



Enterprise Architecture
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Practical Enterprise Integration

Realising the Benefits of a Strong Canonical Architecture

Andrew K. Johnston
Independent consultant at National Grid

www.andrewj.com
www.agilearchitect.com

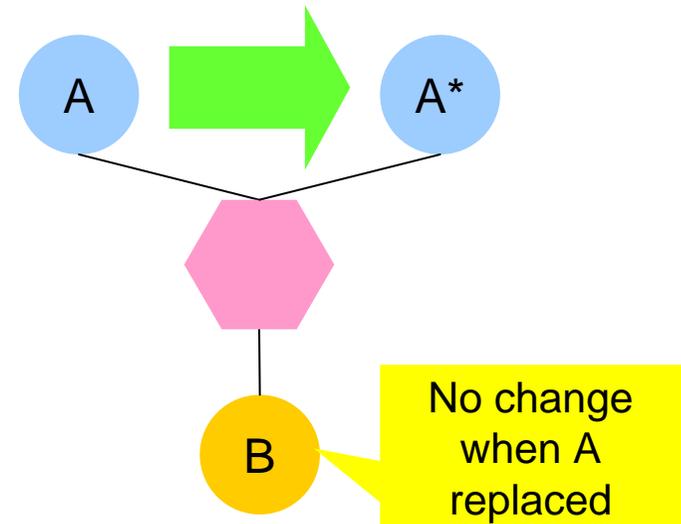
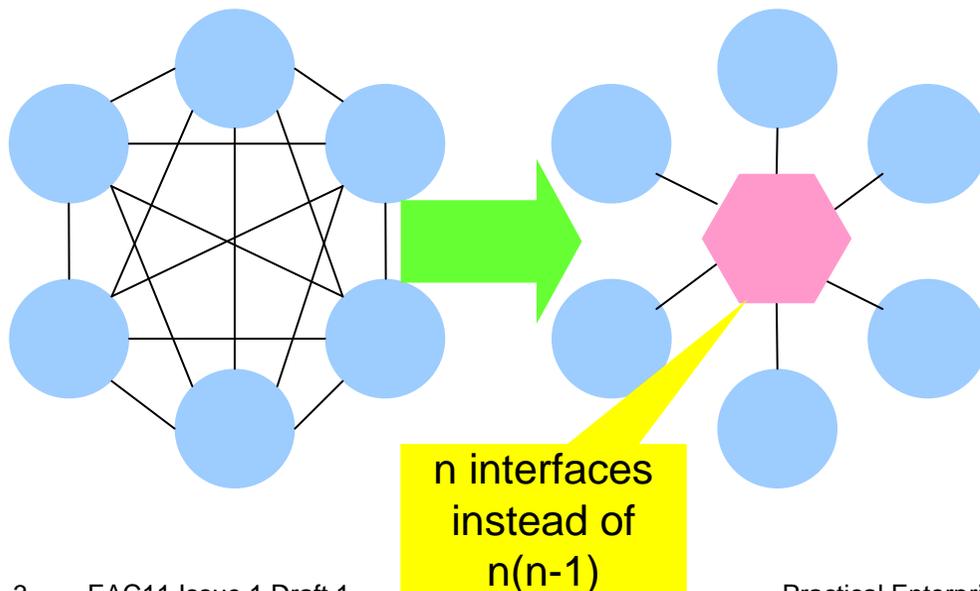
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What's This About?

- ◆ We've all heard of EAI
- ◆ We all know the theoretical benefits
- ◆ We haven't all seen evidence of actually delivering multi £M benefits
- ◆ This is the multi-year story of a real, enterprise-scale example
 - ◆ An example of "Pace Layering" in action!

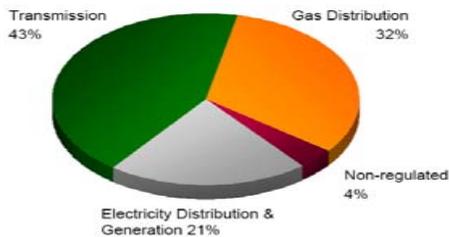
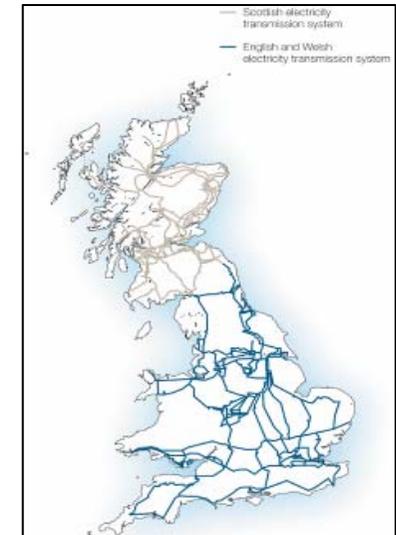


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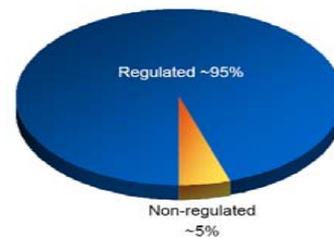
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- ◆ Largest investor owned utility in the UK, second largest in the US
- ◆ Electricity & Gas
- ◆ Generation, Transmission, Distribution & Retail Supply
- ◆ US & UK
- ◆ UK Transmission run both the UK's high voltage electricity transmission grid, and the high pressure gas transmission system

UK Electricity (T)



Asset Base



Revenue

US Electricity (T & D Network)



Our Scope: Enterprise Within an Enterprise

- ◆ These slides describe what has been done for UK Transmission
 - ◆ UKT manages, maintains and operates UK's high voltage electricity grid, and national high pressure gas transmission network
 - ◆ EAI development focused on Asset and Work Management systems, but supporting links to operational systems and shared services such as supply chain
 - ◆ Model originally developed for electricity, now applies almost equally to gas
- ◆ This is an “Enterprise within an Enterprise” - Line of business focus, but enterprise-scale size & complexity
 - ◆ Significant numbers of users and supply chain partners
 - ◆ ~ 1 million maintained assets
 - ◆ At least 100 work and asset management systems before rationalisation
- ◆ National Grid has single IS function across all regions and lines of business. However:
 - ◆ There is considerable variation in core systems due to history
 - ◆ Strategic consolidation on SAP and “best of breed” systems in progress but not complete
- ◆ A key challenge is to leverage experience and solutions across different parts of National Grid

Key Players in EAI Implementation

- ◆ Very much a collaboration between multiple parties partnered with National Grid
- ◆ “We couldn’t have done it without...”
 - ◆ AMT-Sybex
 - ◆ Suppliers of MIMS/Ellipse and integration expertise
 - ◆ Designed and built the original version
 - ◆ Continue to manage the design
 - ◆ Accenture
 - ◆ Developed and maintain the integration around FFE
 - ◆ Wipro and TCS
 - ◆ Developers of integration code since 2008
 - ◆ Operate and support the system
- ◆ My role as Solution Architect
 - ◆ Enterprise architecture: develop and maintain the “big pictures”
 - ◆ Solution architecture: ensure designs are consistent and of high quality
 - ◆ Innovation: originating improvements and solutions to specific problems
 - ◆ Co-ordination: trying to hold it all together!

AMTSybex[®]

accenture

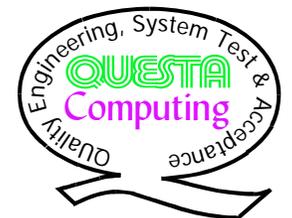
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Where Did It Start?

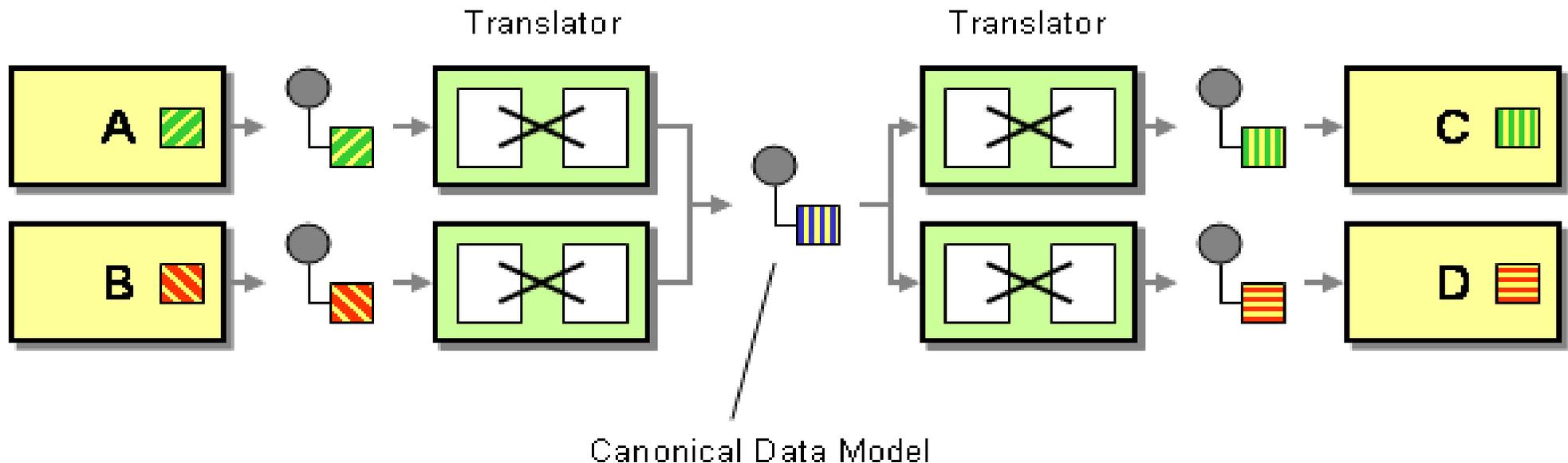
- ◆ Pre-2000: Significant system fragmentation, lots of bespoke “integration spaghetti”
 - ◆ 64 Asset Management Systems, and that’s excluding Gas Transmission!
- ◆ 2000-3: Business consolidation and asset systems review drove investigation into role of EAI in systems rationalisation
 - ◆ Identified potential future core systems, and role of an EAI backbone
 - ◆ Highlighted SeeBeyond as most likely technology
- ◆ 2003: Acquisition of Transco provided UK experience of EAI, and SeeBeyond eGate as incumbent product set
- ◆ 2003-5: “Staying Ahead” programme to provide key new business capabilities for UK Transmission, reduce workforce by 20%: £30M IS investment in new & rationalised systems
 - ◆ Consolidation of asset systems
 - ◆ Field force mobile system
 - ◆ New document management system
 - ◆ Data warehouse and decision support tools
 - ◆ **EAI backbone to link it all together!**

Early Successes and Failures

- ◆ What we got right
 - ◆ “Core plus satellite” model for asset systems
 - ◆ The Common Message Model
 - ◆ Re-use and change isolation capabilities
- ◆ What wasn't so good...
 - ◆ Fragmented integration responsibilities
 - ◆ Multiple hand-offs in key integration chains
 - ◆ Varying integration models driven by different supplier preferences
 - ◆ Performance and reliability problems, exacerbated by complex responsibilities

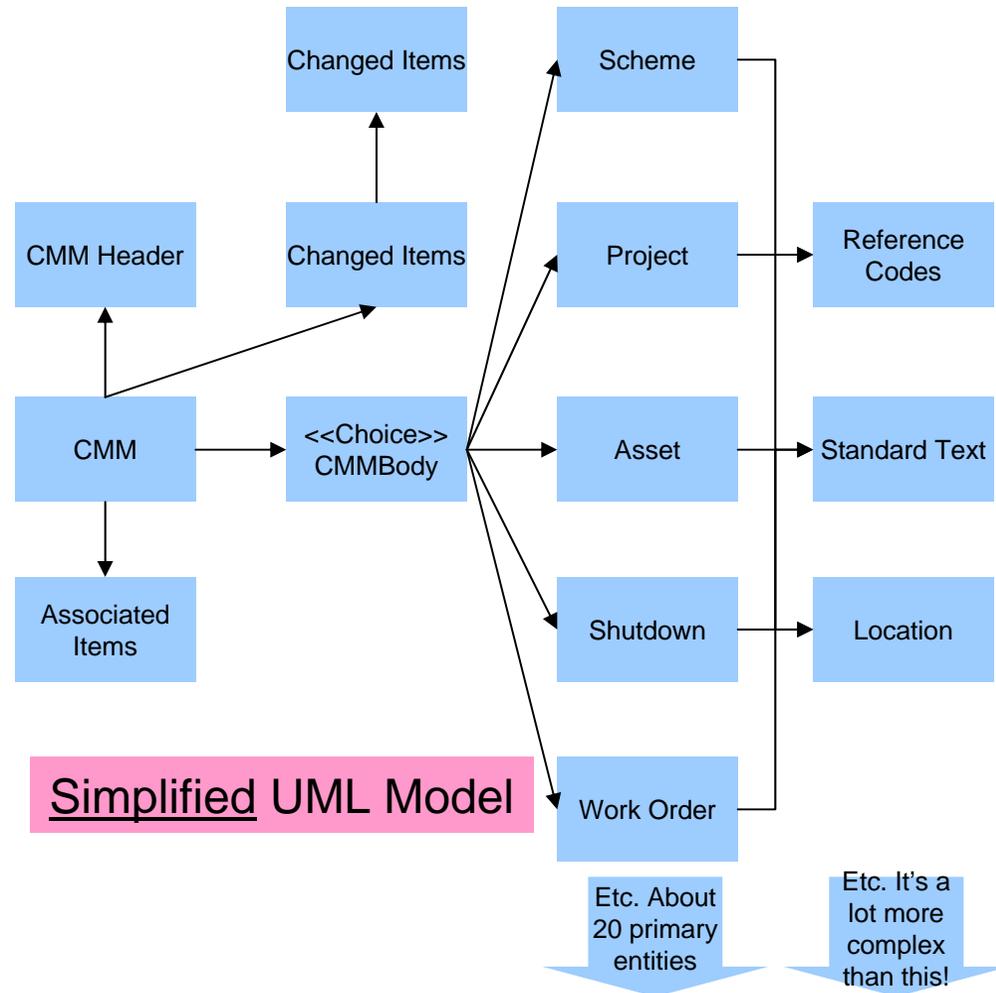
The Canonical Data Model Pattern

- ◆ Problem: Many-many message-based integration
 - ◆ Many/all systems have different data formats
- ◆ Solution: Use the “Canonical Data Model” pattern
- ◆ Delivers “hub and spoke” benefits at the logical level, as well as the physical

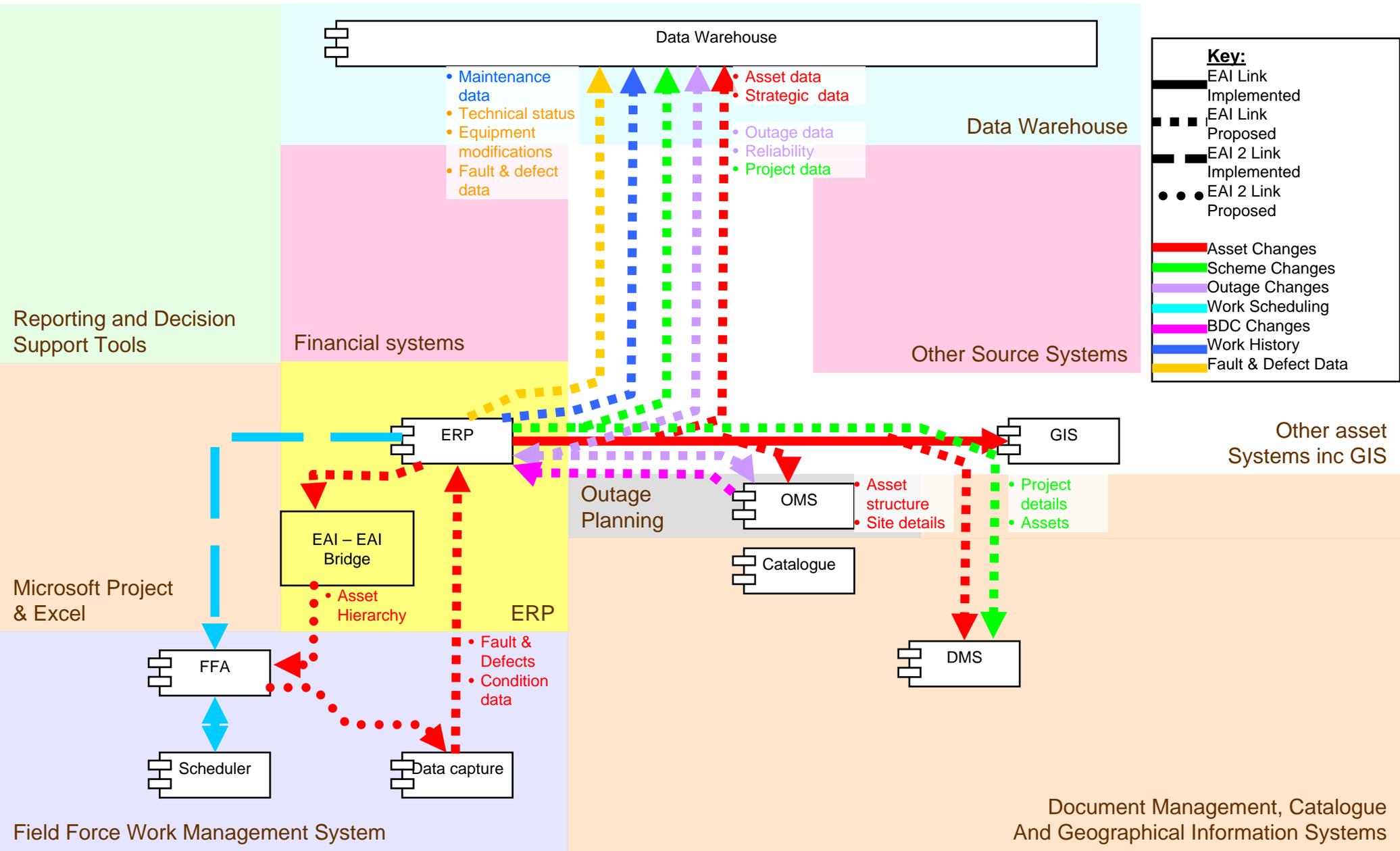


UK Transmission's Common Message Model

- ◆ Canonical message model used to intermediate between system-specific formats
- ◆ Used for all except a few very high volume, low complexity links
- ◆ Business meaningful structure, rather than “meta model”
- ◆ Modelled in UML
- ◆ “First cousin” to IEC CIM: CIM wasn’t mature when we started, but provided key concepts and formats
- ◆ Early implementations suffered from errors in manual coding. Now use Sparx Systems Enterprise Architect to generate XSD schema direct from UML

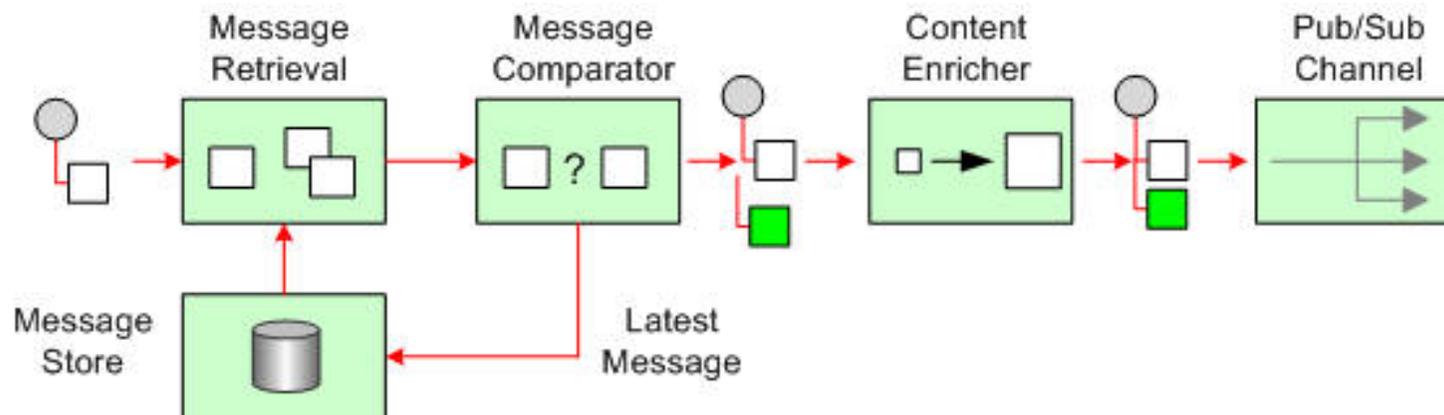


Interface and Data Reuse: the EAI "Bus Map"



Asset Feed Problems and Solutions

- ◆ Envisaged a “trickle feed” of asset updates from Asset Inventory
- ◆ Turned into a flood, because of bulk updates to e.g. account codes, not relevant to downstream systems
- ◆ EAM adapter couldn’t identify “what has changed” – just sent whole record every time
- ◆ Solution exploits integration layer:
 - ◆ Stores last message per asset
 - ◆ Compares content to identify changes, and enriches messages with “changed items” info
 - ◆ Integration layer then filters records per system based on relevance of changed items
- ◆ Solution later exploited to rationalise similar interfaces, and provide auditing features



Adding the “Point of Work” Solution

- ◆ Problem: PC-based field force solution working well, but physically too large & heavy for use “at point of work”
 - ◆ Impractical for overhead line surveys and other inspection work
 - ◆ Resulted in data being captured manually, with costly & error-prone transcription back at office
- ◆ Solution: add a PDA version of the Field Data Capture Solution, as a “satellite” device to the PC
- ◆ Challenges: limited funding, strong desire not to change field force system itself (now stable after initial problems)
- ◆ Design mantra: exploit existing interfaces, **zero** change to FF system
 - ◆ PoW solution “transparently” uses and updates same files as PC solution
- ◆ Outcome: success! Zero change required to FF or back end systems. Initial prototype delivered in about 10 weeks and immediately exploited in the field

The Next Big Challenge: Core EAM System Upgrade

Having just about got things stable, we embarked on another major change...

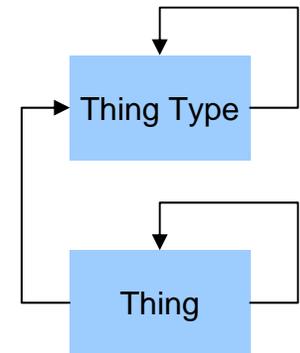
- ◆ Replaced core Work and Asset Management system (MIMS) with much newer version (Ellipse)
- ◆ Completely new hardware, operating systems & database
- ◆ Changed “back office” system from Oracle to SAP
- ◆ “Boundary change” moved key back office functions previously in MIMS (e.g. materials management) to new SAP system
- ◆ Replaced SeeBeyond eGate integration layer with new version (Sun JCAPS)
- ◆ Significantly rationalised the integration model, got rid of a lot of “spaghetti”
- ◆ Replaced custom integration adapters with standardised flows

And...

- ◆ Largely avoided knock-on impacts the other core systems, through strength of integration model

The Transformation Engine

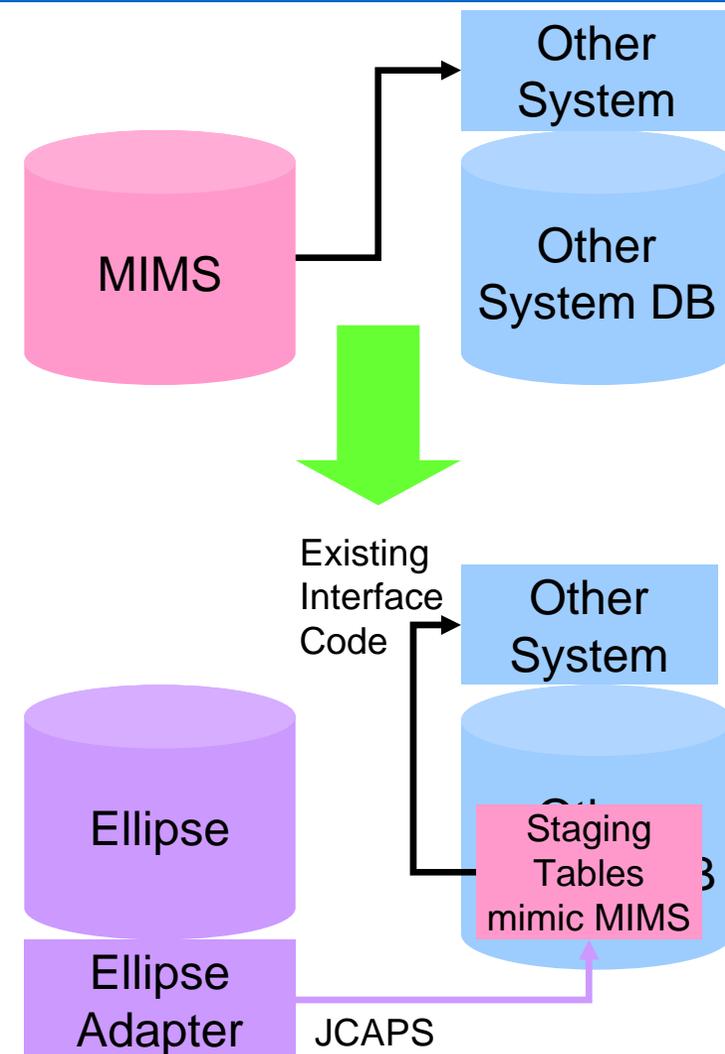
- ◆ MIMS / Ellipse has a powerful integration model, but it's based on a meta-model of the data (e.g. the payload is an object which other payload data describes as an asset)
- ◆ Our CMM is based on a “business meaningful” model of the data (e.g. the payload is an asset, so the “asset” node is populated)
- ◆ Prior to the upgrade, each transformation was a complex hand-coded mapping, with separate “request” and “enrichment” stages
- ◆ In the Ellipse world, we would have >50 of these!
- ◆ Enter “The Transformation Engine”
 - ◆ Two generic transformations (one in each direction)
 - ◆ Request and mappings defined in a common, configurable rule table



The eTXML Model!
(somewhat simplified 😊)

Integration Successes from the EAM System Refresh

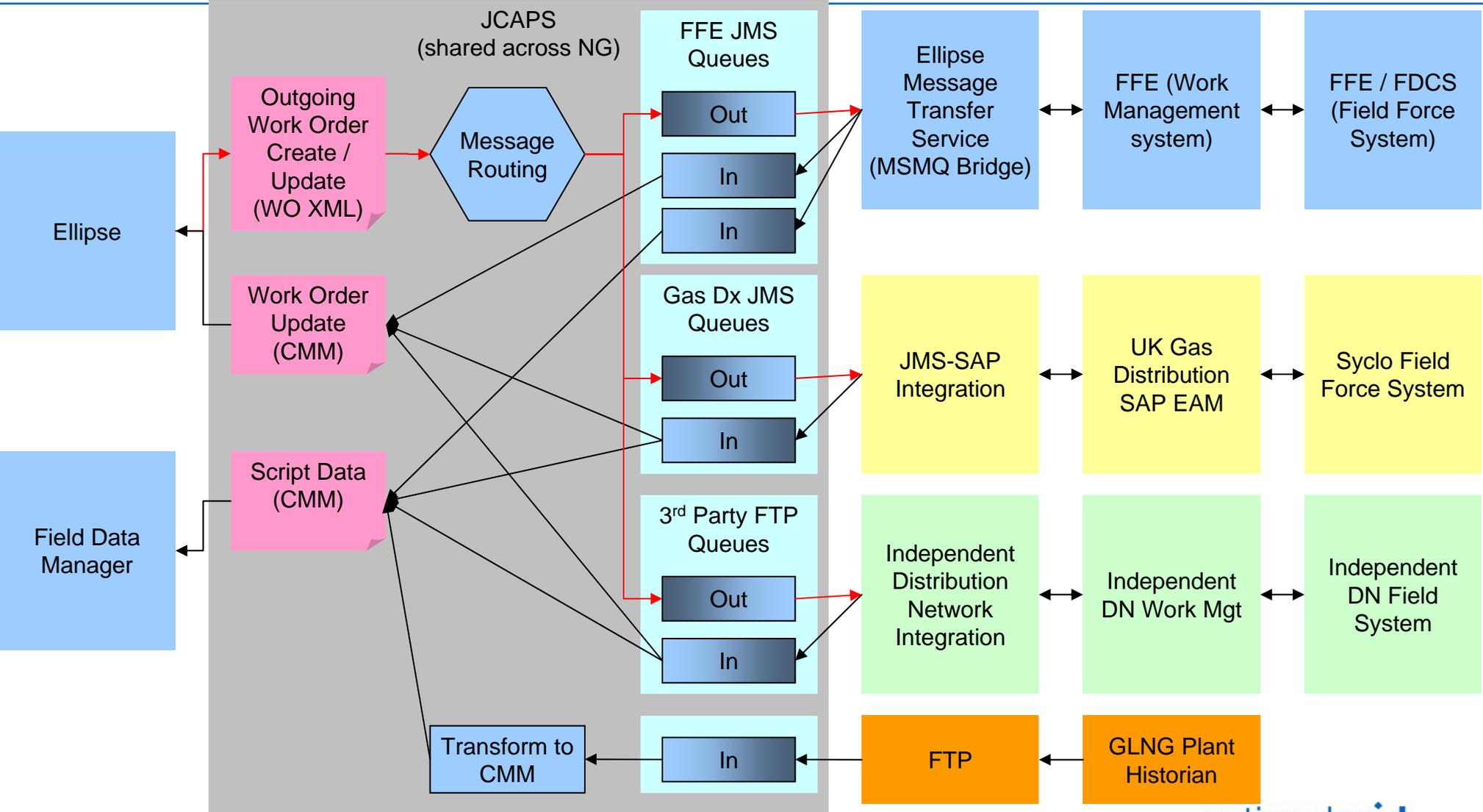
- ◆ All Ellipse interfaces converted to JCAPS, with JMS or FTP interface
 - ◆ Got rid of all database / ODBC links
 - ◆ Avoided downstream changes using “staging table” design pattern (see right)
- ◆ Proper message based interfaces replaced wide variety of file and database links
- ◆ Consolidated several similar EAI flows
- ◆ Web Services used for real-time request / response exchanges between Ellipse & SAP
- ◆ **No significant change to other major systems:**
 - ◆ Field force system
 - ◆ Data warehouse
 - ◆ Geospatial information system
 - ◆ Document management system
 - ◆ Minor work management systems



Extending Further Into the Enterprise

- ◆ Through 2009-2010, we have progressively applied the pattern across other parts of National Grid in the UK
- ◆ Liquid Natural Gas Storage and Grain LNG “non-regulated businesses” adopted Ellipse as EAM system
 - ◆ Needed own Ellipse “district” (effectively separate “company” in same instance)
 - ◆ Made integration model “multi-district” with **zero knock-on changes**
 - ◆ Now exploiting existing asset information flows to integrate to Plant Historian Database
- ◆ NG Gas Distribution do some work on behalf of Gas Transmission
 - ◆ New EAM system “tees” into existing work and asset data feeds (see next slide)
 - ◆ **No changes required to Ellipse or OITH**
 - ◆ Same approach can be used for work done by independent Gas Distribution companies
- ◆ Cathodic protection surveys managed in a separate system (Uptime)
 - ◆ Will exploit similar architecture to schedule surveys and confirm their completion
- ◆ **All possible because we are working with a strong, flexible message model!**

Tapping into the Existing Work and Asset Flows



A Reduction of Spaghetti

- ◆ System continues to evolve with progressive reduction of “integration spaghetti”
- ◆ Each upgrade / replacement project tries to streamline and standardise interfaces
- ◆ Example: bridging to MSMQ
 - ◆ Originally: complex, unreliable “adapter server” with support responsibilities split 5 ways
 - ◆ After Ellipse: server still existed, but adapter software reduced to simple “transfer service”
 - ◆ Now: JCAPS connects directly to MSMQ, server virtualised and moved under single party control
- ◆ Example: interfaces to “My Calendar” system
 - ◆ Originally: single-purpose HTTP “screen scraping”, with complex proprietary “adapter” software
 - ◆ Late 2011: web services using Common Message Model as native message format



Looking Forwards

- ◆ What are the future challenges?
- ◆ Promoting the lessons and best practices elsewhere in NG
 - ◆ Can we do the same thing with other technologies, in particular for the strategic SAP footprint?
- ◆ Extending the model for more service exchanges
 - ◆ Can we use the CMM as a basis for true SOA?
 - ◆ What's the right model for a mix of asynchronous messaging and synchronous service exchanges?
- ◆ Supporting Strategic Asset Management
 - ◆ How do we move dynamic asset condition & performance data around for novel analysis and presentation?
 - ◆ How should we bring data from multiple systems together in composite applications and portals?
- ◆ Incorporating industry standards
 - ◆ Can we use IEC CIM for real-time asset data flows?
 - ◆ Can we use IEC CIM as an “external” message standard?



Looking Backwards

- ◆ Lessons Learned
 - ◆ You need a strong logical architecture as well as technical tools
 - ◆ Otherwise you just produce “technically consistent spaghetti”
 - ◆ Someone has to act as guardian of the architecture
 - ◆ Don't wed yourself to technical perfection
 - ◆ Ideas which look good on paper may not always be the best fit
 - ◆ Remember: No battle plan survives contact with the enemy!
 - ◆ Allow systems to evolve at their own speed – “pace layering”
 - ◆ Design so that the most volatile components are separate from the less volatile ones, and ideally treated as data
 - ◆ Exploit the integration architecture to minimise knock-on impacts of system changes
- ◆ Can we quantify the benefits?
 - ◆ Business value delivered – met original 25% efficiency targets, now supporting growing footprint and business volumes
 - ◆ Dramatic avoided costs – easily £0.5-1.0M per project, probably around £10M total by now
 - ◆ **Well worth the investment in both EAI and CMM**



Any Questions??