GSAW 2011 Implementing Shared Capabilities

Ground Software Integration in Various Bus Architectures:

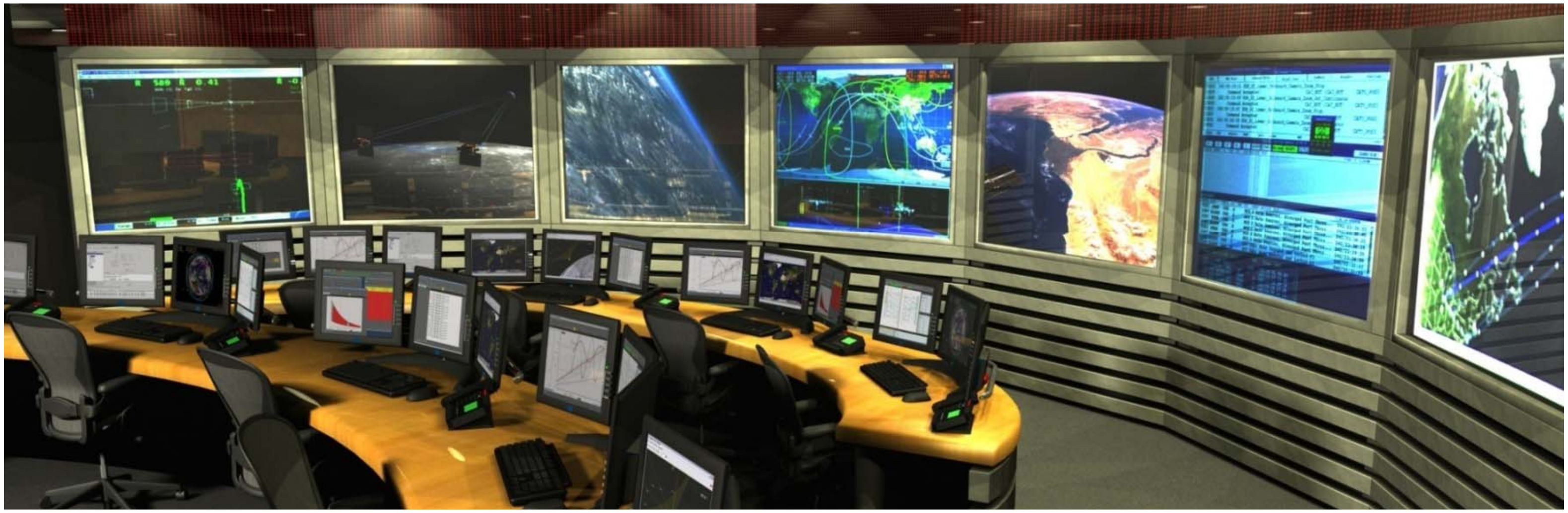
Lessons Learned from Recent Experience

INNOVATING SOLUTIONS

Who Are We?

GMV is....

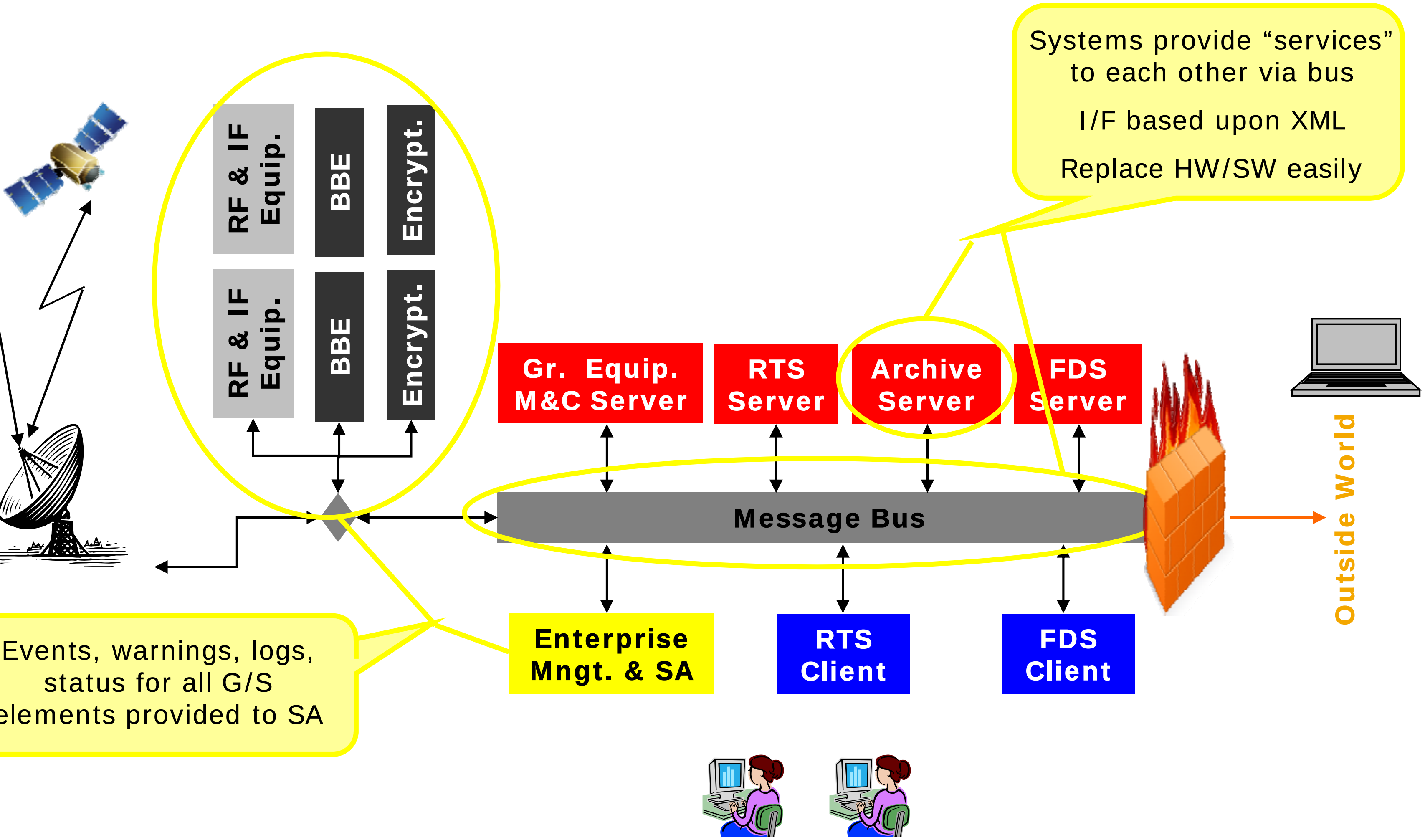
- Privately-owned, family business (woman-owned)
- Established in 1984 with affiliates in the US, Europe and Asia
- ISO 9001 certified, CMMI level 5 certified for SW development
- Space News Top 50: #48 for 2 years in a row
- #1 Commercial telecom ground system supplier in the world
- Only company to sell ground SW to space institutions around the world (NASA, NOAA, USGS, CNES, ESA, Eumetsat, Roscosmos, ISRO, ETRI)
- GMV ground systems deployed to 26 countries on 6 continents



Recent Experience

- 5 GEO fleet migrations successfully completed
- Largest independent GEO fleet migration in the world ever done was successfully completed by GMV in 2008
- NASA Goddard's GMSEC
  – Interoperability standards with wide application
- Satellite manufacturer R&D
  – Test benches to demonstrate spacecraft compatibility
- NASA SGSS and GOES-R programs
  – GMV COTS products fit in to larger architectures
  – SOA is required
  – Dovetails with product development of upcoming GMV COTS versions

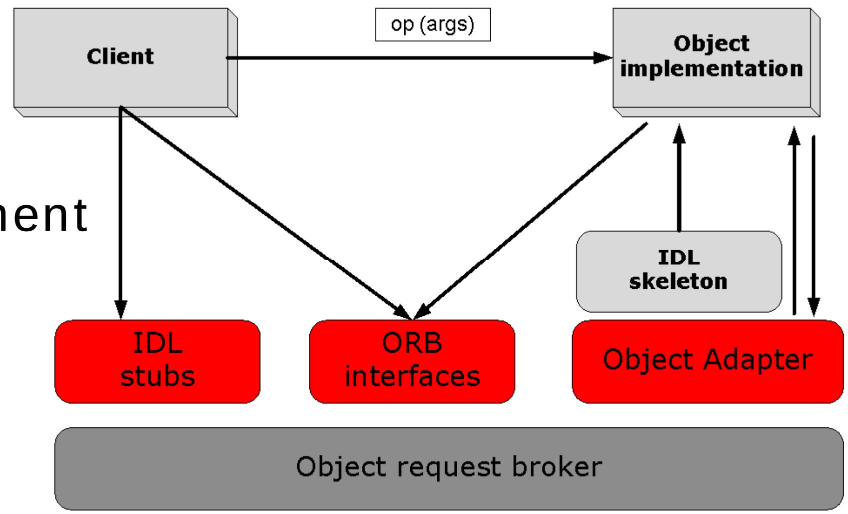
stribution Architectures: Message Bus



stribution Architectures: Corba

/idely used in

- Banking & Finance Online account access
- E-commerce
- Network management
- Hospital Patient Record Management
- Entertainment pay-per-view
- Spacecraft control centers!

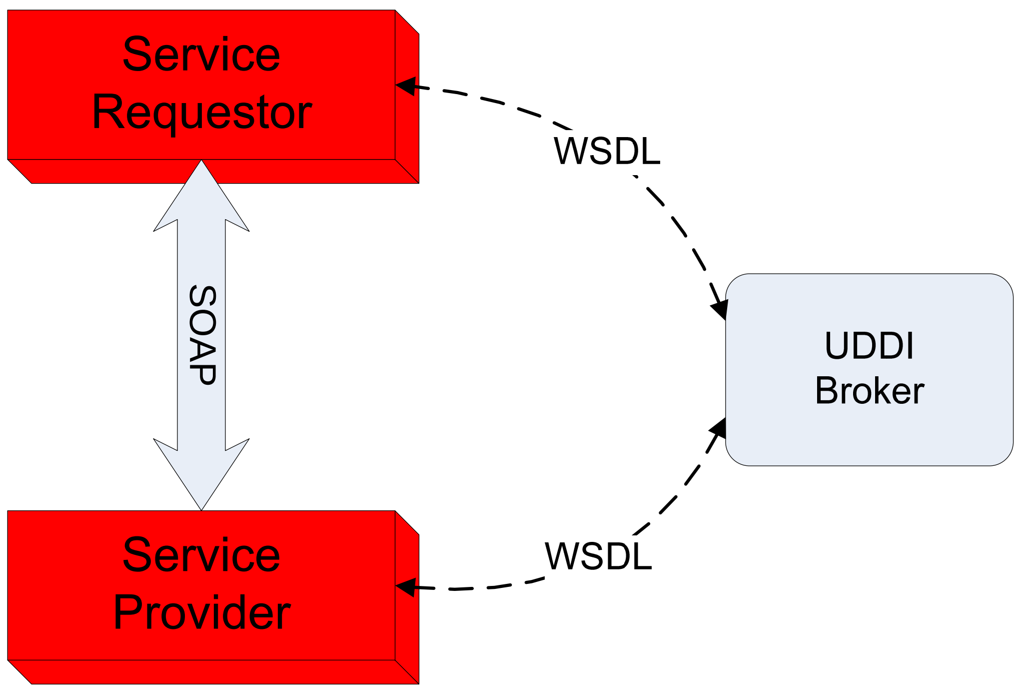


imitations

- Significant learning curve
- Complex object life cycle
- Requires bridging to older legacy systems
- Network difficulties (firewalls, non transparent addresses)
- Mobile environment limitations (changing and unreliable network addresses)

stribution Architectures: Web Services

- 3C Activity to layer ditional features above)AP and XML
  - Service discovery
  - Security
  - Web Services Description Language (WSDL)
- n use other transports
  - RPC (like Corba)
  - Message Bus
- verages the rastructure of the web
  - HTTP(S) communications
  - URI resource location
  - REST techniques aid caching



ade Spaces: Learning Curve

Message Bus

- Relatively simple

Web Services

- Requires many technologies
- Skills are widely available

Corba

- No way to start small
- Skills availability may have peaked

ade Spaces: Binding

Message Bus

- Runtime
- Infrastructure doesn’t enforce

Web Services

- Runtime
- WSDL allows run-time check of data structures

Corba

- Build time
- Early detection of type errors
- Often circumvented with ‘any’ type

ade Spaces: Scalability

Corba

- RPC based point to point

Message Bus

- Scales well within the LAN

Web Services

- Scales to the world
- Requires attention to caching and load balancing
- REST: ‘get’ requests cacheable

ade Spaces: Tool Maturity

Web Services

- Changing rapidly
- Growing provider base

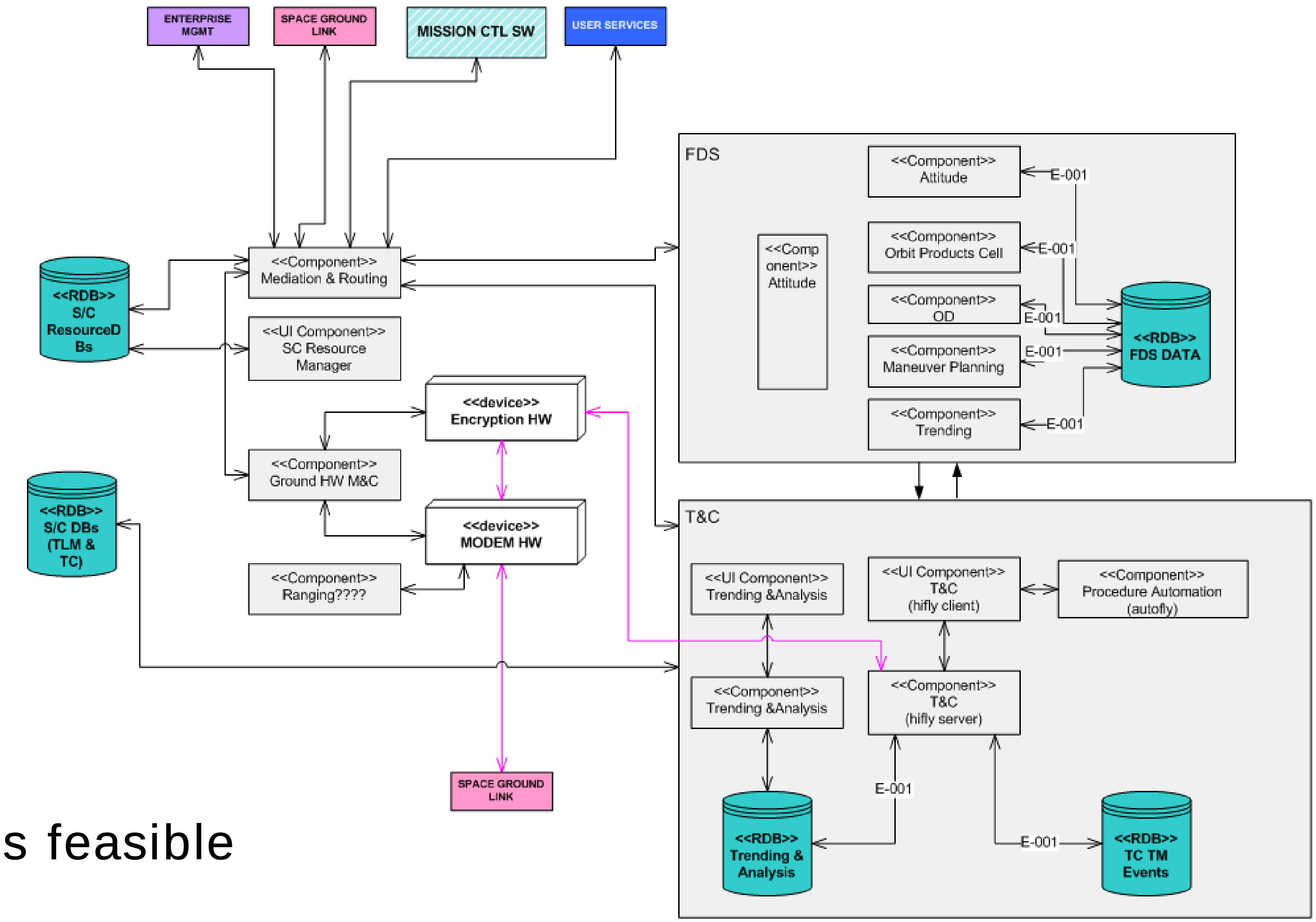
Corba & Message Bus

- Flight proven
- Provider base is shaken out and stable

chnical Enablers

e the legacy systems built from distributed components?

e the interfaces fixed and known?



-plumbing is feasible

chnical Disablers

me algorithms are difficult to replicate in new hnologies

ming sensitive feedback loops

arefully tuned rule bases

Black Box' components with lost source code

e end of the interface is immutable

he ground system and flight software were eveloped together

ow the flight side is out of reach (literally!)

We're no smarter than "Those Who Have Gone Before"

tegration Obstacles

ny **barriers** prevent quick deployment of
w technologies into existing architectures

- **Long missions** (e.g. typical GEO is 15 years). Difficult cost/benefit ratio for technology upgrade

- Operators are **reluctant to lose features** in transition to a new system. *I want everything I have plus a lot more…*

- Large **variability** of requirements across missions.
  - What works well for one may fail for the next
  - Scalability issues (e.g. single satellite vs constellations)
  - Difficult to create a 'generic' technology that will suit all
- Difficult **deployment** of systems and quickly evolving OS

dging

“green fields”

Existing operations centers have frameworks in place

Every component has a legacy ail – otherwise it wouldn’t be elected

Team skills are long-lead items

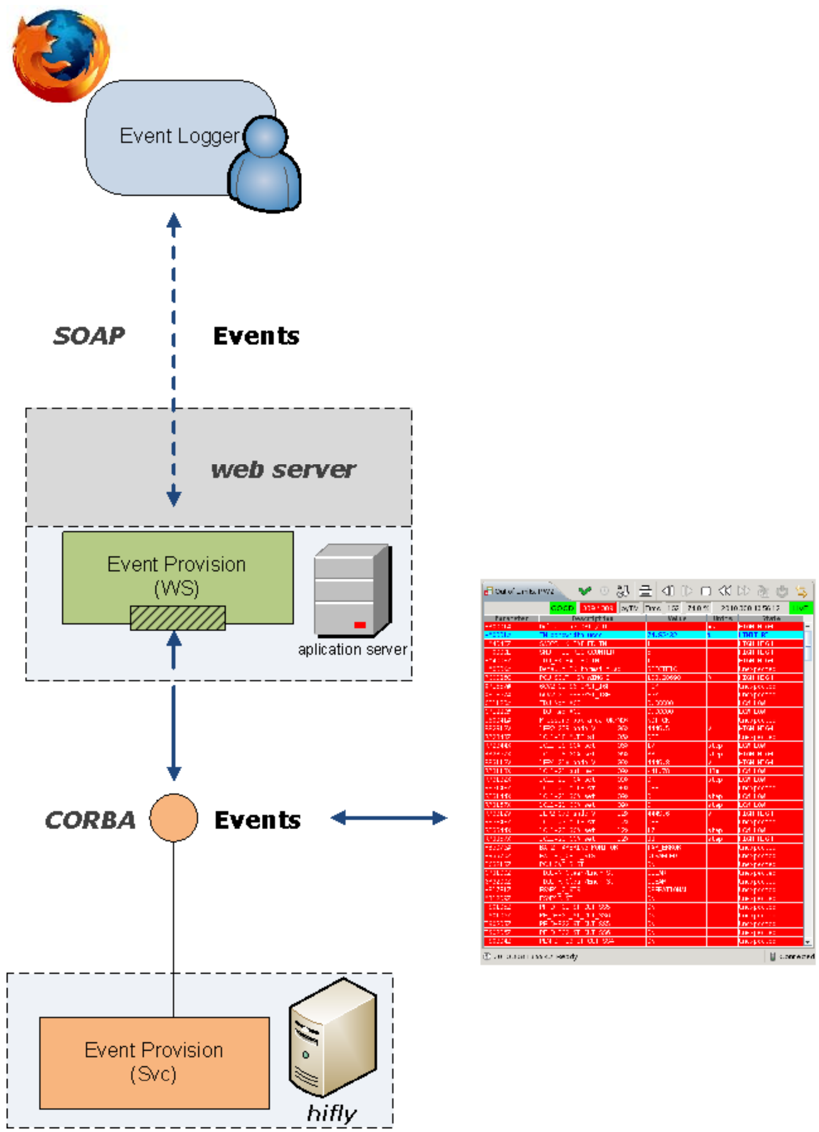
oose bridge points

Prefer

- Minimize # bridges
- Stable component boundaries

Avoid

- Latency-sensitive interfaces
- Introducing critical failures



nclusions

- “one right answer”
  - Message Bus for steady-state flows (e.g. telemetry frames)
  - Veb Services for highly variable and scalable client loads
  - Corba for tightly bound internal transactions
- gacy is important
  - Existing equipment and systems may have infrastructure in place
  - Baseline COTS may have a preferred infrastructure
    - Smart vendors are ready to support others as well
  - Maintenance staff may be highly skilled with an infrastructure
- dge as required
  - Systems of systems may require combinations of architectures

Thank you

gmv

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