ISSUES TO CONSIDER IN BUILDING SECURE COMPUTER NETWORK DEFENSE SYSTEMS

NuParadigm Government Systems

Distributed Applications in a Web Services Environment Create Opportunity but present New Challenges:

- Asynchronous non-deterministic network behavior
- Object and/or message driven dependencies
- Security/Information Assurance
- Complicated provisioning/deployment when distributed
- Flat peering of control domains

Distributed Applications in a Web Services Environment Create Opportunity but present New Challenges:

- Modeling, simulation and testing are complex
- Life cycle development spreads across multiple modules/nodes with differing completion levels complicating the testing and certification of app
- Centralized versus distributed management
- Shared services and orthogonal use cases create chaos and noise in the mixed domains/communities/applications
- Inherited behavior

More Specific Problems in GIG and NCES Oriented Programs:

- Overwhelming Scale
- Interoperability and Rational Legacy Integration N-Square Permutations
- Cross Boundary Security - Traditional Firewalls are not Content Aware
- Ad-Hoc bi-directional Connectivity between users, domains, and systems
- IDM: Persistence, Asynch, Push, Pull, Smart Pull, Assurance, Pub-Sub

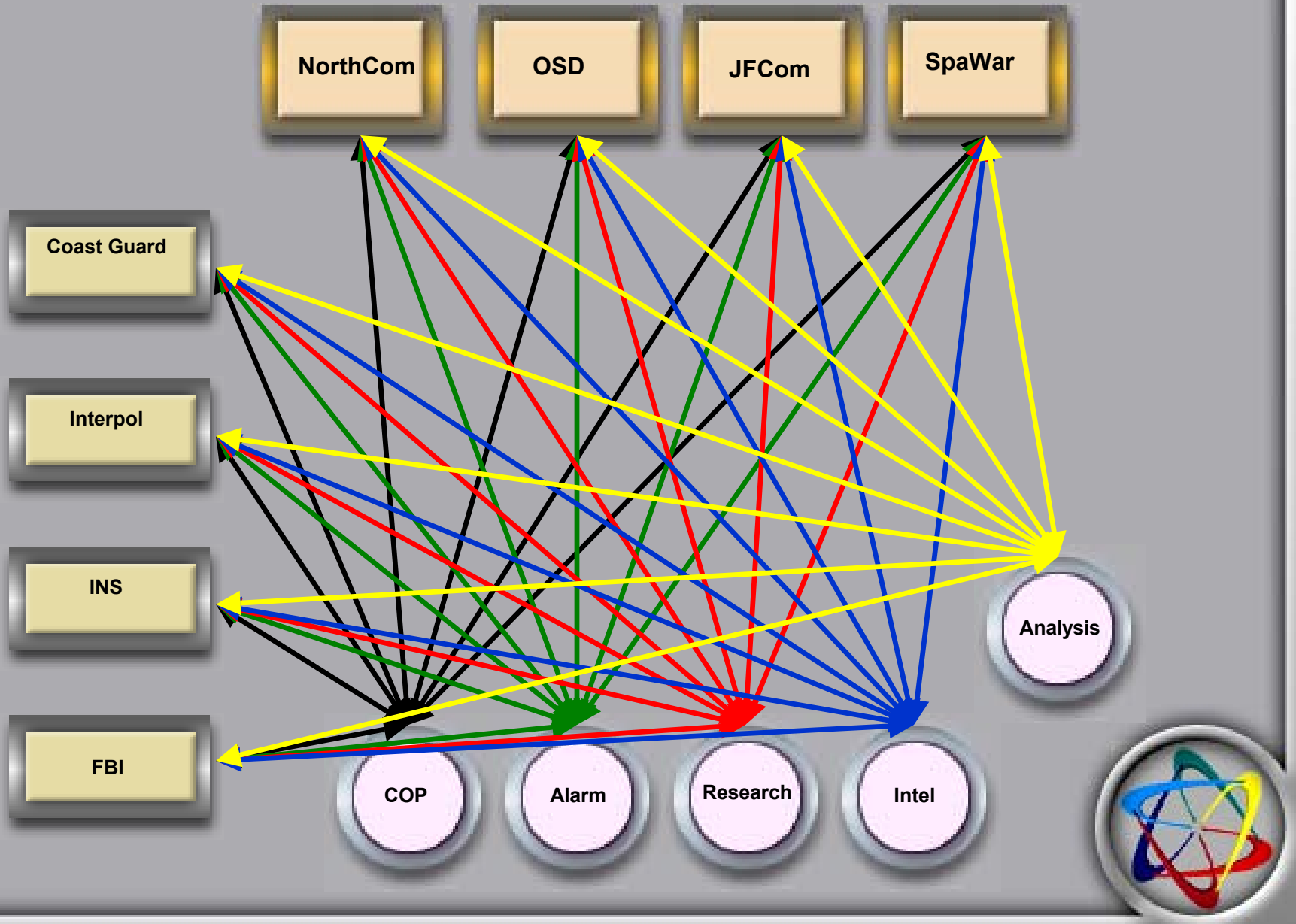
System Development Reqs Include:

- Composeable distributed web services application development environment
- Rapid, visually driven application prototyping and development
- Highly granular, complex transaction and systems modeling & simulation; directly interface live code to simulation environments such as OPNET
- Complete end to end control of entire object framework
- Directly extensible

A Secure Object Framework for Development:

- Robust object-based security model
- Isolates community, control, private and local data
- Active agent-based fabric for network router defense, provisioning, control, redundancy and management
- Large to massive scale heterogeneous systems integration
- Supports distribution of policy and pre-positioning of contingent policy
- Active control of networked application

The N-square Problem as an Application Issue



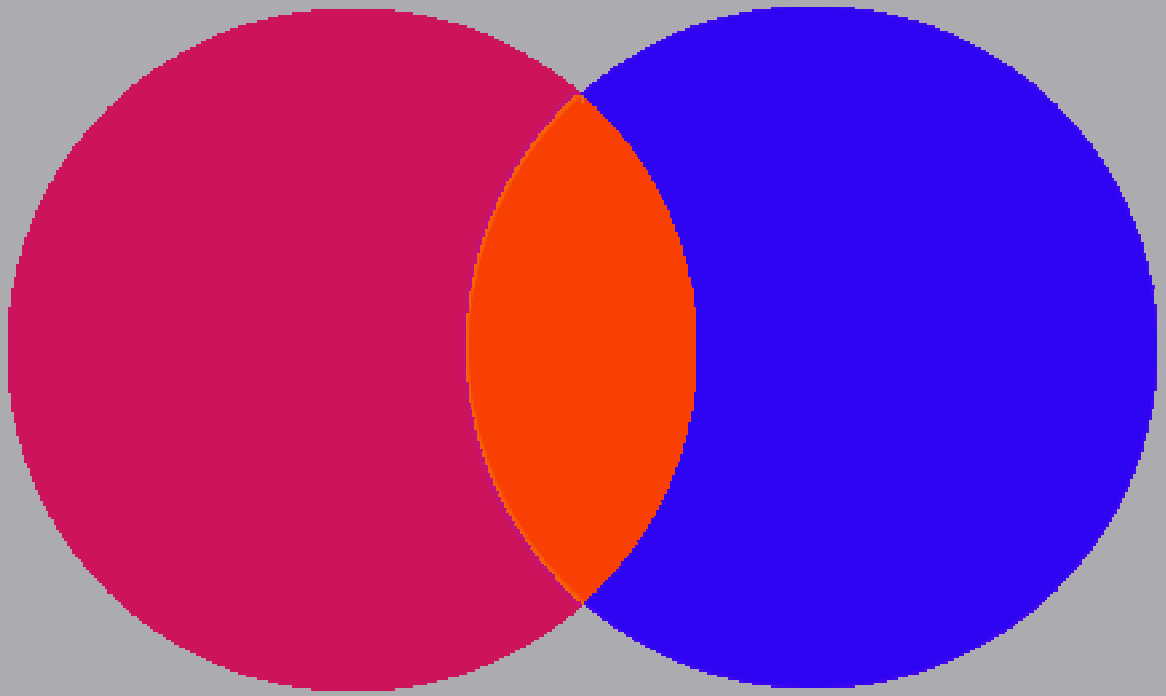
The N-Square Problem:

- **N-Square Permutations**
  - Multiple manifestations
    - Application Interfaces
    - Permission Mapping
    - Community Data Set Noise versus Granular Differentiation
- **Interoperability**
  - Incompatible Hardware, OS, and Applications
  - Abstraction and permission difficulties
    - Orthogonality
    - Unfiltered
  - Incompatible Data Structures

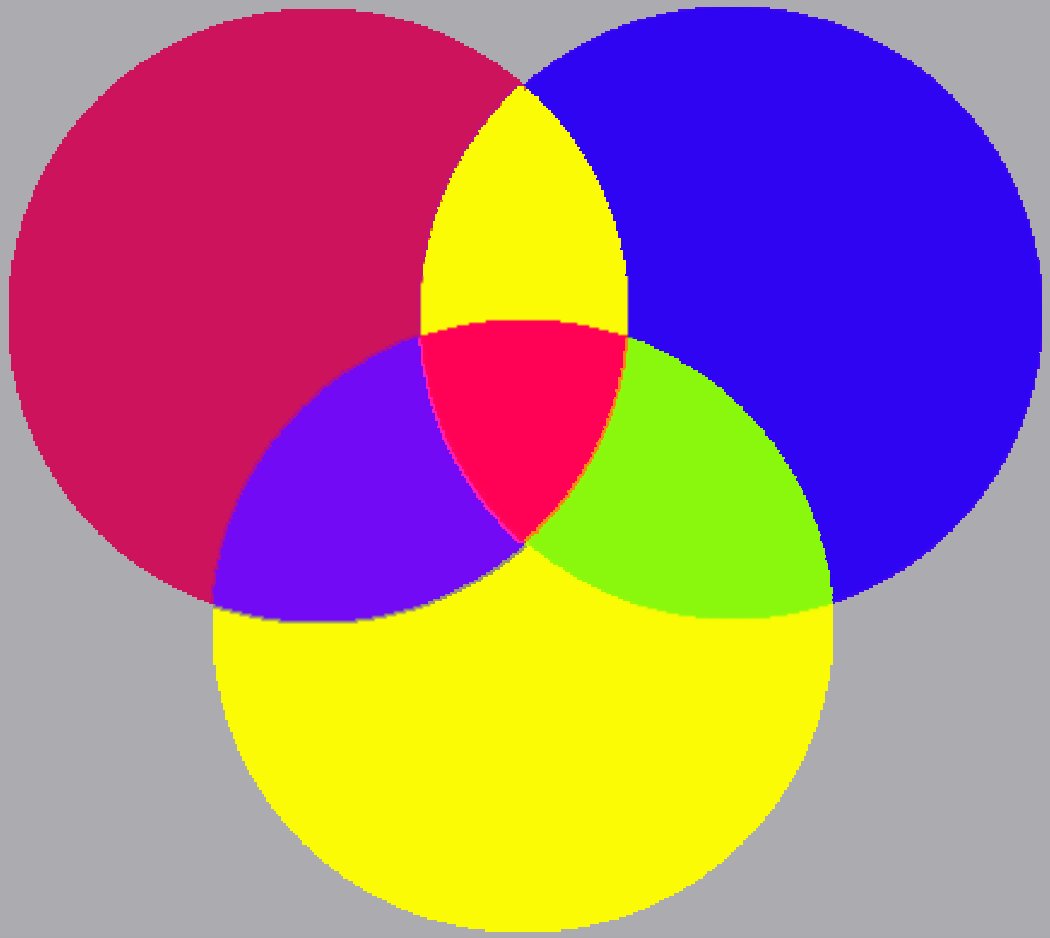
The Problem and How to Solve It:

- **The Solution Must Support:**
  - Platform Independence
  - Multi-tier Abstraction
  - Transformation

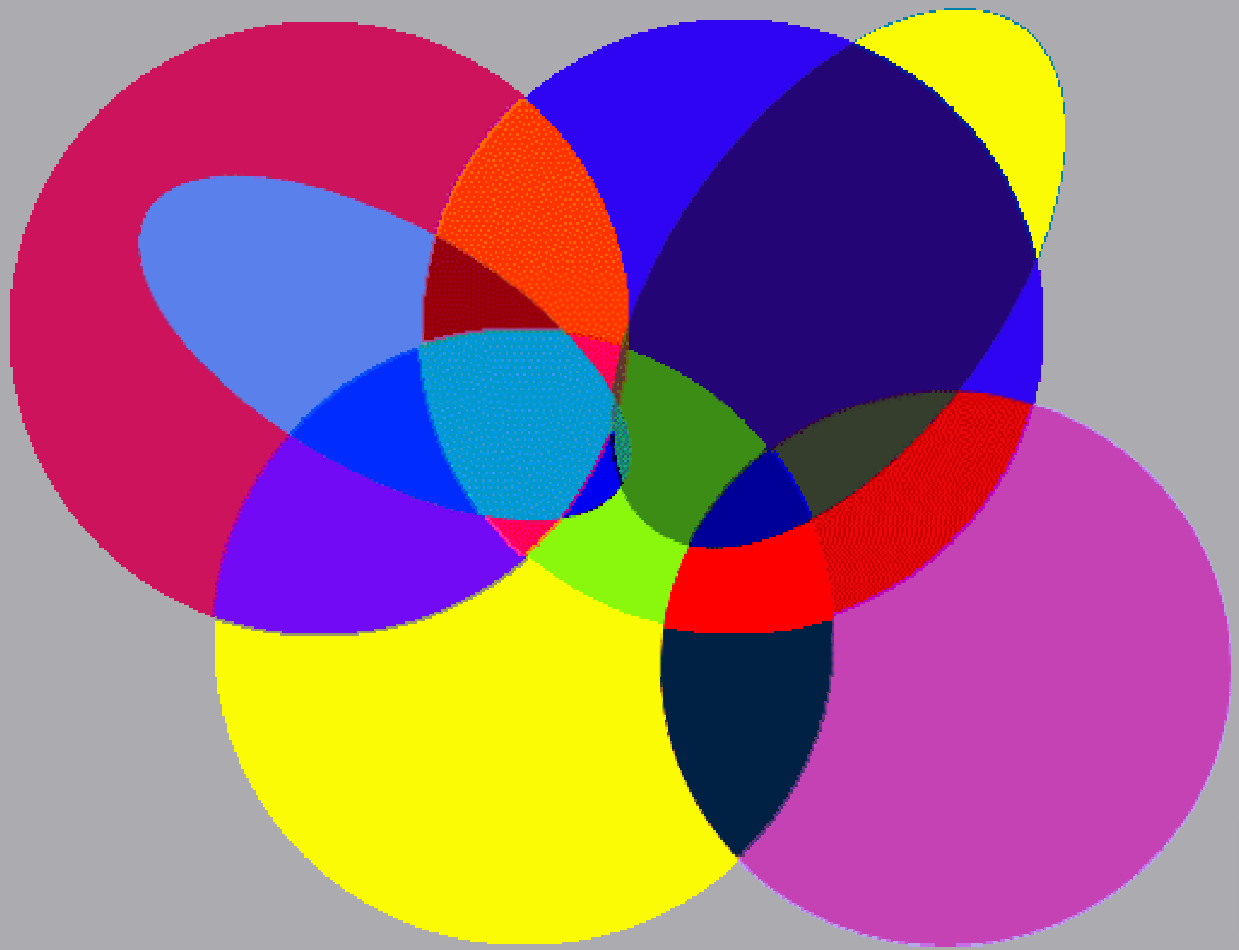
N-square as it Applies to Data Sets or Heterogeneous User Communities – the Simple Intersection of Two Data Communities



Real Data and User Relationships Are More Granular



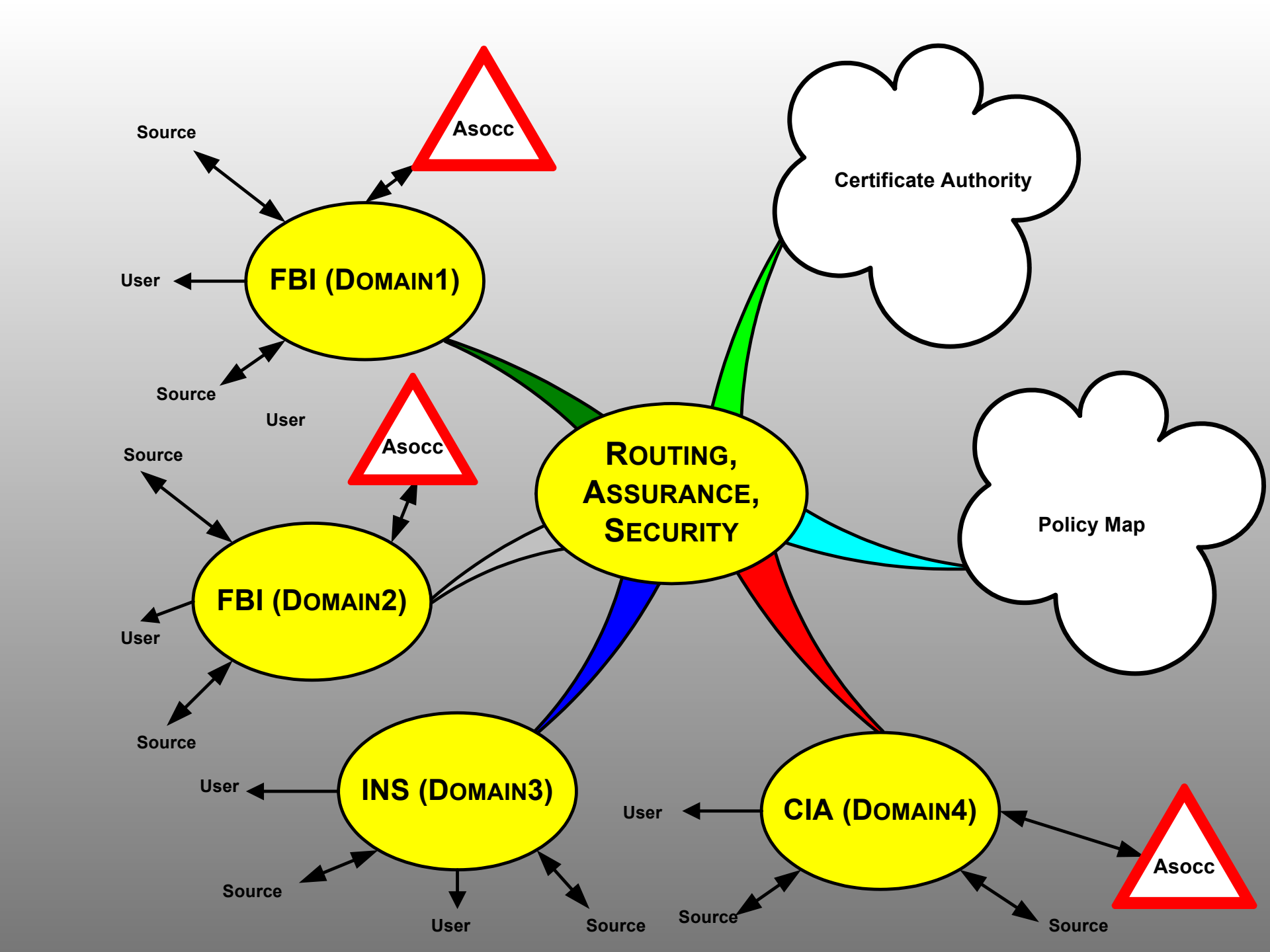
World of Coalitions and Mixed Data Sets – Complexity Escalates Rapidly – Which Users and Domains should have Access to what Data?



The Problem and How to Solve It:

The Solution must support:

- Object level granularity
- Intelligent mapping of use, purpose and permission policy on an ad-hoc basis
- Multiple encapsulated tiers separating object connections, user permissions, application connectors, and user presentation

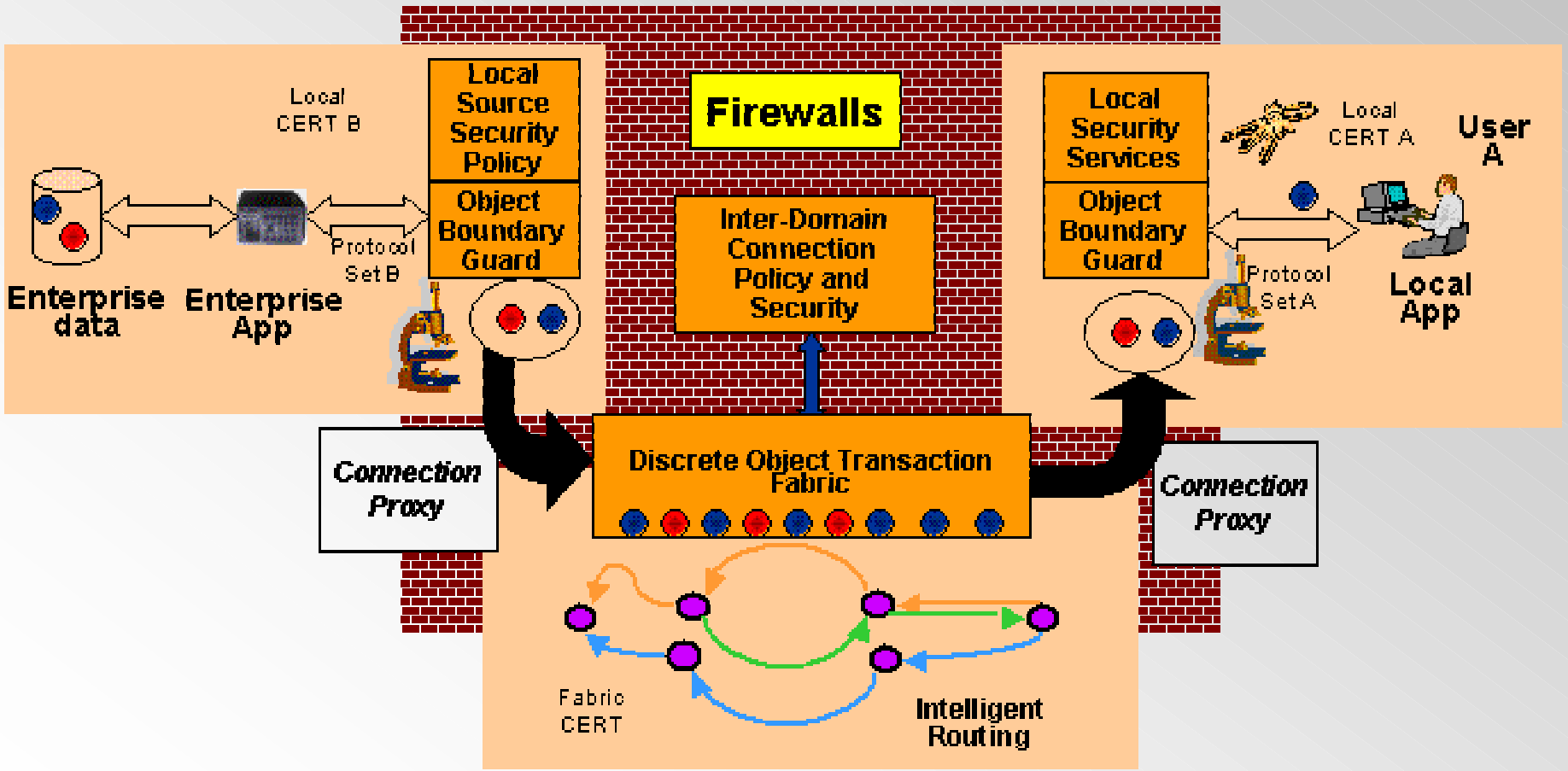

Source
Asocc
Certificate Authority
FBI (DOMAIN1)
User
Source
User
Asocc
Source
ROUTING, ASSURANCE, SECURITY
Policy Map
FBI (DOMAIN2)
User
Source
User
INS (DOMAIN3)
CIA (DOMAIN4)
User
Asocc
Source
User
Source
Source
Source

The Problem and How to Solve It:

- **Cross Boundary Security - Traditional Firewalls Are Not Content Aware**
  - Susceptible to DoS attack
  - Spoofing
  - Mal-formed or illegal requests
  - Permission hacking
  - Trojan or insider manipulation

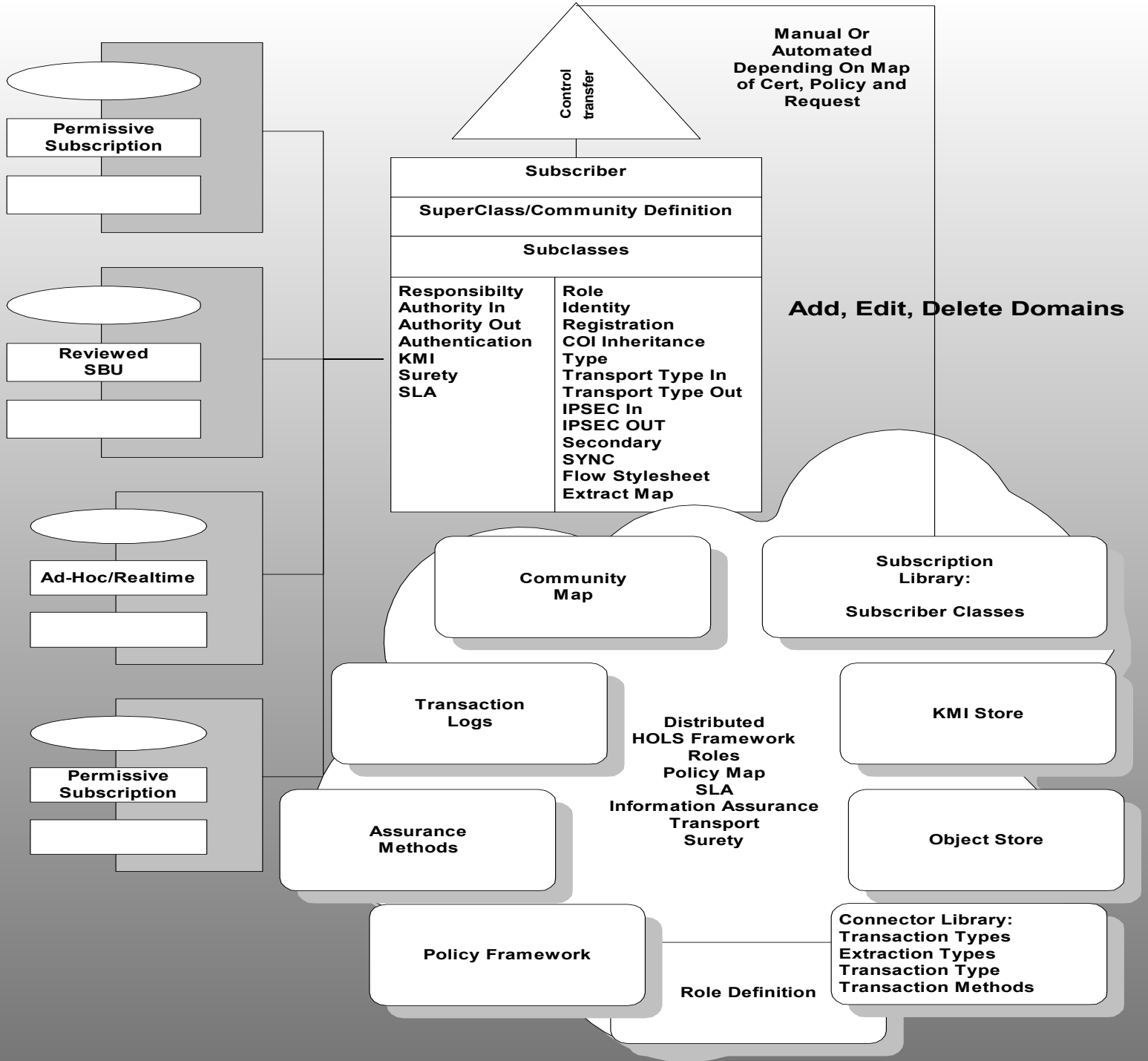
Four Key Enablers

- Protocol independence through customizable gateway proxy of format, security and protocol
- Granular object inspection/authentication inside well understood boundaries
- Encapsulation for both source data and user application domains
- Object fabric distributes routing policy without requiring end-point control



The Problem and How to Solve It:

- The Solution Must Support:
  - System Wide Distribution of Policies
  - Role-Based Access Control
  - Object Level Encryption with Nested Security Levels within a Single Object
  - Boundary or Domain Guard Verifying Content Signatures/Permissions


Permissive Subscription
Reviewed SBU
Ad-Hoc/Realtime
Permissive Subscription
Control transfer
Manual Or Automated Depending On Map of Cert, Policy and Request
Subscriber
SuperClass/Community Definition
Subclasses
Responsibilty
Authority In
Authority Out
Authentication
KMI
Surety
SLA
Role
Identity
Registration
COI Inheritance
Type
Transport Type In
Transport Type Out
IPSEC In
IPSEC OUT
Secondary
SYNC
Flow Stylesheet
Extract Map
Add, Edit, Delete Domains
Community Map
Subscription Library:
Subscriber Classes
Transaction Logs
KMI Store
Distributed
HOLS Framework
Roles
Policy Map
SLA
Information Assurance
Transport
Surety
Assurance Methods
Object Store
Policy Framework
Role Definition
Connector Library:
Transaction Types
Extraction Types
Transaction Type
Transaction Methods

The Problem and How to Solve It:

- **VPN type tunneling; like HAIPE:**
  - Does not scale well due to point-to-point dependency
  - Wastes bandwidth because of multiple point-to-point transmission and retransmissions of data
  - Results in degraded reliability without support for asynchronous connections
  - Often exposes content in actual application due to uncontrolled local caching
- **The Solution Must Support:**
  - Object tunneling
  - Caching of objects across network fabric
  - Object level encryption and keys with nested security levels

Other Practical Deployment Issues Must be Addressed:

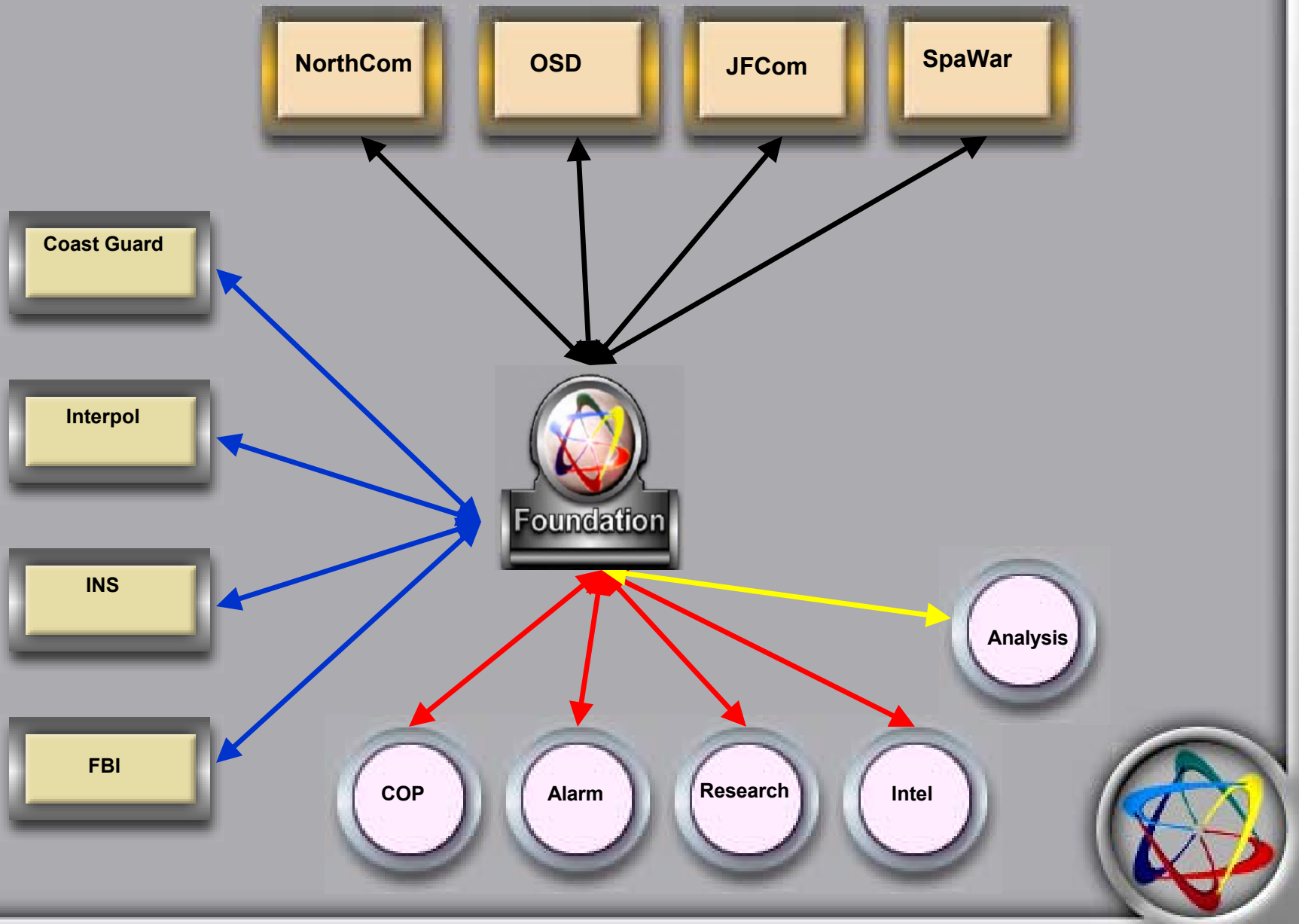
- Survivability / Reliability
  - Confirmation of delivery
  - Redundant delivery routes
  - No central hubs or transfer points
- Ease and speed of deployment
- Flexibility to address wide variation of requirements for information creation, delivery and access
- Accommodation of Ever-changing Requirements
  - New Relationships
  - Flexibility
  - Change
  - Escalation
- Web platform connectivity

The Secure Object Framework must address all of these requirements:

The framework provides an agent-based distributed grid computing platform that has been optimized for rapid development, high performance, flexibility and cross platform application deployment supporting:

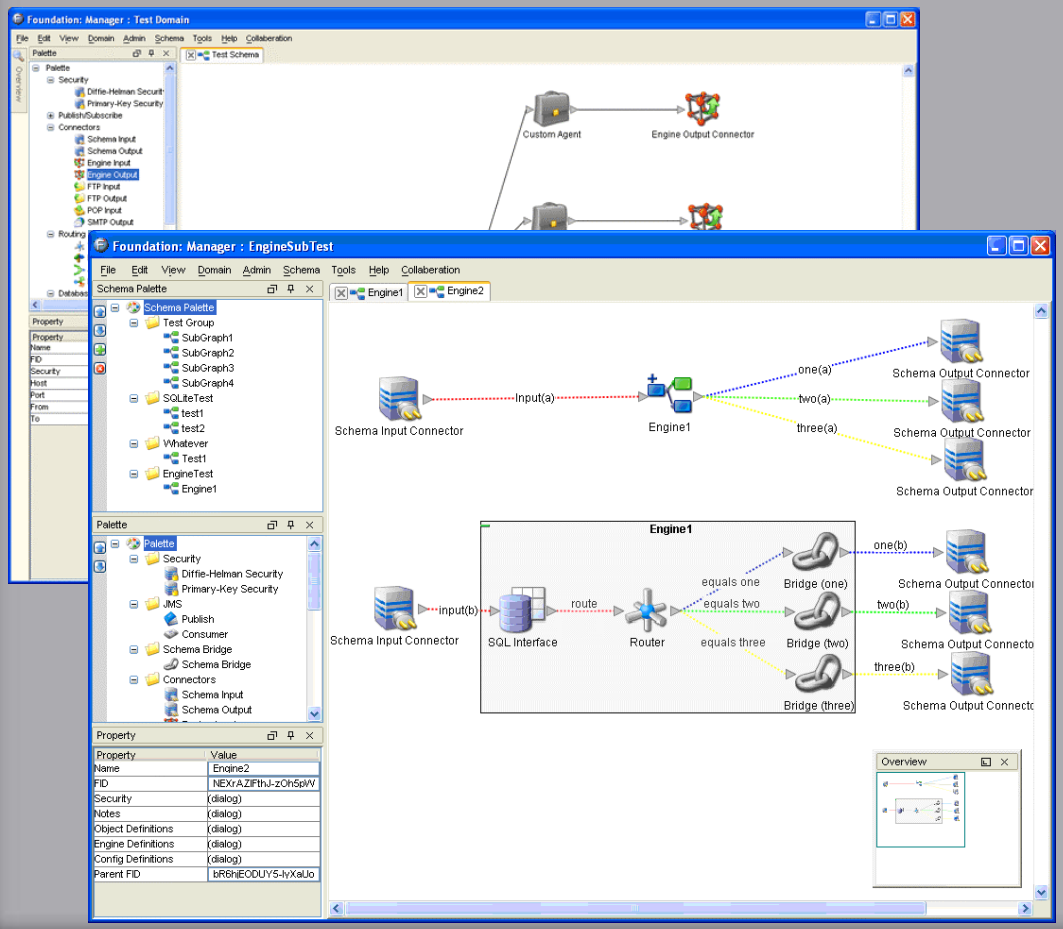
- An unlimited number of participating users and systems,
- A robust multi-level, multi-tier security model,
- Simple implementation,
- Visual framework implementation, and
- Direct extensibility

Handling the N-square Application Problem



Core Technology Base

EXISTING OBJECT TRANSACTION FABRIC
(Standards-based at edge, proprietary if necessary)



Supported Protocols

- HTTP(S)
- SAML
- FTP
- CORBA
- TN3270
- SNA
- SQL
- SMTP
- Others as needed

Security Environments

- Commercial X.509 series
- PKI
- WSDL
- Proprietary

App/Service Environments

- SOAP/XML/UDDI
- J2EE
- .NET
- SQL
- VB
- MQ Series
- Others as needed

Network Centric Solution Components

GATEWAYS/AGENTS

- ***Independent software program independently running on various machines that create the network, each executing its own rule set or code***

RULE SETS

- ***Rule sets are business rules that determine how a piece of information is to be treated as it flows through the complex distribution network, implemented in an extremely powerful and flexible way, the rules support almost any processing requirement***

COMMUNITY of INTERESTS/LIBRARIES

- ***Groups that wants to receive or may generate different types of information***

VISUAL CONFIGURATION MANAGER

- ***Used to securely administer the operation of the gateways through remote configuration and implementation of business rules***

- *End User Gate Way*- acts as the user's portal into the Foundation network
- *Special Service Gateways*-move information in to and out of the network in the form that other systems can understand-ranging from fax and e-mail support to connection standards for applications like SOAP, .NET, JMS, Corba, MQSeries and many others
- *Traffic Gateways* are placed at the necessary points throughout the network to optimize traffic and routing allowing certain types of information to be preferentially sent down certain paths

- *Community of Interest*-when information is generated across the network it is automatically classified as belonging to one or more communities of interest
- *Community Library*-when it is delivered to the network it is then automatically replicated to the communities in the format those communities can utilize and is stored in the community library.
- End user gateways subscribe to a community library and are permitted to provide and use information according to their security rights

- Cross boundary security and internal control is maintained by the organization

Foundation Architecture to support a network-centric computing platform that provides a platform for developing complex high performance distributed applications

Base Components –Solution Framework

Function	Differentiating Factor
Platform Independence	Pure JAVA end to end deploys on any compatible JVM 1.4.1+
Cross-Firewall Transportation	Moves information across firewall and physical boundaries and verifies that individual content delivery requests are permitted
Filtering Domain Guard	Automates filtering of improper requests, broken instructions and non-permitted object transportation; request flooding never penetrates past the Gateway
LDAP/UDDI/ Directory Service	Allows external user directory and system permissions reference
Prioritization	Gateways will deliver information in priority order holding or interrupting large object transmission when higher priority information comes in
Multiple Community Access	Routing capability extends a single request to multiple communities
Service Proxy	Seamlessly connect and route multiple service connections in multiple formats
Parallel Processing/Routing	Supports breaking communication into many multiple paths, and manages parallel decision and delivery systems

Base Components –Solution Framework

Function	Differentiating Factor
Pullbacks/Rerouting	Reroutes gateway information around bottlenecks and obstructions providing for network self healing and ensuring content delivery
Alternative Routing	Provides robust intelligent load balancing across the system allowing the efficient use of all resources
Instream Transformation	Supports the automatic reformatting of over 260 types of content, allowing other entities to receive and use information in a format they can accept; support for other formats easily installed
Delivery Assurance	Internal business rules, system logic and information queuing can be used to create sophisticated information delivery assurance processes beyond the already high level of assurance built into the product
Gateway/AGENT Independence	Enhances performance and provides immense scalability, systems have been installed running more that 100,000,000 routing decisions/hour; multiple platform support allows the Gateways to run on any system including wireless devices
Database Connectivity	Support for native and JDBC connectivity
3DES, RSA, AES, Strong Encryption	Ensures that the Gateways perform as authorized and protect content from being manipulated or improperly disclosed; support for nested and proprietary architectures

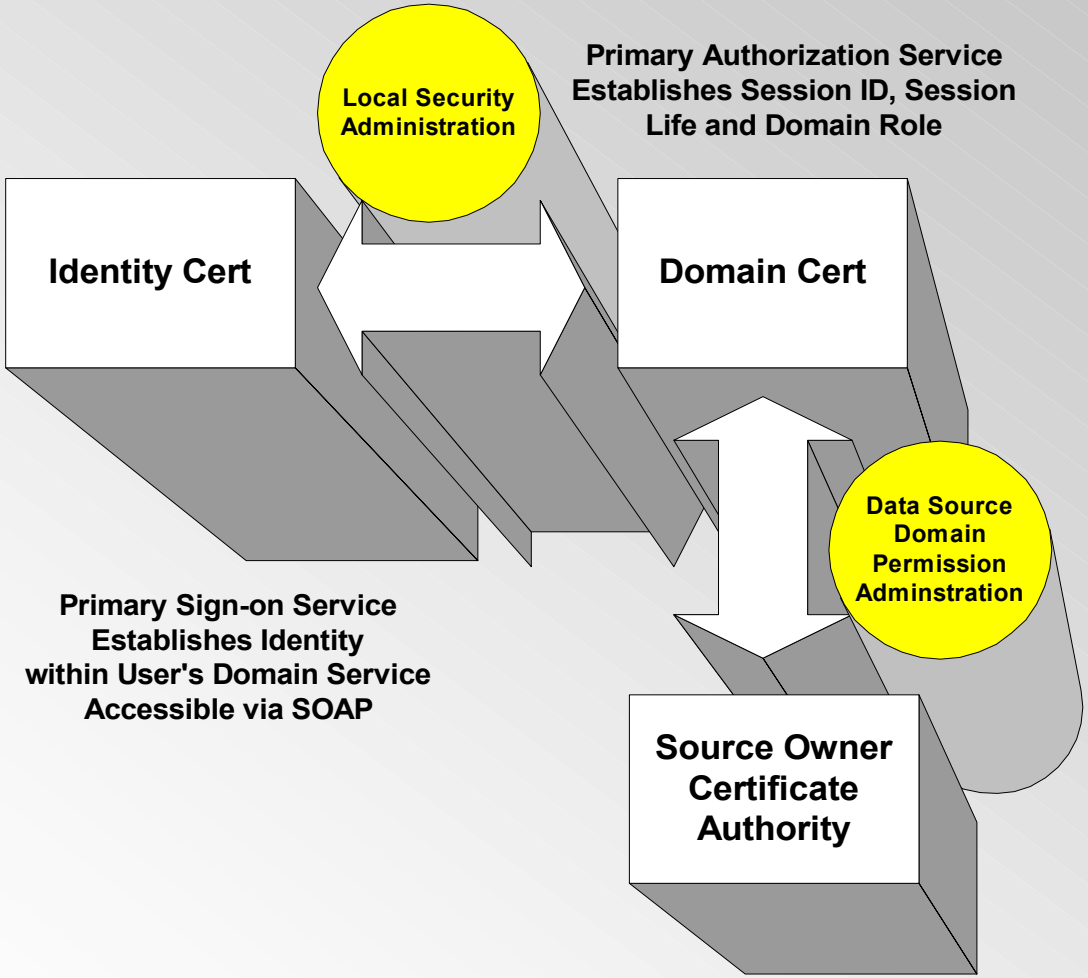
Key Inter-Domain Security Issues:

- Separation of User Identity Certification from Data Owner
  - User Identity is a Global Concept, it is the sign-on domain that provides User/Domain Authentication
  - Domain Authentication requires inter-domain policy administration with MOU between participants
  - No central hubs or transfer points but efficiency demands that MOU's between owners and subscribers be standardized
  - Within certain environments there will be central administration authorities
  - User cert inherits its domain specific privileges
- Mixed signing and message filtering must be supported
- Owner maintains sovereignty and defines the policy for access to their data

Other Key Inter-Domain Security Issues:

- Certificate Authorities are separated from each other and available via web services
- Authorization dialog uses self-contained XML objects with permissive syntax
- Process is Asynchronous using internal session identifier(s) to track object history and permissions
- Recursive signing and encryption are permitted
- XML context tags may be contained within the encryption envelope
- Keys optionally contained within object
- Role assertion can include reference routing separate from access authority
- Side-band signaling points to reference object ID
- Owner and return tags can sit inside or outside encryption/signature boundary

Example Multi-tier Security Model



Application Use Cases:

- Object-based cross domain application integration,
- Seamless cross platform communication protocol integration,
- Role-based access control in a complex multi-application environment,
- Cross domain firewall/guard implementation,
- Silent data mining,
- Application integration,
- Dynamic assembly of Communities of Interest, and
- Application federation/reachback solutions.