  - Protocol specific identifiers
  - Packet Dynamics
    - Inter-packet arrival times
    - Packet Size
  - Transactional Dynamics
    - Duration
- Non-flow Attribute Matching
  - Time
  - Observation Domain
  - Cross Domain Transactional Keys
  - Flow Identifiers

Distributed Situational Awareness

Attack Scenarios - External Threats



⬜ White/Visible Node

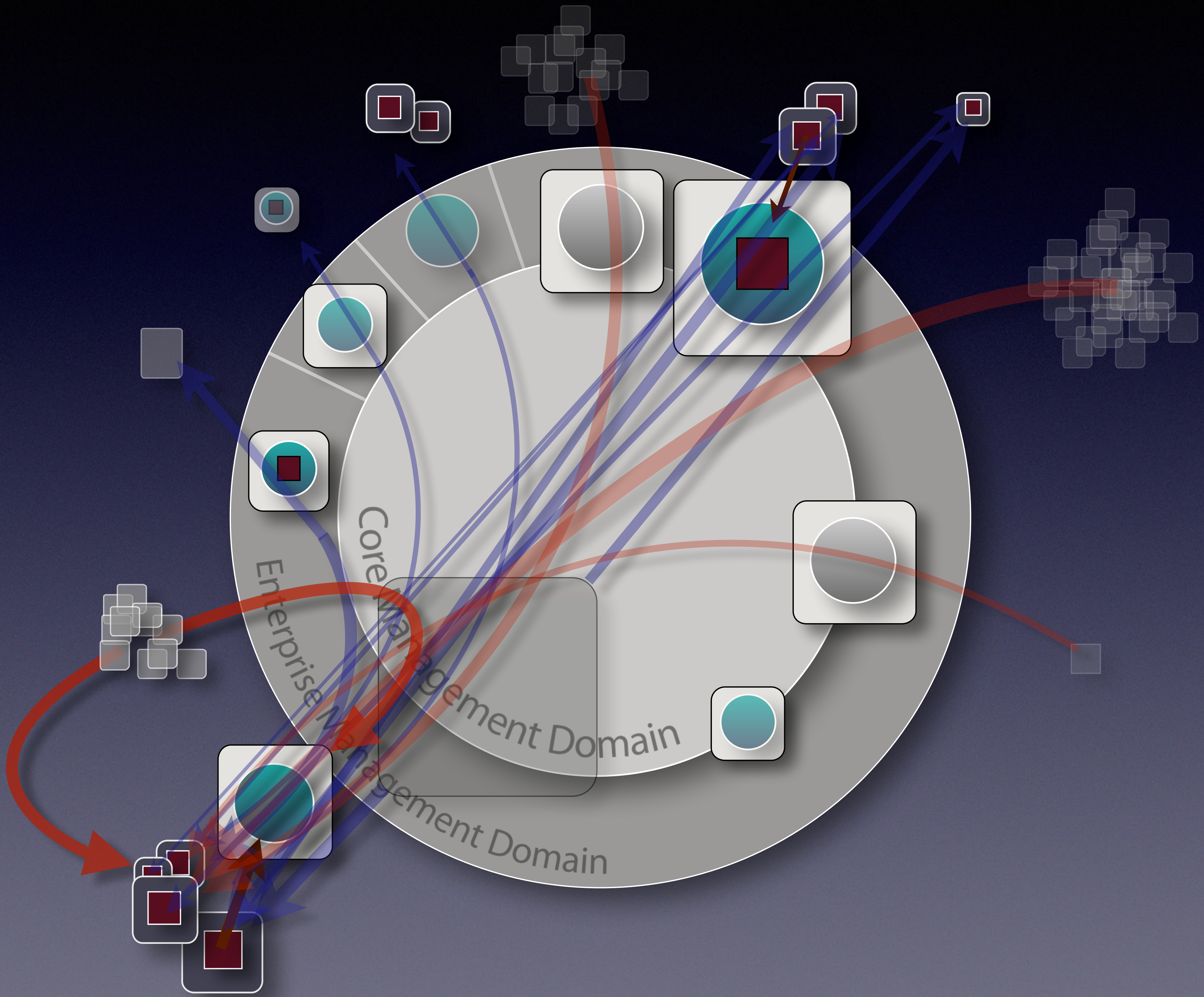
⬛ Black/Non-Visible Node

🟦 Data Plane

🟥 Command and Control Attack Traffic

Distributed Situational Awareness

Attack Scenarios - Interior Exterior Spoofing



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🟦 Data Plane

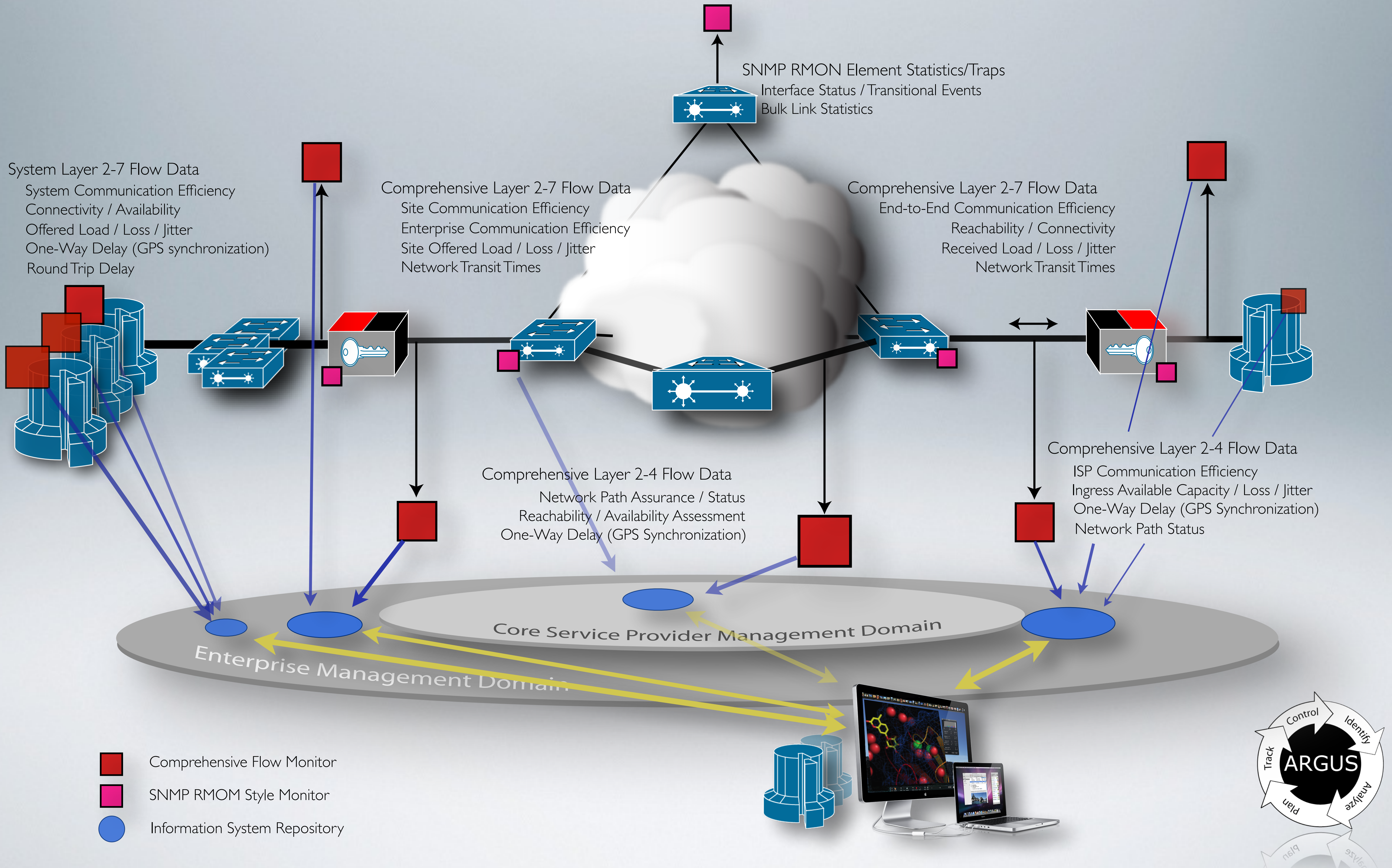
🟥 Command and Control
Attack Traffic

Spoof Correlation

- Simple multi-domain flow correlation
- However, with NAT, encryption, tunneling, traditional flow correlation is not possible.
  - No applicable flow identifiers for matching
  - Flow granularity mismatch
- Need flow metadata to make assessment
  - Content
  - Time
  - Packet dynamics (PD).
- Absence of correlation is the key
  - Statistical systems are unusable

End-to-End Situational Awareness

Network Optimization - Black Core Mesh



SNMP RMON Element Statistics/Traps
Interface Status / Transitional Events
Bulk Link Statistics

System Layer 2-7 Flow Data
- System Communication Efficiency
- Connectivity / Availability
- Offered Load / Loss / Jitter
- One-Way Delay (GPS synchronization)
- Round Trip Delay

Comprehensive Layer 2-7 Flow Data
- Site Communication Efficiency
- Enterprise Communication Efficiency
- Site Offered Load / Loss / Jitter
- Network Transit Times

Comprehensive Layer 2-7 Flow Data
- End-to-End Communication Efficiency
- Reachability / Connectivity
- Received Load / Loss / Jitter
- Network Transit Times

Comprehensive Layer 2-4 Flow Data
- Network Path Assurance / Status
- Reachability / Availability Assessment
- One-Way Delay (GPS Synchronization)

Comprehensive Layer 2-4 Flow Data
- ISP Communication Efficiency
- Ingress Available Capacity / Loss / Jitter
- One-Way Delay (GPS Synchronization)
- Network Path Status

Core Service Provider Management Domain
Enterprise Management Domain
Control
Identify
Analyze
Plan
Track
ARGUS

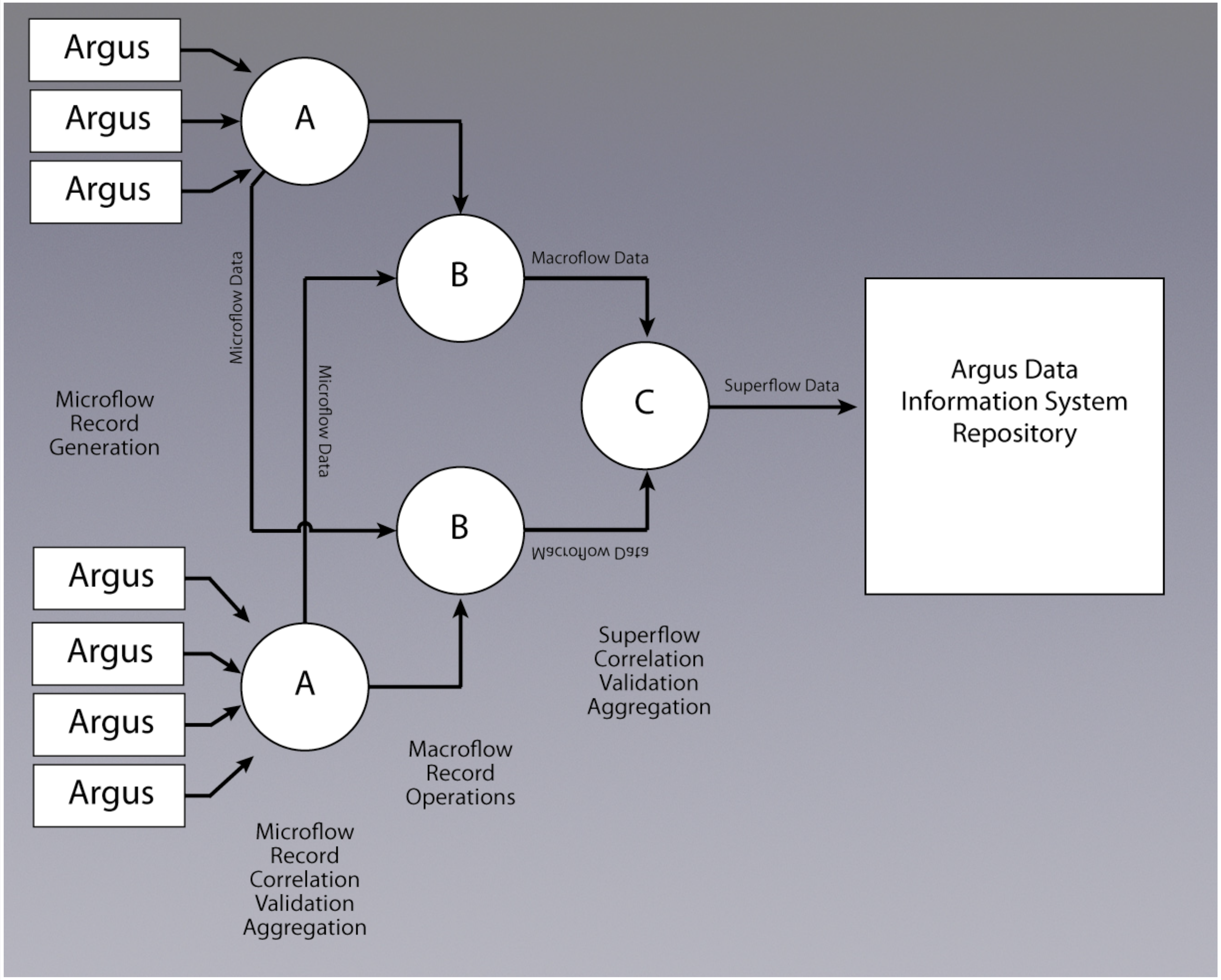
🟥 Comprehensive Flow Monitor

🟪 SNMP RMOM Style Monitor

● Information System Repository

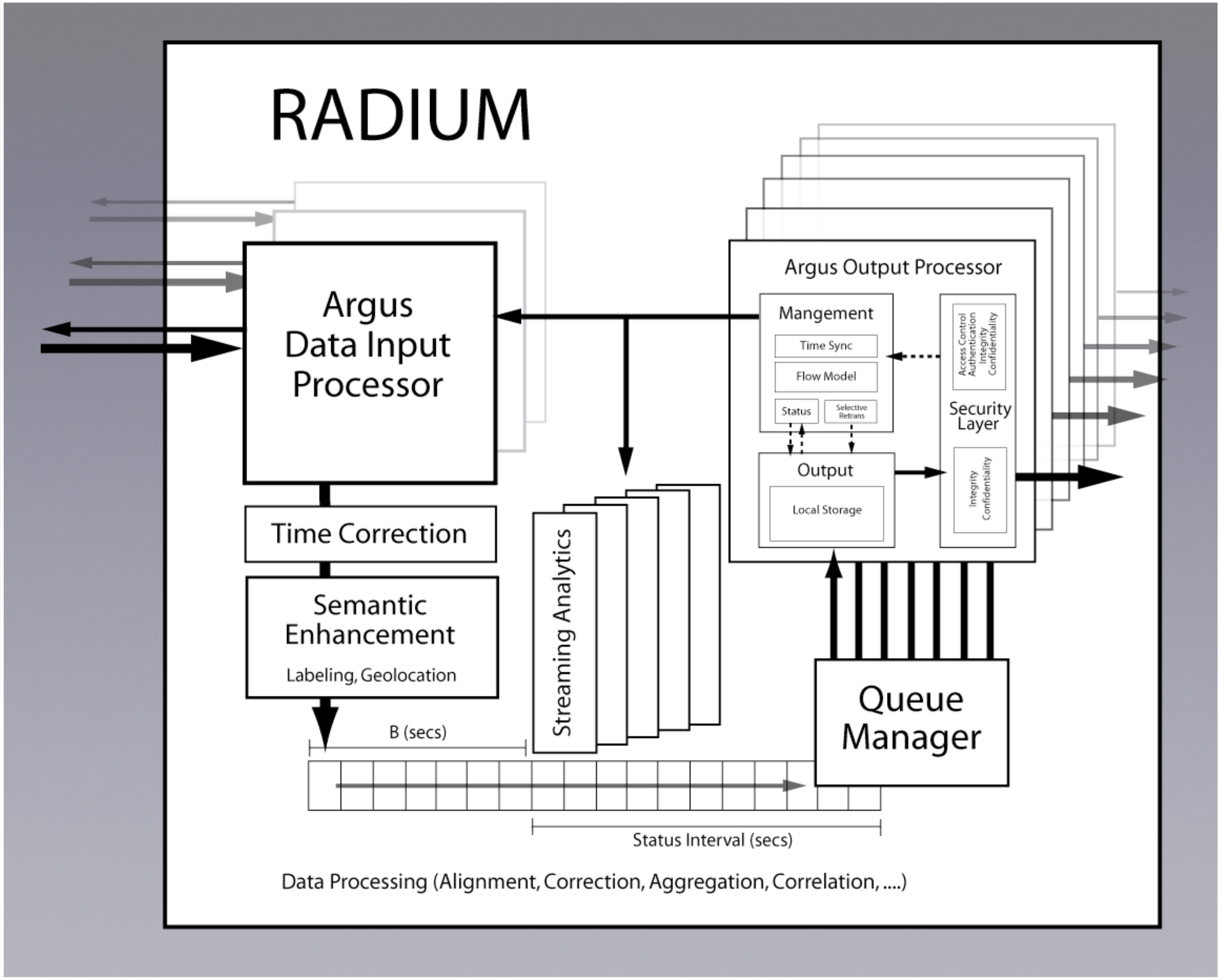
Radium

Data Flow Machine Architectures


Argus
Argus
Argus
A
Microflow Data
B
Macroflow Data
Microflow Data
C
Superflow Data
Argus Data Information System Repository
Microflow Record Generation
B
Macroflow Data
Argus
Argus
A
Argus
Argus
Superflow Correlation Validation Aggregation
Macroflow Record Operations
Microflow Record Correlation Validation Aggregation

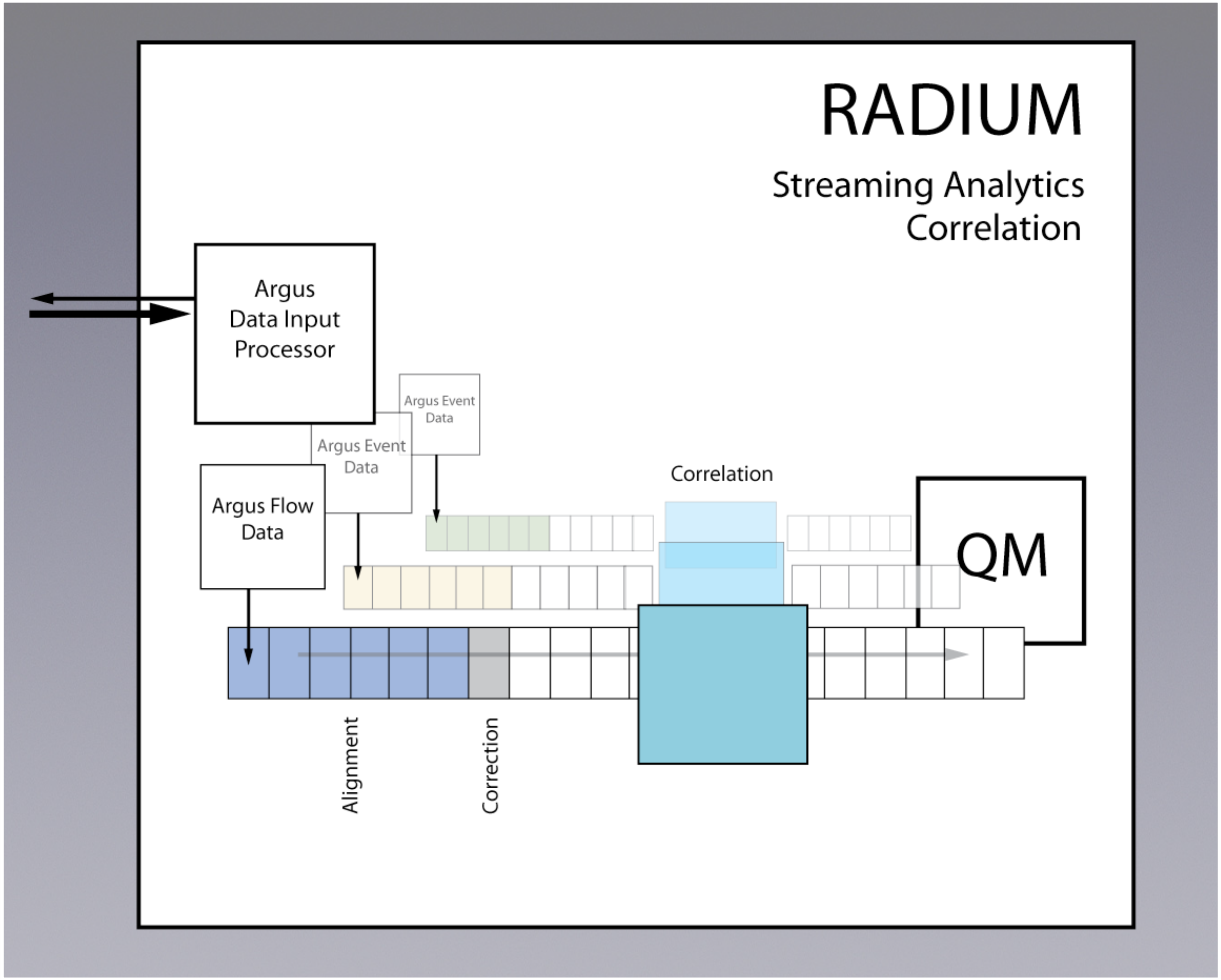
Radium

Data Flow Design



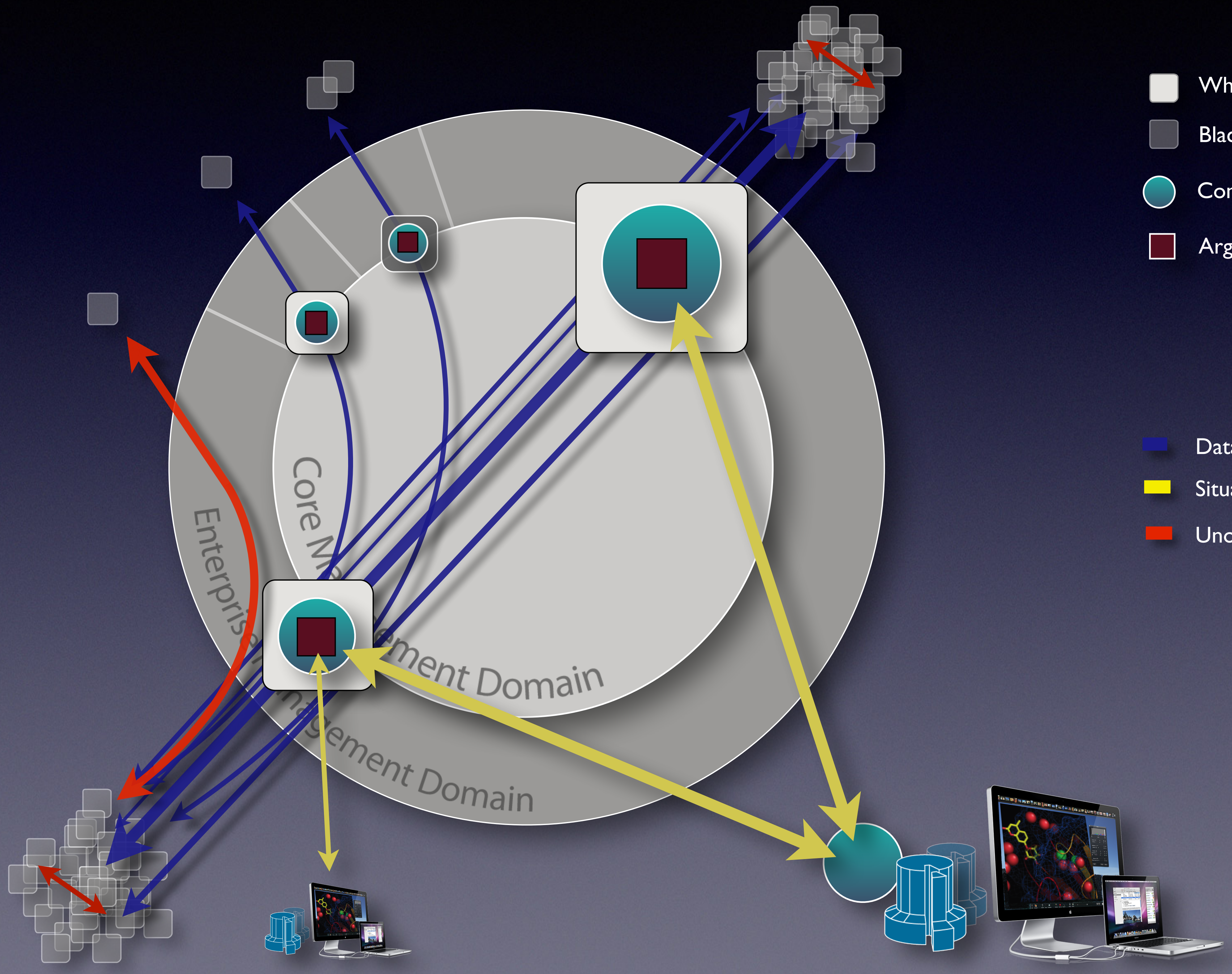
Radium

Data Flow Design



Enterprise Border Awareness

Outside Inside / Them vs Us



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● Comprehensive Flow IS

🟥 Argus Sensor

🟦 Data Plane

🟨 Situational Awareness Data

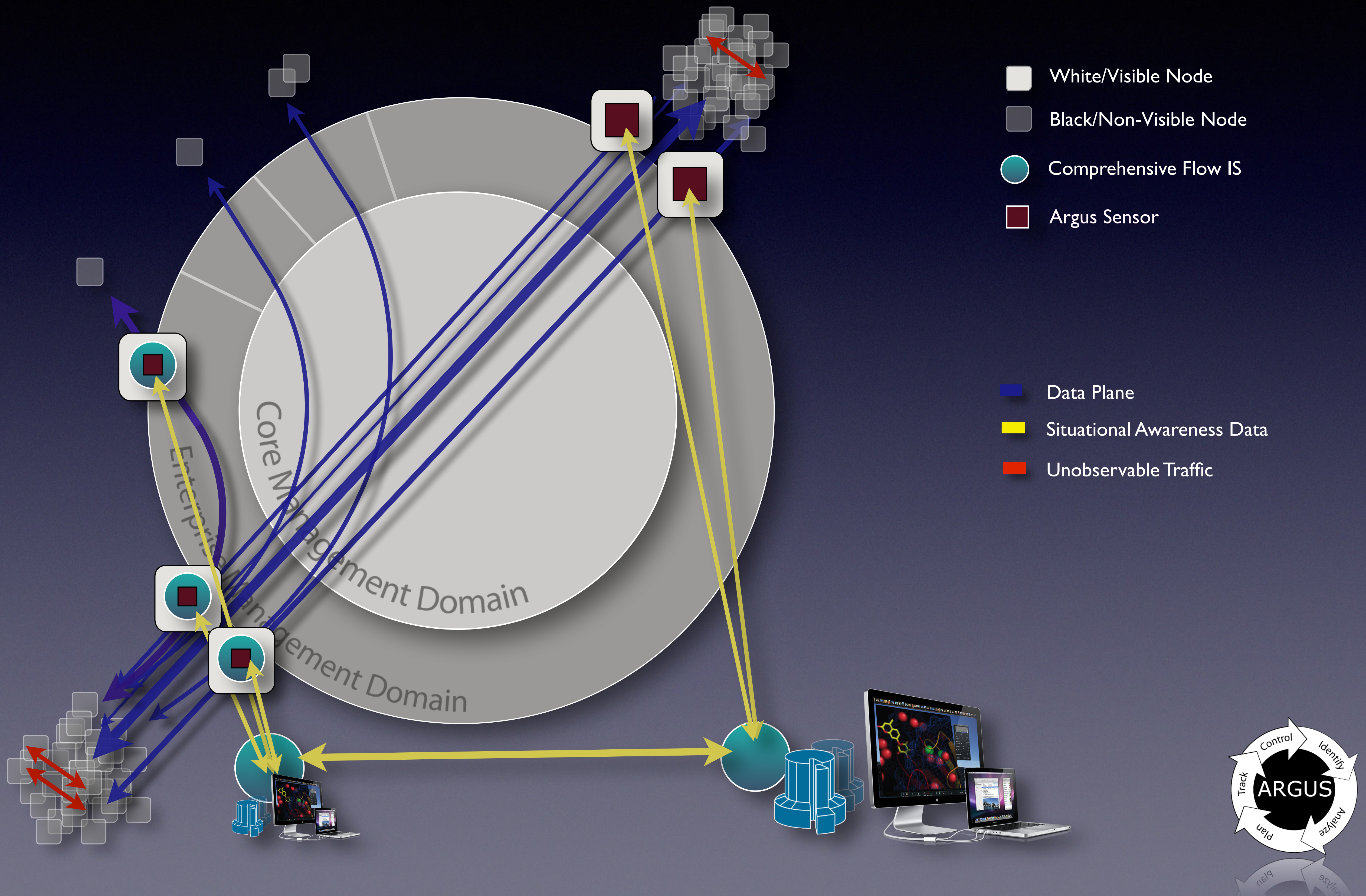
🟥 Unobservable Traffic

ARGUS

Control Identify Analyze Plan Track

Subnet Border Awareness

Local and Remote Strategies



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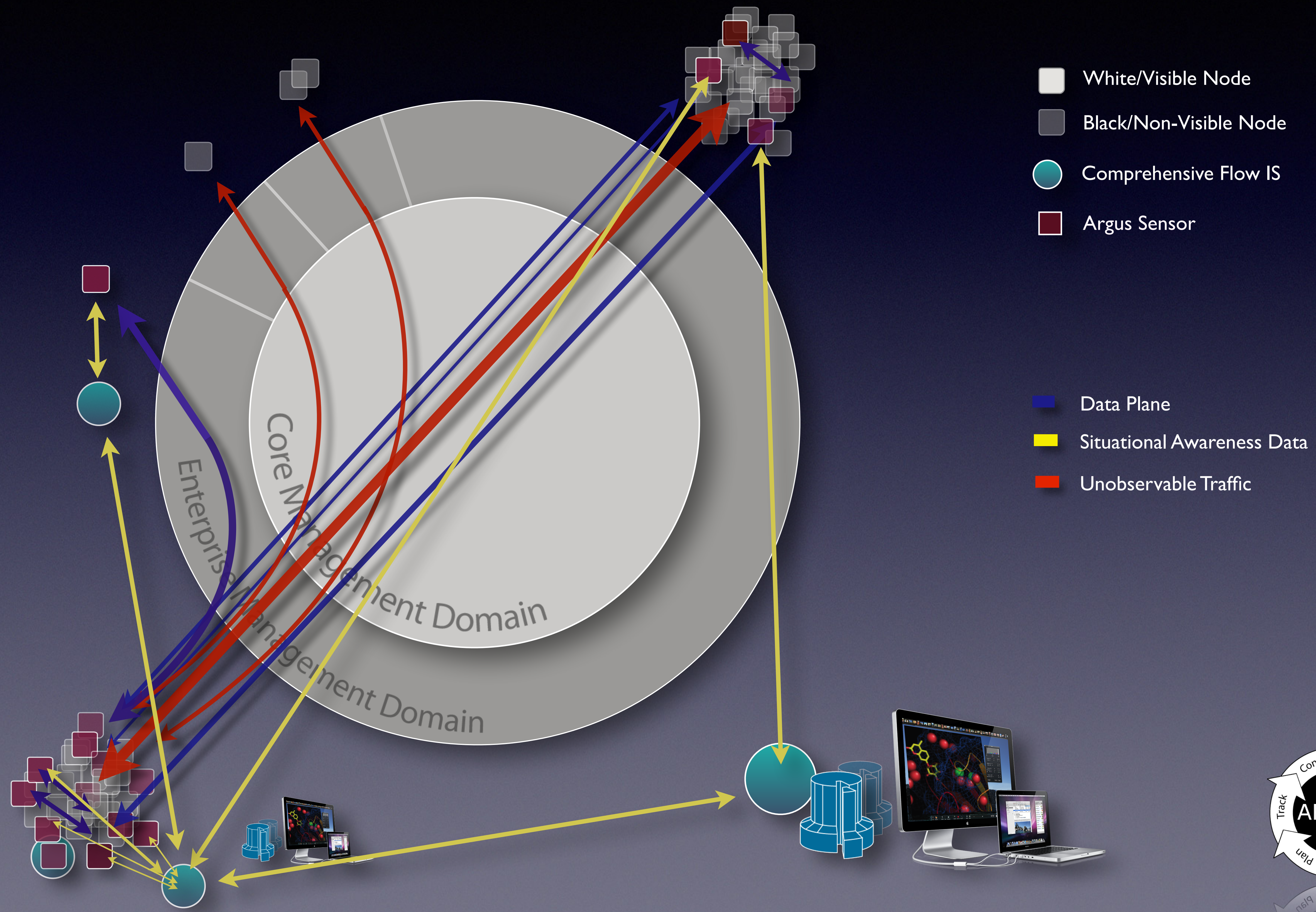
End System Awareness

Local and Remote Strategies



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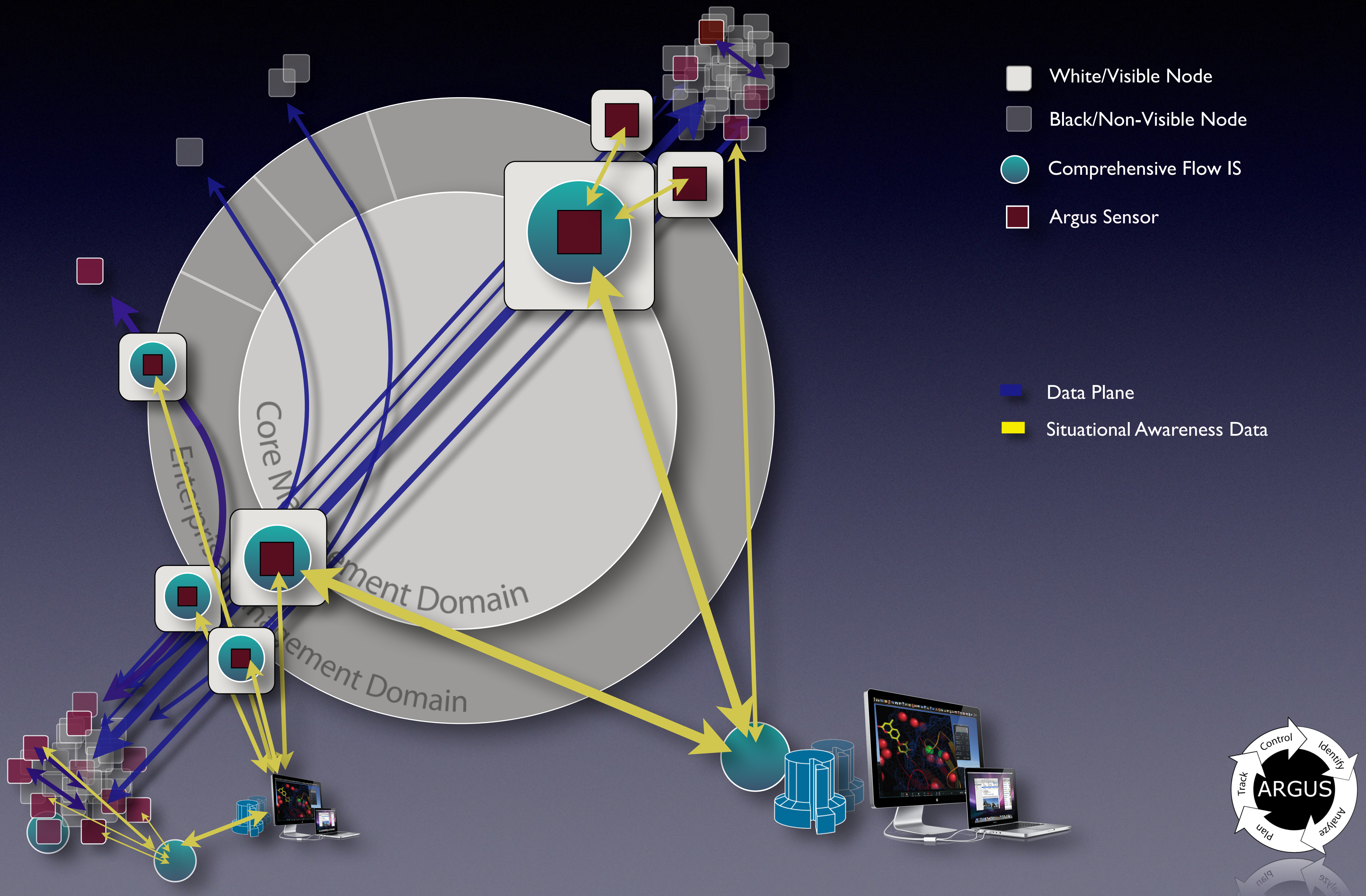
🟥 Unobservable Traffic

Complex Comprehensive Awareness

Local and Remote Strategies



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● Comprehensive Flow IS

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🟨 Situational Awareness Data

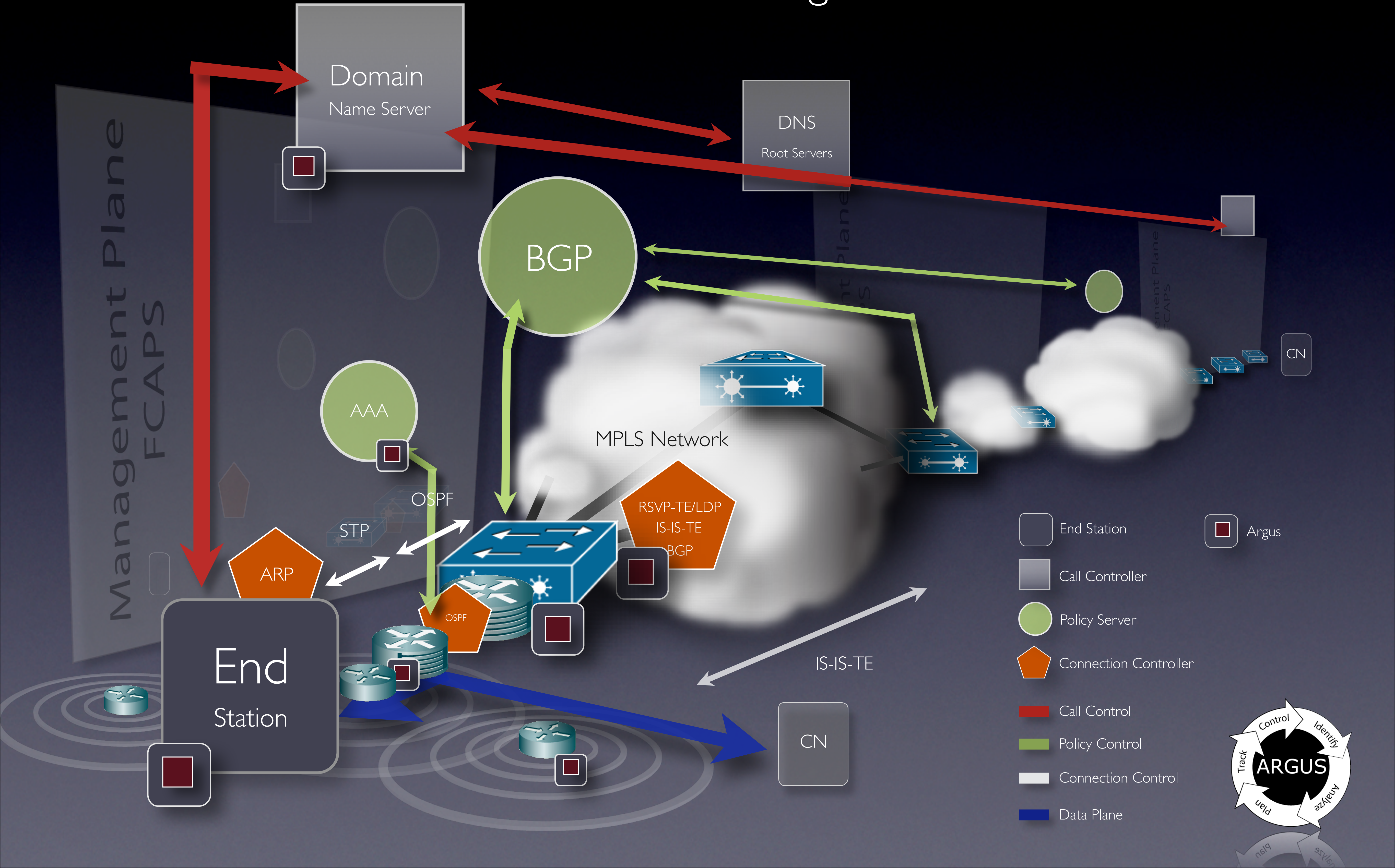
Flow - Non Flow Correlation

- Replay attack detection
  - Bi-Directional Protocol Time Uncoupling
- Stepping stone detection
  - Two completely independent flows, that share the same instantaneous burst behavior and packet size frequency distribution (shifted for encapsulations)
- Man vs Machine detection
  - Interactive vs Non-Interactive Session Detection
  - Packet, transaction and session jitter analysis
- Man-in-the-middle detection
  - Pass Thru - Detectable one-way latency, hop count, path resource modifications
  - Proxy - Connection setup time modifications, header attribute changes
- Performance as an Asset that needs Protection
  - Path Availability, Bandwidth, Latency, Jitter, MTU, ...
  - Continuous One-Way latency determinations

Supporting Slides

Comprehensive Enterprise Awareness

Dealing with the Insider Threat


Domain
Name Server
DNS
Root Servers
BGP
Management Plane
FCAPS
AAA
MPLS Network
OSPF
STP
ARP
RSVP-TE/LDP
IS-IS-TE
BGP
OSPF
End
Station
CN
IS-IS-TE
CN
End Station
Argus
Call Controller
Policy Server
Connection Controller
Call Control
Policy Control
Connection Control
Data Plane
Control
Identify
Analyze
Plan
Track
ARGUS