XML, Web Services & SOA:

Data Protection and Privacy Opportunities and Challenges in the Government Sector

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Agenda

- XML and Web Services Impact on Security
- Security Underlies Government SOA Success
- Why SOA Security is a Concern
- Major Categories of SOA Security Functions
- Web Services Security and SOA
- WS-Trust, SAML, Access Control
- The Need for Hardware-based XML Security
- XML Hardware Encourages Interoperability
- IBM SOA Appliances Overview
- Summary

XML and Web Services can Impact Security

They help form the foundation of SOA, but bring new security obstacles:

- Scalability: XML is bandwidth, CPU and memory intensive
- Performance: some XML apps literally grind to a halt
- Privacy: connecting systems never before connected
- Data Protection: clear text over HTTP with no inherent security
- Integration: exposing Web services to legacy applications
- Standards are still in flux
- Financial, technical and organizational challenge

Government SOA

- IP-based network data flow
- Internal access moving to external access
- Federal Enterprise Architecture (FEA) composed of interrelated ‘reference models’
- eGov Initiatives built upon XML, Web services
  - Procurement, Supply Chain, etc.
  - Promote services re-use and consolidation
  - Increased integration and communication
- Cross-domain services, information, identity sharing
- DOD Net-Centricity transformation

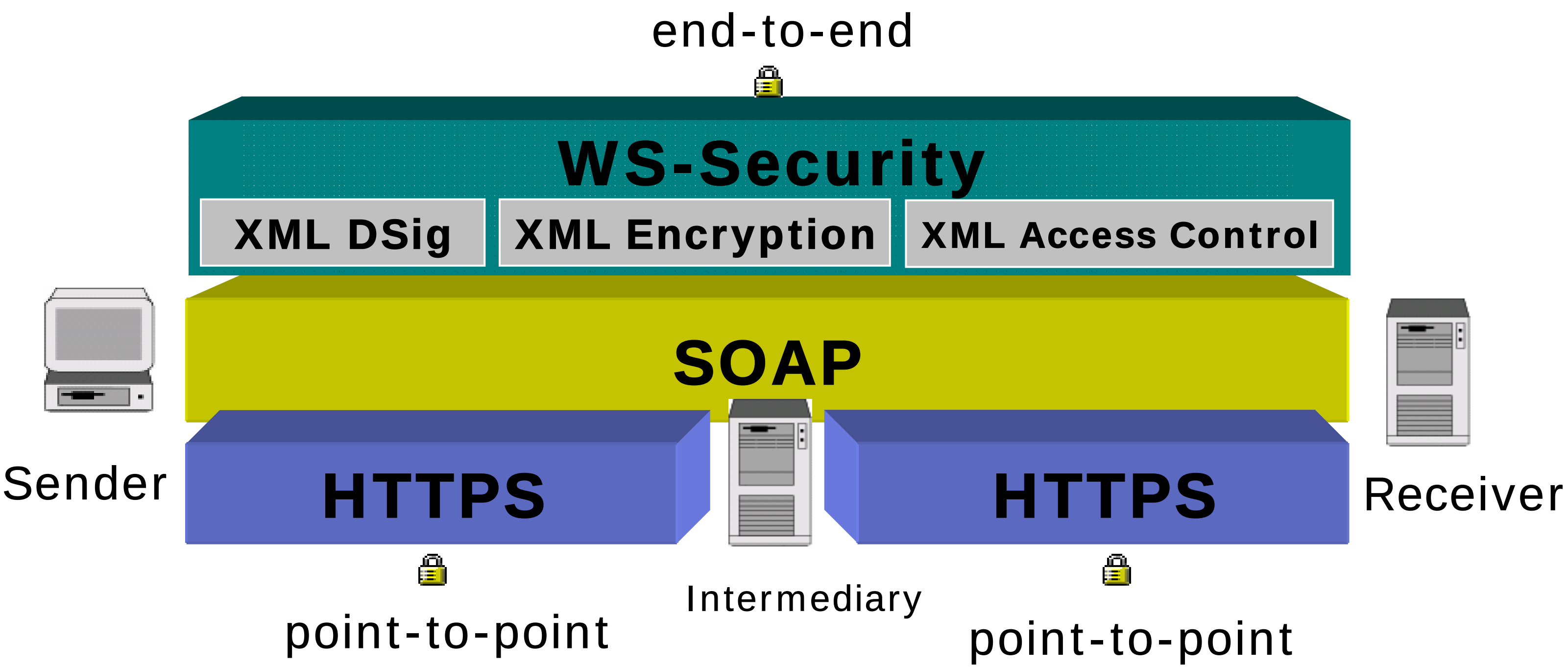
Security Underlies Government's SOA Success

- Shift to Message-Level Security
- Security standards: WS-Security, WS-Trust
- SAML & Federation - eAuthentication & eAuthorization certificates
- COTS products that support standards
- DHS integration
- Netcentricity Phase II: Service-oriented Fusion
- Privacy, Integrity, ID management
- PKI
- Right information to right people in timely fashion
- Ubiquitous access vs. control, policy enforcement

Why SOA Security is a Concern

- Any new technology has new security implications
- XML and SOAP easily connect to backend systems
- For a business-centric SOA, the exposed systems are critical business systems
- Traditional packet-level security devices do not secure XML/SOAP
- New compliance and regulatory requirements
- In addition to application developers, many other parts of the organization need to be involved

Roles of Different Protocol Layers



- **SSL is not enough**
  - XML-level threats and XML-aware security
  - securing stored or spooled messages
  - multi-party transactions, multi-hop networks

Major categories of SOA Security Functions

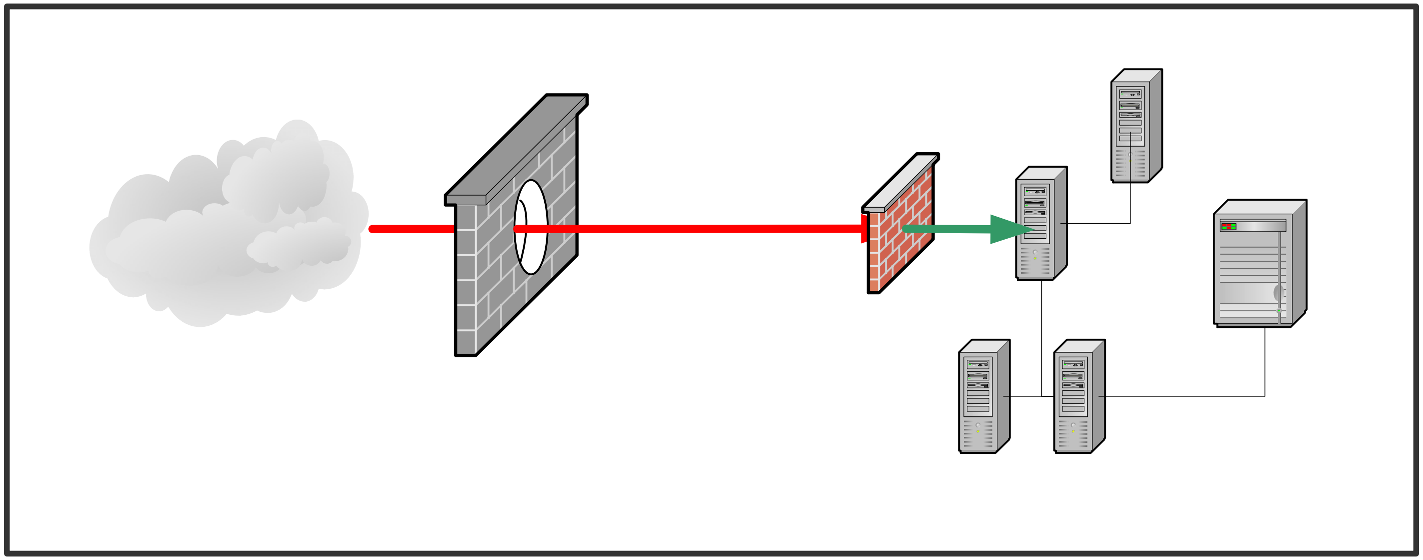
- XML threat protection
  - Concerned with keeping out malicious XML
  - Sometimes called XML firewall or XML intrusion prevention
- Message confidentiality & tamper-protection
- Secure enablement
  - Concerned with allowing in only XML compliant with access policy
  - Example: access control policy enforcement
  - Some vendors may call this “trust management”
- Identity management
- Misc. web services management functions
  - Example: service level management

XML/SOAP Firewall

- Integrated multi-layer filters
  - **IP-layer params (e.g., client IP address)**
  - **SSL params (e.g., client certificate)**
  - **Any part of HTTP header**
  - **XPath or XML configuration files for any part of SOAP header**
  - **XPath or XML configuration files on any part of XML payload**
  - **First-level filter select based on service, URL, etc.**
- Easy “point and click” Xpath Filtering
- Enable/Disable each SOAP method using WSDL wizard
- Can be applied at any point in message processing

Multiple Level of Defense for SOA

- First Level: XML Security Gateway for enhanced security, scalability, and simplicity
- Second level: Application server for additional processing



XML Threat Protection

- XML Entity Expansion and Recursion Attacks
- XML Document Size Attacks
- XML Document Width Attacks
- XML Document Depth Attacks
- XML Wellformedness-based Parser Attacks
- Jumbo Payloads
- Recursive Elements
- MegaTags – aka Jumbo Tag Names
- Public Key DoS
- XML Flood
- Resource Hijack
- Dictionary Attack
- Message Tampering
- Data Tampering
- Message Snooping
- XPath Injection
- SQL injection
- WSDL Enumeration
- Routing Detour
- Schema Poisoning
- Malicious Morphing
- Malicious Include – also called XML External Entity (XXE) Attack
- Memory Space Breach
- XML Encapsulation
- XML Virus
- Falsified Message
- Replay Attack

XML/SOAP Data Validation

- Raw XML and SOAP message inspection **(inbound and outbound)**
- XML well-formedness checks
- SOAP protocol checks
- XML Schema validation options:
  - **Explicitly set XSD in validate step**
  - **Fetch “trusted” copy of XSD based on XSD self-declared by incoming XML document**
  - **Validate from WSDL for SOAP web services**
- Streaming schema and well-formedness processing
  - **Errors can be detected before the entire message is read in**
- Business logic and other arbitrary validation
  - **XSLT transformations to extract or validate business-level information contained in XML/SOAP payload**

Enforcing Access Control

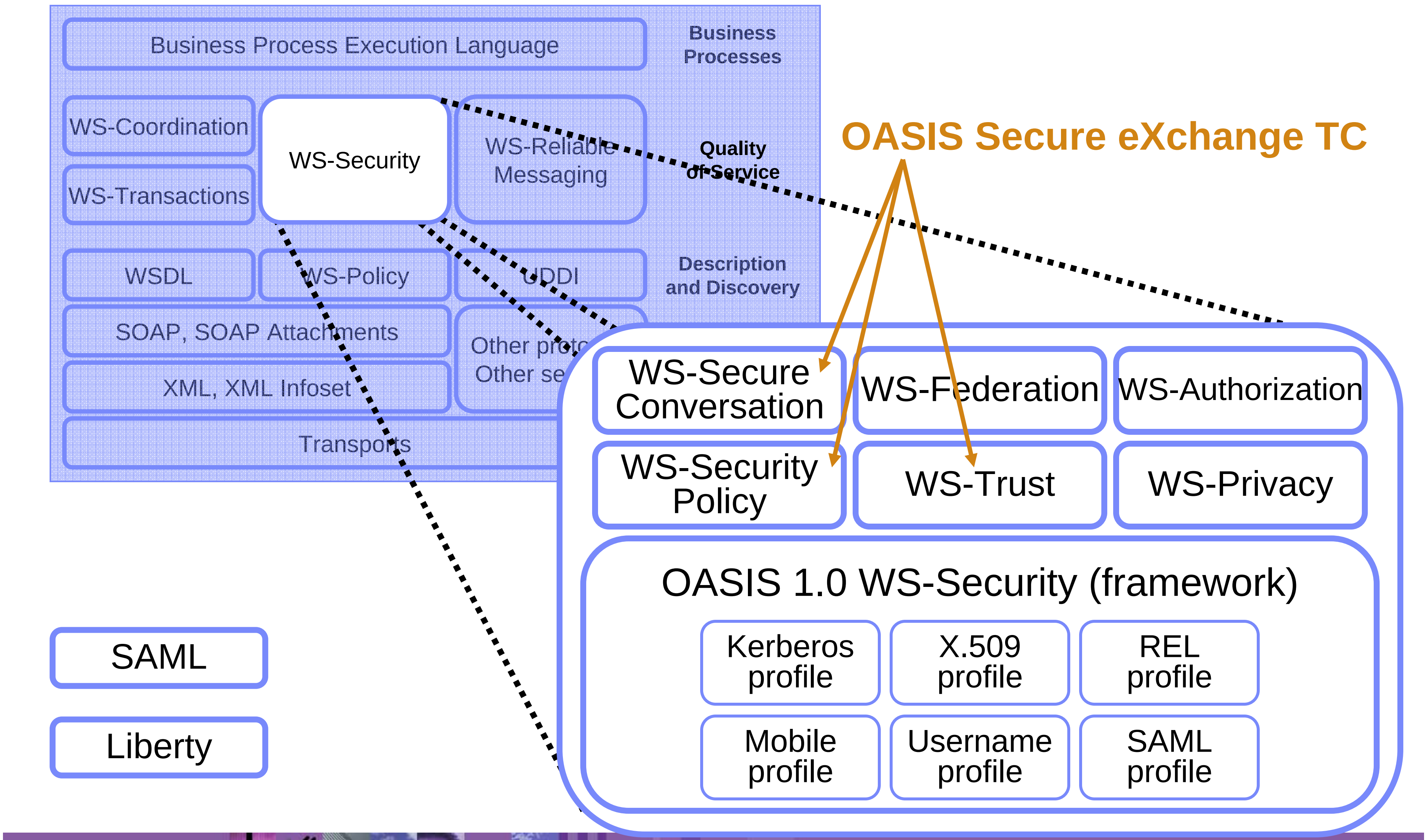
- High-speed Security Hardware access policy enforcement point
- Modular authentication/authorization architecture

```
x = extract-identity()
z = extract-resource()
zm = map-resource(z)
y = authenticate(x); if (y = null) reject
ym = map-credentials-attributes(y)
allowed = authorize(ym, zm); if (!allowed) reject
audit-and-post-processing();
```

- Identity examples include:
  - WS-Security user/pass token
  - SSL client certificate
  - SAML assertion
  - HTTP basic-auth
  - Proprietary SSO cookie/token
- Resource examples:
  - URL
  - SOAP method

Web Services and SOA Security

http://www.ibm.com/developerworks/webservices/library/specification/ws-secmap



Business Process Execution Language

Business Processes

WS-Coordination

WS-Transactions

WS-Security

WS-Reliable Messaging

Quality of Service

WSDL

WS-Policy

UDDI

Description and Discovery

SOAP, SOAP Attachments

XML, XML Infoset

Other proto

Other se

Transports

OASIS Secure eXchange TC

WS-Secure Conversation

WS-Federation

WS-Authorization

WS-Security Policy

WS-Trust

WS-Privacy

OASIS 1.0 WS-Security (framework)

Kerberos profile

X.509 profile

REL profile

Mobile profile

Username profile

SAML profile

SAML

Liberty

What "supports SAML" can mean

- SAML browser artifacts
  - Support for exchange of several interoperable token information via HTTP (without XML) for web single-sign-on
- Consume SAML assertions
  - Ability to accept a SAML in an incoming web service request or web service transaction, use it to enable access to some protect service
- Produce SAML assertions
  - Generating a SAML assertion based on AAA processing that took place for subsequent access control purposes
- Make SAML queries
  - Make web service calls to a SAML server for AAA decisions
- Accept SAML queries
  - Respond to authentication, authorization or audit requst via web service protocol defined by SAML

WS-Trust

- Extends WS-* and WS-Security directly
- Security tokens:
  - Issue
  - Renew
  - Validate
- Trust relationships
  - Establish
  - Assess the presence of
  - Broker trust relationships

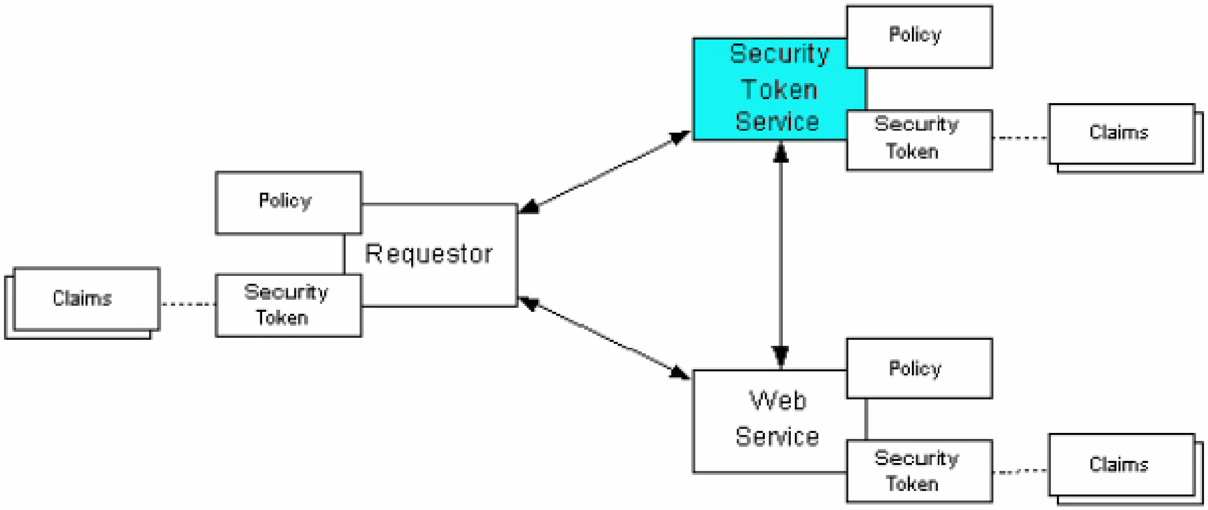


Figure courtesy of WS-Trust specification

The Need for Hardware Based XML Security

- Hardware XML Security Reduces Complexity
- Hardware XML Provides Hardened Security
- Hardware XML Security Delivers superior Performance
- Hardware XML Security Encourages Interoperability

Hardware provides Hardened Security

- **Accountability:**
  - OS upgrades
  - Security software upgrades
  - Hardware upgrades
- **Hardened OS**
  - Eliminate generic processes, daemons or listeners.
- **Hardware-based crypto Algorithms**
  - Prevent application developers from using weak crypto implementations
- **Separation of Security Policies from Applications**

XML Cryptography & Security Performance

- Crypto operations are resource-intensive
- Public-key crypto operations are very expensive
- Familiar example SSL
  - A couple RSA ops per connection, bulk encryption
  - Today, SSL hardware acceleration is well-accepted practice
- XML example: WS-Security based XML message
  - Signed header(s)
  - Public-key encrypted symmetric key
  - Encrypted payload sections
  - Signed payload sections
  - 10+ public-key ops per message is quite likely
- Multiple messages per connection
- XML processing also significant

XML hardware encourages interoperability

- Coupled to the other systems by Ethernet jack, not custom code

- Separation of concerns

- Network gear business model based on “out-of-the-box” interop

- Large software vendors focused on creating XML-enabled platforms
  - Functionality and development tools benefit
  - Interop is necessarily secondary, standards wars looming

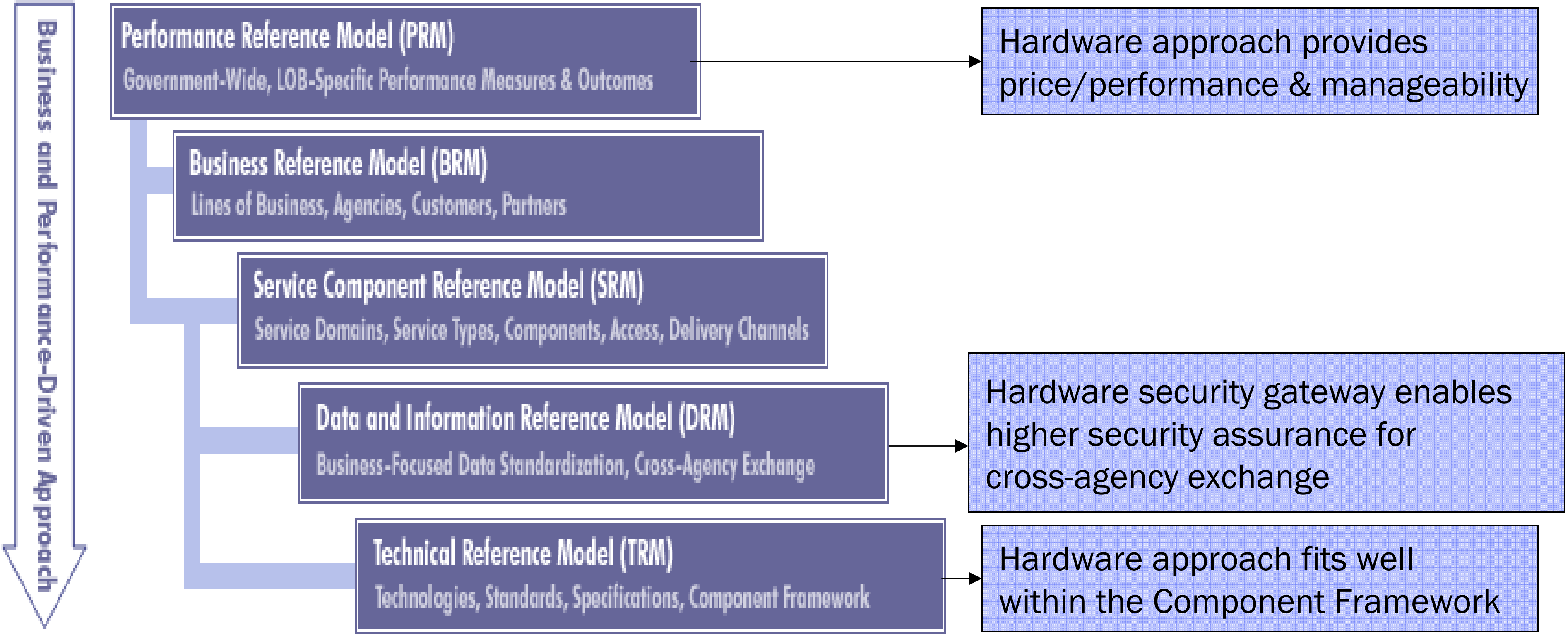
- Network vendors architecturally unable to achieve “lock-in”

- Focused on a concrete set of challenges
  - XML security performance
  - Interoperability.

Interoperability promoted through Standards Bodies

- Interoperability is hard work, but much more likely
  - WSI promotes webServices Interoperability.
    - The WS-I testing tools are designed to help developers determine whether their Web services are conformant with Profile Guidelines.
  - “SOAP Specifications Assertions and Test Collection”
    - A SOAP 1.2 implementation that passes all of the tests specified in this document may claim to conform to the SOAP 1.2
- Baseline Standards have matured, for example:
  - SOAP 1.1 – May 2000
  - XML DSIG – Feb 2002
  - SAML 1.0 – November 2002
  - WS-Security – April 2002
- Integration with CA’s, policy stores, schema repositories, service repository registries
- Interoperability in a heterogeneous environment with application servers, in-house software, hardware devices from other vendors

SOA Appliances Fit with FEA



Business and Performance-Driven Approach

Performance Reference Model (PRM)
Government-Wide, LOB-Specific Performance Measures & Outcomes

Business Reference Model (BRM)
Lines of Business, Agencies, Customers, Partners

Service Component Reference Model (SRM)
Service Domains, Service Types, Components, Access, Delivery Channels

Data and Information Reference Model (DRM)
Business-Focused Data Standardization, Cross-Agency Exchange

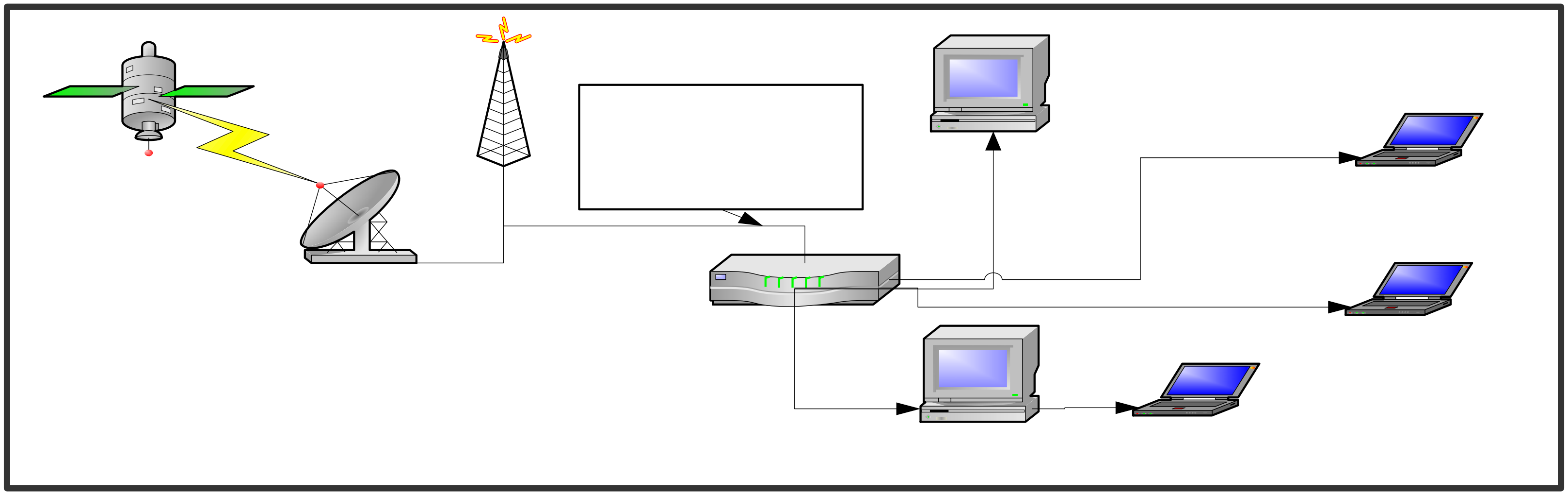
Technical Reference Model (TRM)
Technologies, Standards, Specifications, Component Framework

Hardware approach provides price/performance & manageability

Hardware security gateway enables higher security assurance for cross-agency exchange

Hardware approach fits well within the Component Framework

Example of other SOA appliance use: XML Routers



- Content-based routing based on dynamic XPath tables
- SOAP protocol routing and load balancing
- Message enrichment via headers
- Publish-Subscribe based on content in messages
- Message duplication & relay
- QoS and QoP based on message content
- Routing and delivery independent of producers or consumers

Thank You