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*6th Integrated-CNS Technologies
Conference & Workshop*

Data Access and Distribution

Paul Comitz/Avinash Pinto



May 1, 2006

Agenda

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- **Context**
 - **Technology**
 - **Networked Systems**

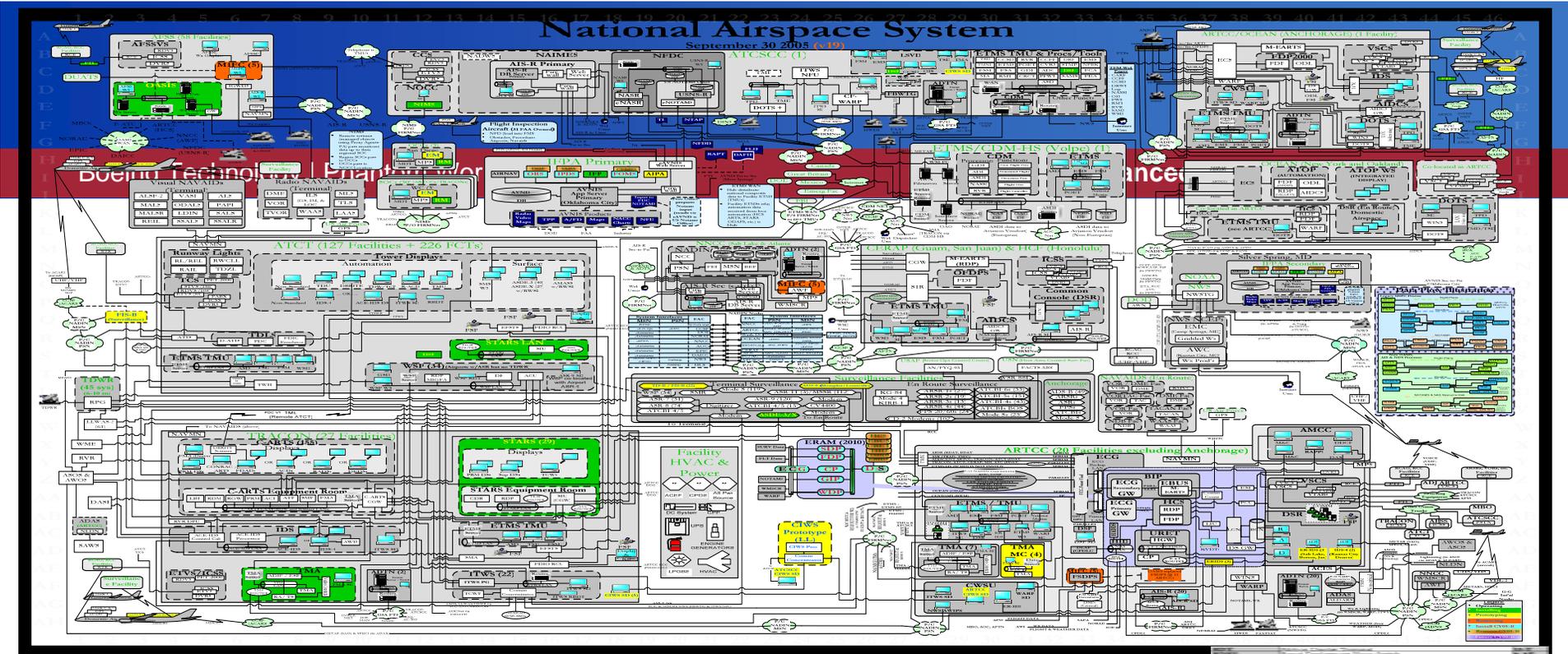
- **Studies**
 - **Network Performance Study**
 - **Web Services Technology Evaluation**

- **Data**
 - **Domain Specific Modeling**
 - **Interface Factories**

- **Points to Consider**

- **Enterprise Information Management**
 - **Lighting swift advances in technology**
 - **Current Landscape**
 - **Many Users**
 - **Communities of Interest**
 - **Many missions**
 - **Many technologies**
 - **Safety, Economy, Value, Security**
 - **Funding and management aligned by individual roles**
- **Air Traffic**
 - **High Value - a national asset**
 - **Essential – 9% to 11% of GNP**
 - **Must be internationally competitive**
 - **OMB Presidential Mandate to share information across lines of business**
 - **Complexity**

Where are we and where do we go ?



Can we build next generation systems by focusing on, and managing, infrastructure ?



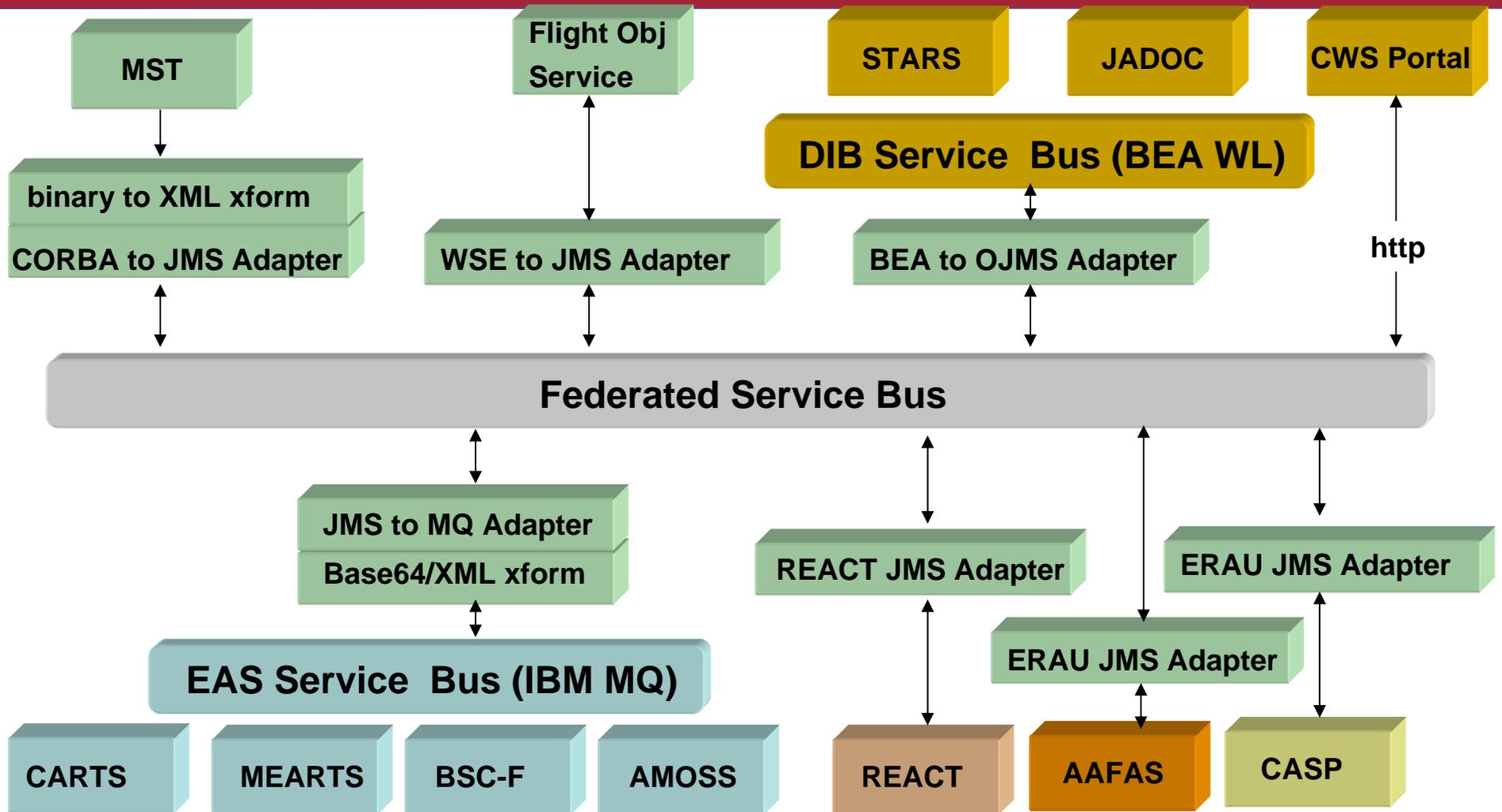
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Context Networked Systems

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Challenges

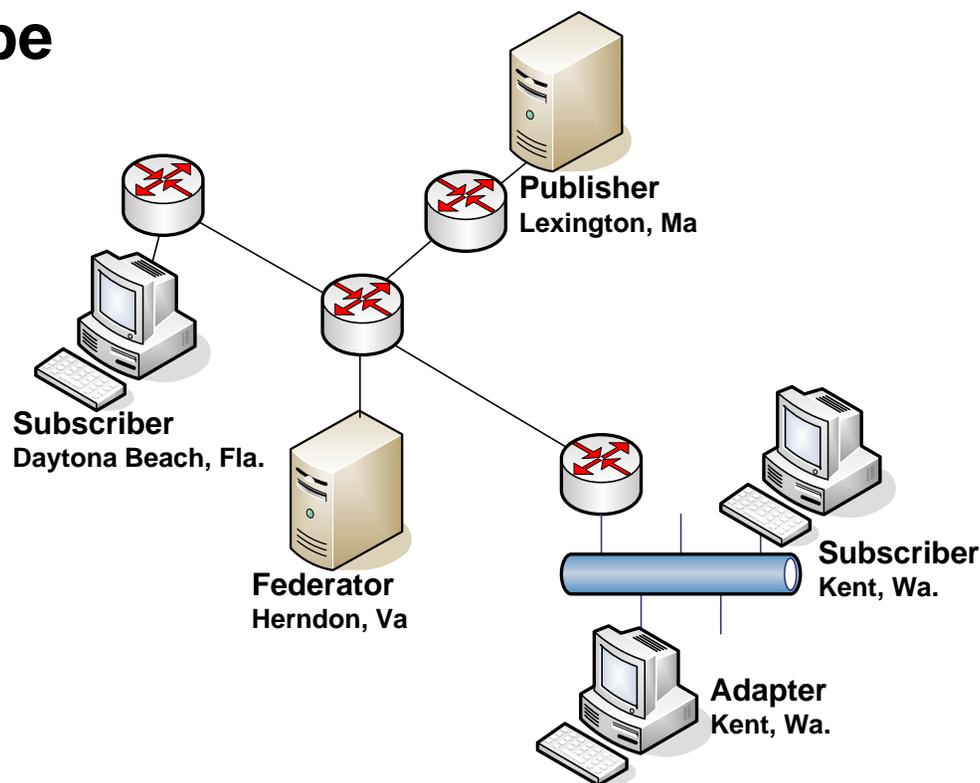
- **Avoid virtual point-to-point mechanizations**
 - **Potential N^2 problem**
 - Each of N systems must implement and test N-1 interfaces
- **Joint NEO Security Demonstration**
 - **5 distribution technologies, 3 data types**
 - **Adapters**
 - Bridge protocol, translate data
 - Reduce approximately 30 interfaces to 5 interfaces
- **Lesson Learned**
 - **Adapters/Translators**
 - Error Prone, difficult to scale, complex
 - **Part of the strategy – not *the* strategy**
- **Areas to investigate**
 - **Performance**
 - **Specific Technologies**

Network Performance Study

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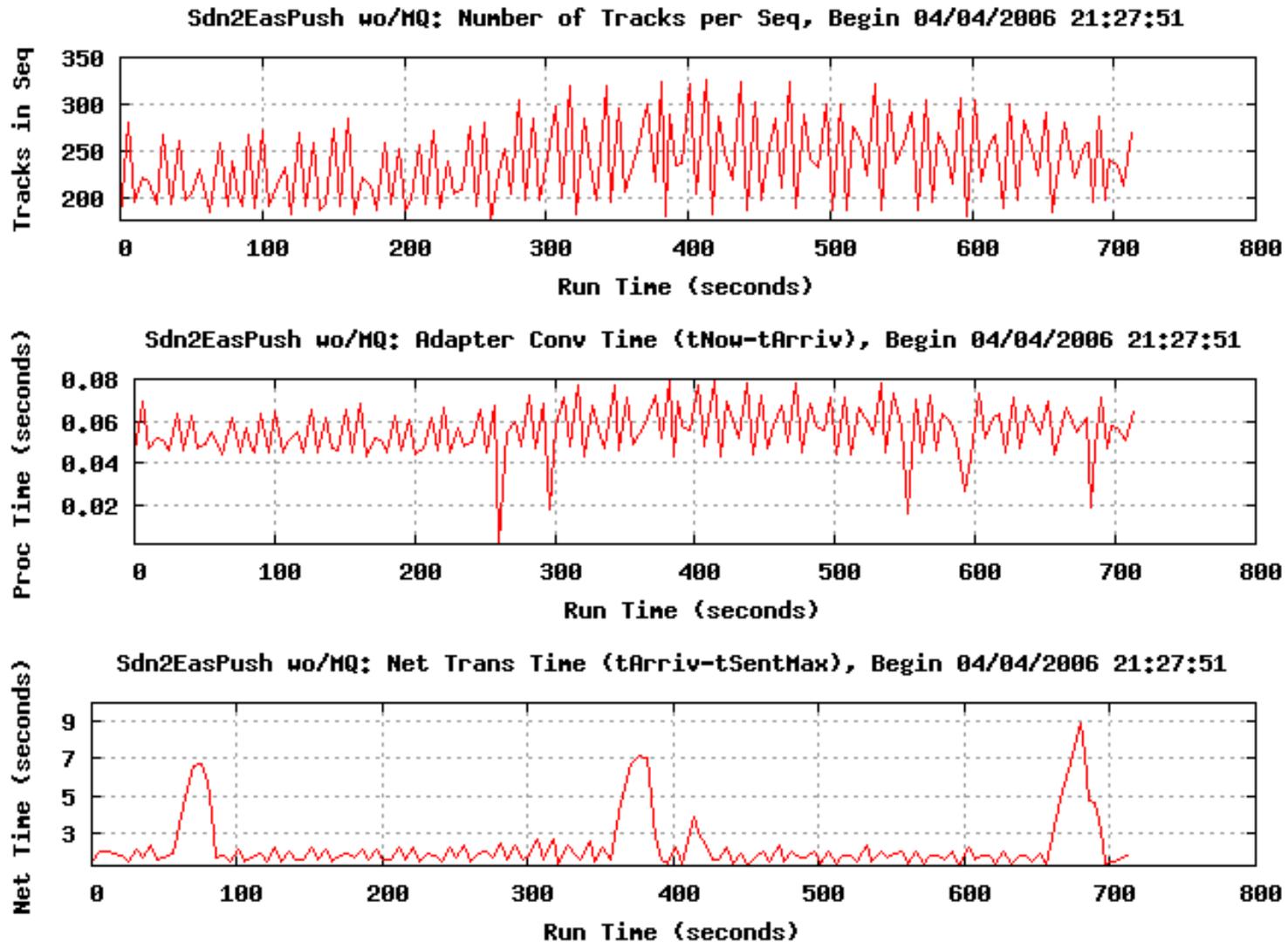
- Evaluate publish/subscribe over a WAN in an ATM environment
- Scenario
 - Publisher : Lexington, Ma
 - Federator: Herndon, Va
 - Subscribers:
 - Daytona Beach, Fla.
 - Kent, Wa
 - Adapter
 - Write data to IBM MQ at endpoint
- Volume
 - Approx 250 tracks every 5 seconds



Network Performance Study Measurements

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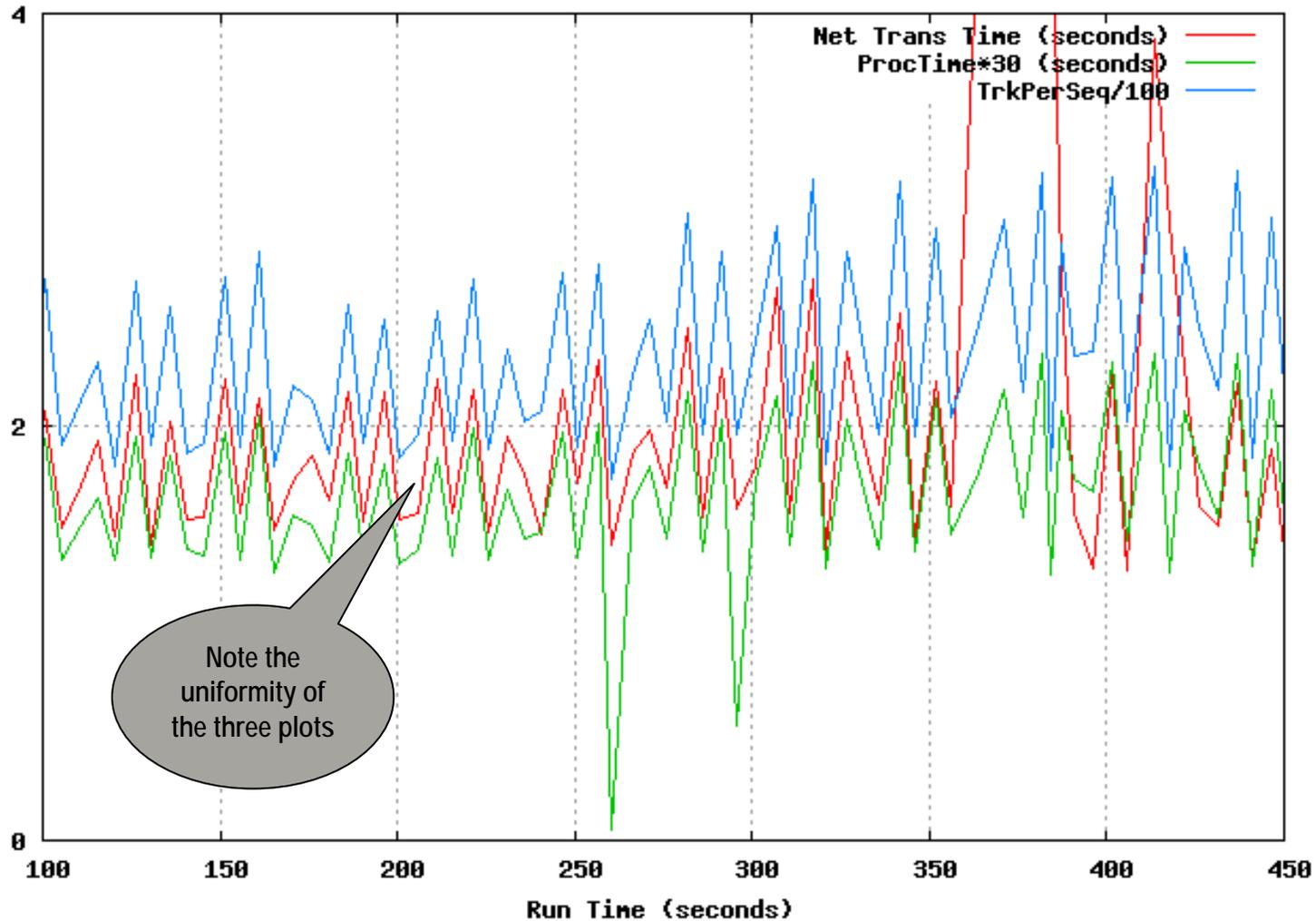
Network Performance Study

Performance scales with density

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Sdn2EasPush wo/MQ; Shape of NetTime and TrkPerSeq lines are Mostly Consistent
Begin 04/04/2006 21:27:51



Network Performance Study Observations

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- **Performance is OK, room for improvement**
 - Similar performance with JMS
- **More to do**
 - Connectionless protocols
 - Channel Management
 - Compression
 - Improve adapter performance

Sdn2EasPush Adapter Test With and Without Publishing to MQ				
Test Start Time	Test	Avg Number of TrksPerSeq	Avg CORBA Push Time Per Seq (tArriv-tSentMax)	Avg Adapter Time Per Seq (tFinish-tArriv)
4/4/06 21:27:51	No MQ	237.364	2.289	0.056
4/4/06 21:41:49	MQ	231.297	2.310	1.009

Web Services Technology Evaluation Overview

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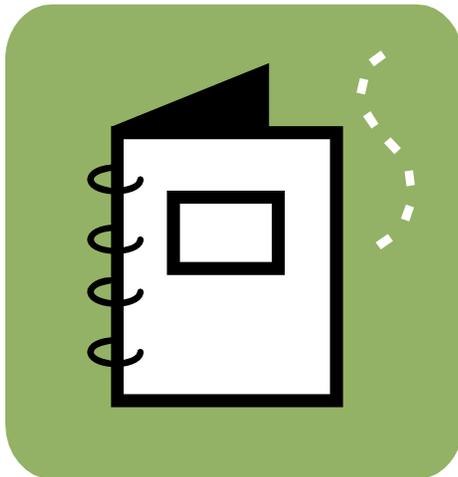
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Are Web Services appropriate for use in the air traffic domain?

Web Client

Web Service

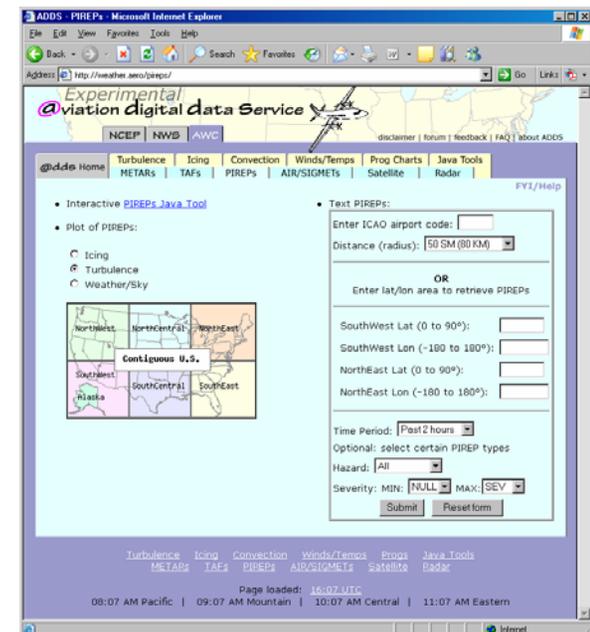
PIREPs



- Detailed logs of daily development activities
- Evaluation of criteria used to assess Web Service technology (documentation, cost, standards, etc)

Developer Notebooks

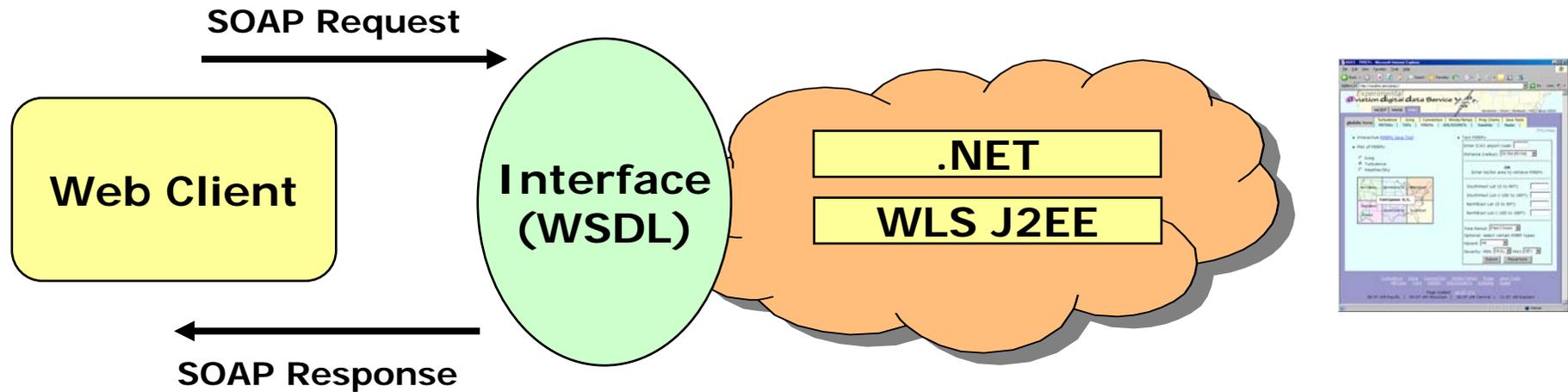
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Web Services Technology Evaluation Method

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- Using WSDL, specify a common interface for client to Web Service interaction
- Develop identical Web Services using the candidate technologies
- Test and evaluate the technologies used

Web Services Technology Evaluation Comparison

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Technology	.NET	Weblogic 9.1
Documentation	Thorough. Online and Offline. Third party training offered.	Documentation adequate. Sometimes referred to previous product version. Examples too trivial.
Support	Several options. Knowledgebase, FAQs, downloads. Free (MSDN) and paid support and training. Web forums.	Web forum available to ask and answer questions – extensively used by community.
Costs	.NET framework free – included in Windows. Microsoft Visual Studio costs. Hardware costs - \$.	Free SDK for development. Limited license for testing. License costs based on negotiated costs with vendor – vary by CPU - \$. Hardware costs - \$.
Ease of Setup	Straightforward – standard installation package. Updates available on website.	Easy. Installed from a web download. Ran a development server with a test configuration for web services.
Platforms	.NET: many to all Microsoft operating systems on x86 architecture. MONO supports Linux, Mac OSX, Solaris, BSD, Windows, HP-UX on x86 architecture.	OS: Windows, Linux, HP-UX, Solaris, AIX. Architectures: x86, PA-RISC, Itanium, POWER4/5, AMD64, EM64T, Sparc.
IDE	MS Visual Studio 2005 - \$.	NetBeans – free.
Standards	Supports many/most mainstream standards including HTTP, XML, SOAP, UDDI, WSDL, etc.	Supports many/most mainstream standards SOAP, UDDI, XML, XSLT, DOM, SAX, etc.
Scalability	Requires further investigation.	Requires further investigation.

Web Services Technology Evaluation Observations

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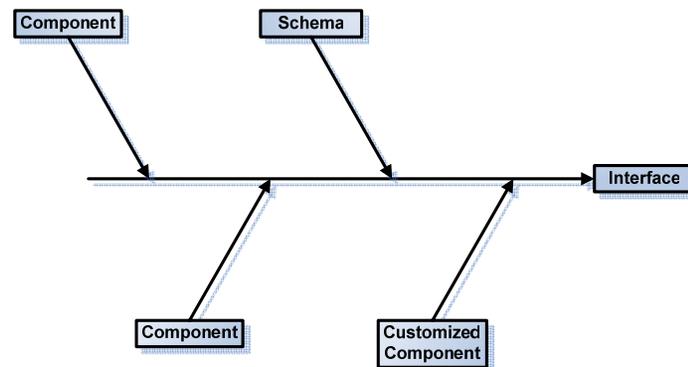
- **.NET and Weblogic Web Services technologies provide sufficient capabilities necessary for data access and distributionin this scenario**
- **Services were developed and tested inexpensively in 6 weeks by experienced developers**
- **Services did not address time criticality or high bandwidth issues**
- **Deploying a MONO web service with .NET code was surprisingly simple**

Data Domain Specific Modeling

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- **Poor data quality costs US business billions per year¹**
- **Systems in a domain often have more similarities than differences**
- **Complex abstractions are built with concrete tools like strings, floats, and loops**
- **Factories**
 - **Create similar, *but distinct*, data models and interfaces by using domain specific components**



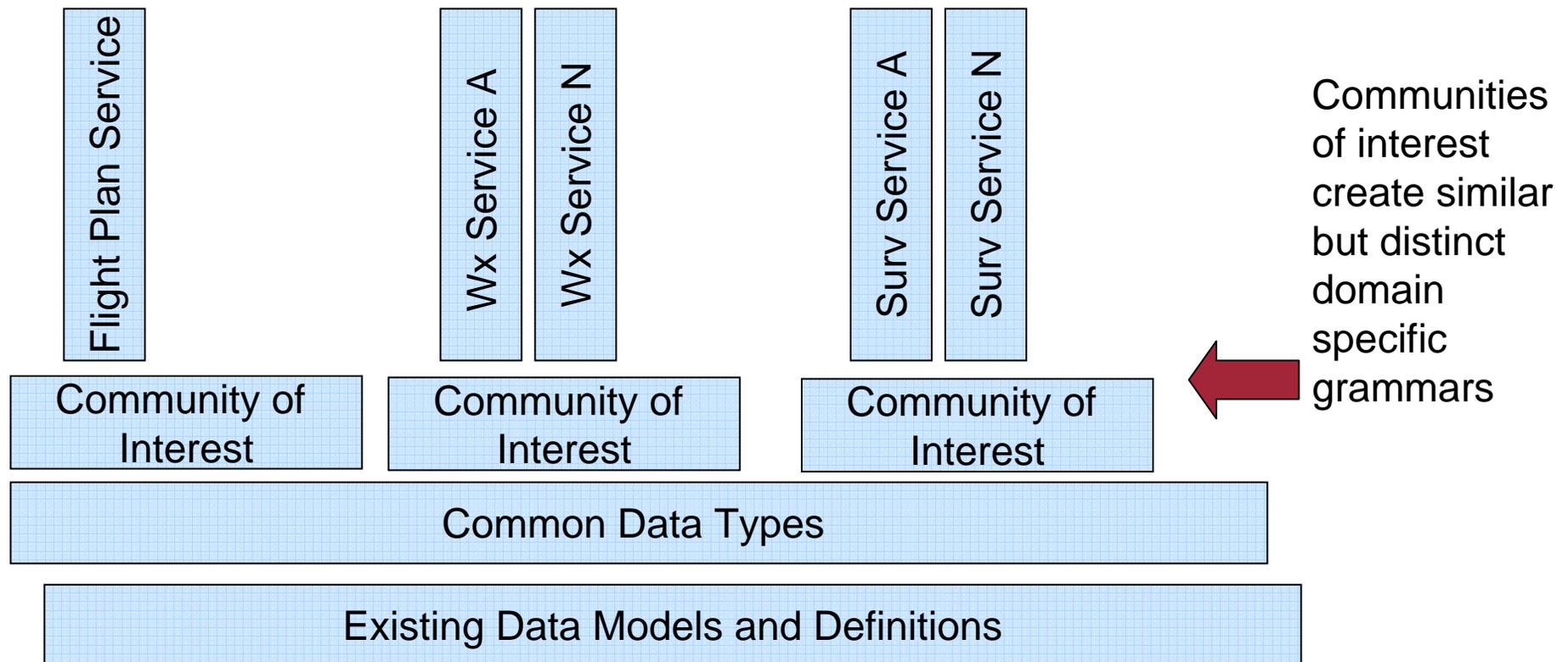
¹ Eckerson, Wayne W. (2002) *Data Quality and the Bottom Line*, The Data Warehousing Institute. Chatsworth, California

Data Interface Factories

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- Perform operational analysis of data usage in domain
- Create domain specific data architecture framework
- Interfaces draw on managed data set
 - Extend and customize as necessary



Points to Consider Technology

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- **Shared secrets, even if they are just schemas, are brittle and hard to work with.**
 - **Discourage the use of variable length formats and optional data**
- **Moving real time data over a wide area network is fundamentally different than moving data over a local or point to point area network**
 - **Batching and decimation**
 - **Connectionless protocols**
 - **More efficient data representation**
- **Enterprise application integration is conceptually simple ... but *much* more difficult in practice**
 - **Provide significant time and funding for integration and test**

Points to Consider Process

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- **Organizations that have invested time, money, and resources in a particular technology should not be asked to significantly change in the near term**
 - **But writing adapters and converters is a complex and time consuming activity**
 - **Short term solution**
- **Good requirements are difficult to write**
 - **System engineering is part of the design, construction, and test process**
 - **Software engineering is part of the concept of use and requirements process**
 - **Accept the fact that requirements will change**
 - **Some requirements will be discovered in a prototype environment**

- **Sea Change**

- Increased focus on infrastructure to enable operations
 - Decreased focus on individual applications

- **Management and Governance**

- Policies, procedures, and strategies for managing the business process

- **Leadership**

- **Risk**

- **Technology**

SWIM is a Marathon

Questions ?

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