



The use of SEDRIS concepts in a net-centric warfighter environment - TEDServices

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Presentation Outline

- What is TEDServices?
 - Net-centric warfighter issues
 - TEDServices Tenets/Architecture
 - SEDRIS concepts employed
 - Performance metrics
 - Summary
- * Meteorological and Oceanographic (**MetOc**)

What is TEDServices?

- TEDServices
 - Tactical Environmental Data Services
 - Component to the Naval Integrated Tactical Environmental System (NITES)
 - Legacy system: Tactical Environmental Data Server
 - Focus: Web centric services
 - Uses SEDRIS concepts as foundation components
 - DRM
 - SRM
 - EDCS

What is TEDServices?

- TEDServices
 - Provides data methods to:
 - Post
 - Subscribe
 - Transport
 - Cache (local)
 - Translate
 - Serves as a “data broker” between data producers, and consumers in a web centric (run-time) environment
 - Supporting a “many-to-many” topology

What are Warfighter Issues?

- Shifting paradigms
 - The adoption of a Net-Centric Data Enterprise
 - It's not just a Client/Server world anymore...
 - Consumers want access to data/information/knowledge immediately
 - Moving from a ...Collector / Product focus
 - Task, Process, Exploit and Disseminate
 - To a ... Analyst / Data focus
 - Task, Post, Process and Use (share)

What are Warfighter Issues?

- Shifting paradigms
 - Reliance on “reach-back”
 - Download data... resource intensive
 - One (producer) to many (consumers)
 - Bandwidth utilization/availability was not a consideration
 - Moving to a “many-to-many” topology
 - Smart “data ordering” agents
 - Sharing of information (at the pointy end)
 - Immediate access to Through-the-Sensor (TTS) data
 - Today, bandwidth is a critical warfighter component

What are Warfighter Issues?

- Highly mobile network topology
 - Mobile forces – all have emerging sensors, that generate data
 - Afloat (surface / subsurface) combatants
 - Manned/unmanned vehicles (sea and air)
 - Smart weapon systems
 - Human assets / ground forces
- Fixed support
 - Naval MetOc Regional Centers, Detachments
 - Production Centers
 - Navy, AFWA, NWS, other foreign allies

What are Warfighter Issues?

- Concepts of net-centric warfare are changing
 - Emerging initiatives
 - Identifying the “next” consumer?
- Just wants the answer
 - Requires a single representation of the “user defined” battle-space environment
 - Example: What’s the “MetOc Answer” for air temperature
 - Not the COAMPS, NOGAPS, MM5, ETA, NCEP, ECMWF, JMA, etc..... answer

TEDServices Tenets/Architecture

- TEDServices is.... An end-to-end, data centric process that facilitates:
 - Simplified **data management**
 - Bi-directional **data transport**
 - Consistent **data representation**
- Designed to provide data availability, and usability, when needed and where needed, to accelerate the decisions process.

TEDServices Tenets/Architecture

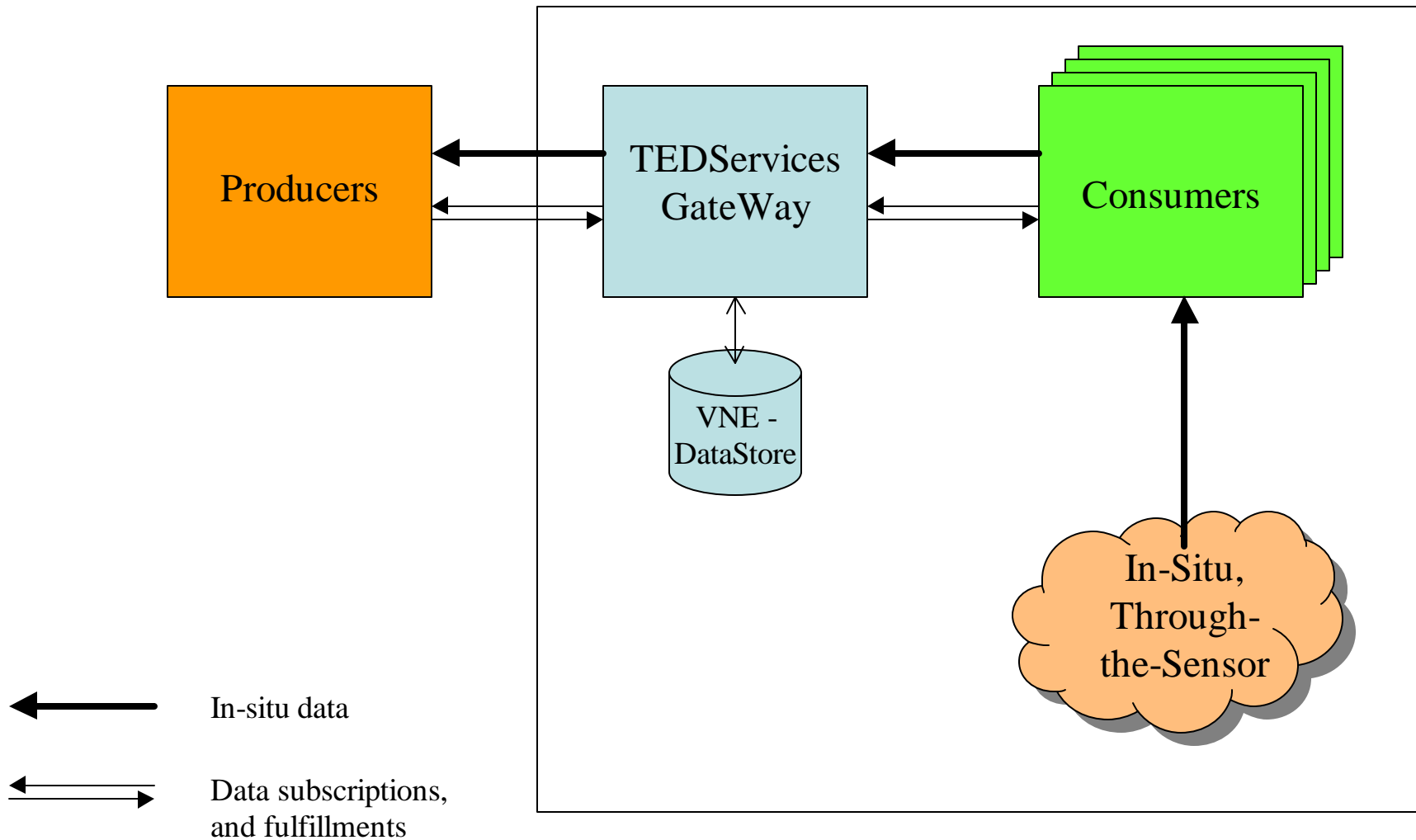
- Consists of nodes – TEDServices GateWays
 - Web Server (Apache/Tomcat)
 - Java based (TEDServices core)
 - Win2K, Linux
 - TCP/IP
 - One GateWay supports an entire platform
 - Ship
 - Plane
 - Command Center
 - ...

TEDServices Tenets/Architecture

- Local data cache / data store
 - Virtual Natural Environment (VNE)
 - Single representation of a parameter
 - Does not derive the “answer”, only represents the “answer”
 - Defines seven (7) domains
 - Space, Atmosphere, Ocean Surface, Ocean Volume, Ocean Bottom, Littoral, and Land
 - Local DataStore
 - Representing individual numerical weather prediction models, derived products, imagery, etc

TEDServices Tenets/Architecture

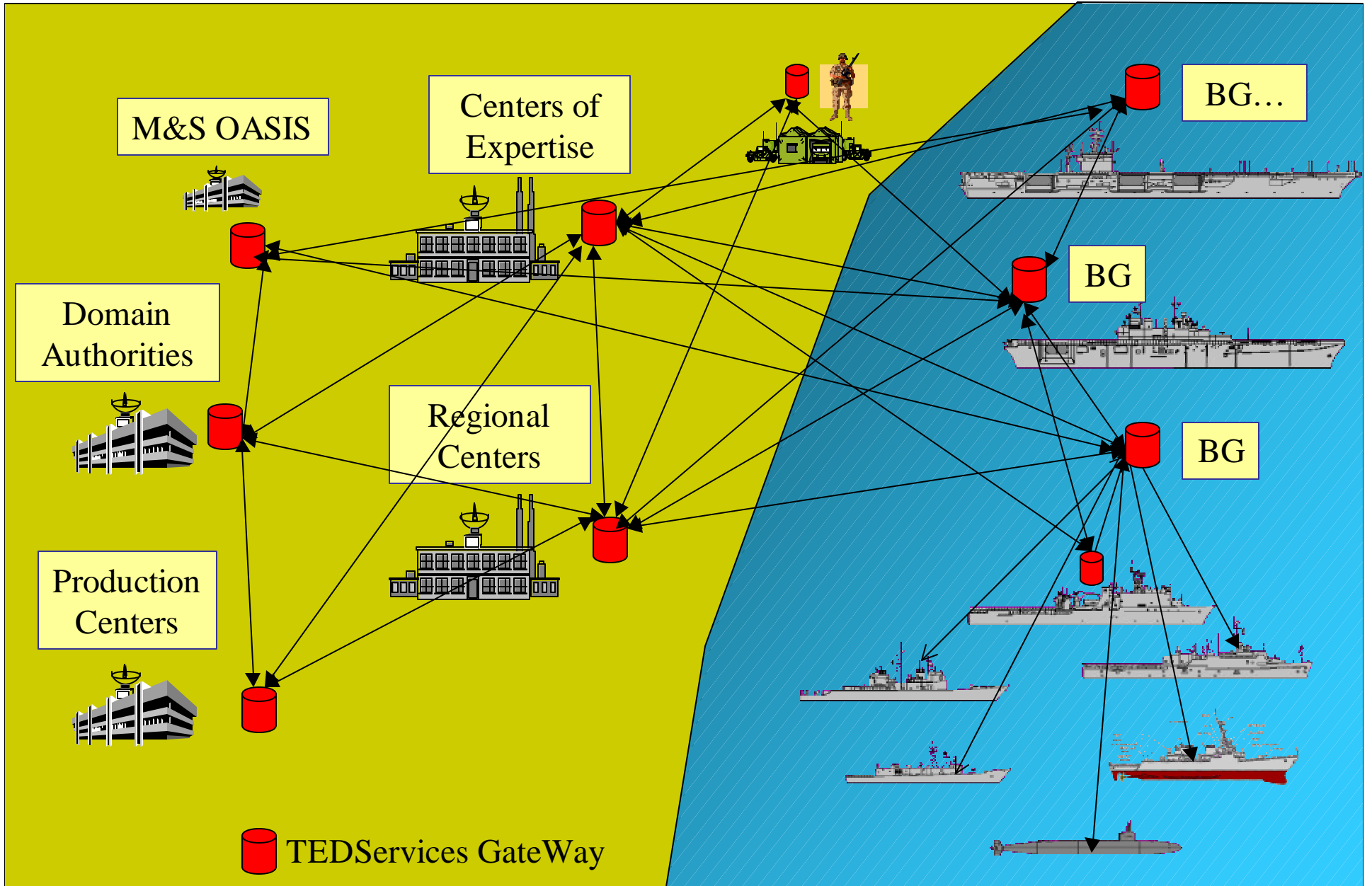
Single “Platform”



TEDServices Tenets/Architecture

- Local DataStores & VNE – forward deployed data cache
 - Use an Object Oriented Database
 - Ozone, Open Source, GOTS performance extensions added
 - Java DataBlade
 - VNE provides a consumer defined 4D representation of the Battle Space
 - Represents all data under one single coordinate reference model (WGS-84 and UTC)

TEDServices Tenets/Architecture



TEDServices Tenets/Architecture

- Local Data Broker
 - Multiple Consumers per platform – Mitigates data orders for same parameters/products (reach back request)
 - Manages all local data I/O
 - DataBlade (Java)
 - Supports spatial and temporal interpolation
 - Supports User defined extensions (special interpolation, derived, etc)
 - Reconstitutes consumer requested physical formats
 - SHAPE, DrawFile, Geo-TIFF, etc

TEDServices Tenets/Architecture

- MetOc/Mission Rules Base Data Ordering systems
 - Rules based data subscription
 - Rules are analogous to a recipe
 - Templates (Strike, ASW)
 - Consumer defined “recipe”
 - Focus is ordering data/products by Mission
 - Implemented as an API (method) or Data Ordering Client (standalone)

TEDServices Tenets/Architecture

- Normalize Data to be Transported
 - Rather than transport dissimilar data formats, implemented a Common Transport Format (CTF) between Nodes
 - CTF is a representation of the TEDServices DRM
 - Upon receipt at a GateWay from a Data Producer, the data is immediately converted to CTF
 - Data is stored as CTF
 - Exception is Imagery; stores in native format

TEDServices Tenets/Architecture

- Implemented seamless lossless compression process
 - LPAC[®]
 - Leverage an SBIR (now in Phase-II)
 - CTF data is held in a compressed state

TEDServices Tenets/Architecture

- Devise and implement the ability to resume a broken HTTP/HTTPS communication session (not ftp) at the byte level – Resumable Object Stream (ROS)
 - Issue remains with HTTPS/SSL due to a Java bug

TEDServices Tenets/Architecture

- Support DoD Joint interoperability
 - Joint MetOc Broker Language (JMBL)
 - XML schema using Joint MetOc Conceptual Data Model (JMCDM) / Joint MetOc Interoperability Board (JMIB) Data Standards Working Group name space
 - In the future, other “dictionaries”
 - Perform dialect translations
 - Adhere to:
 - Navy’s FORCEnet
 - DoD Global Information Grid – Enterprise Services (GIG-ES)

TEDServices Tenets/Architecture

- Consumer Side, TEDServices offers:
 - Data Ordering Client (DOC)
 - Facilitates all data ordering (subscription)
 - Incorporates MetOc/Mission Rules Base Data Ordering
 - Receives data into a local directory
 - Performs local physical transforms (SHAPE, DrawFile, netCDF, Geo-Tiff, etc)
 - Data Ordering Object – STK
 - Interfaces an Application to a GateWay
 - Java Serialized Object (transfer)
 - Incorporates all Data Ordering Client (DOC) features

SEDRIS Concepts Employed

- SEDRIS Data Representation Model (DRM)
 - Used Louis Hembree's (NRL-MRY) template for Gridded data
 - Largest data source
 - Numerical Weather Prediction data
 - SEDRIS DRM is our DR reference guide
 - Implemented TEDServices DRM in Java

SEDRIS Concepts Employed

- SEDRIS Data Representation Model (DRM)
 - Validated TEDServices notion for normalizing all data to a common format for transport and storage (CTF).
 - Early tenet – normalize all data at the source
 - Upon receipt from a producer, data is immediately converted into CTF

SEDRIS Concepts Employed

- SEDRIS Environmental Data Coding Standard (EDCS)
 - JMIB/JMCDM definitions/name space used for atmospheric and ocean (surface, volume & bottom) domains
 - EDCS will be used to define Space and is used to define Space & Terrain domains
 - In the future JMIB/JMCDM should be aligned with EDCS

SEDRIS Concepts Employed

- SEDRIS Spatial Reference Model (SRM)
 - Implemented SRI's Java release for coordinate conversions
 - Implement our own Java datum shifts (3 parameter, 7 parameter and regression) using NGA and USGS specs
 - Plans are to review new SRM Java API

SEDRIS Concepts Employed

- Summary
 - Staunch supporter of SEDRIS
 - ISO standard a huge plus
 - M&S world very important post 9/11
 - SEDRIS saved the TEDServices project \$\$\$ in development costs

Representation & Transport Metric

- Object-Oriented Representation
 - Digital Bathymetric Data Base - Variable Resolution (DBDB-V), ver 4.0 (unclass)
 - Original Format: HDF-5
 - Original size: 74MB
 - OODB representation: 7.75MB
 - Surface Marine Gridded Climatology (SMGC)
 - Original Format: ASCII flat file
 - Original size: 108MB
 - OODB representation: 7.5MB

Representation & Transport Metric

- Object-Oriented Representation
 - Coupled Ocean Atmosphere Prediction System (COAMPS)
 - Original Format: GRID
 - Original size: 95.5MB
 - GRIB: 34.6MB
 - OODB representation: 13.5MB

Representation & Transport Metric

IEEE COAMPS (95.5 MB) GRID

Compression Technique	Comp. Size	Comp. %	Comp Ratio	Time
LPAC-2D	13.6 MB	85.8 %	7:1	193 Sec
LPAC-1D	19.2 MB	79.9 %	5:1	75 Sec
WBDC Wavelet	29.9 MB	68.7 %	3.2:1	N/A
GRIB	34.5 MB	63.7 %	2.8:1	N/A
GZIP	34.5 MB	63.7 %	2.8:1	85 Sec
SEDRIS	34.5 MB	63.7 %	2.8:1	N/A



(*) 75% was an objective

Representation & Transport Metric

During Fleet Battle Experiment – Kilo (FBE)

Model Data Ingested	MODAS & NCOM Data Delivered to NAVO TEDServices GateWay - netCDF (Per 24-hours)	Cumulative Data Delivered to NAVO TEDServices GateWay - netCDF	Cumulative Data Represented in NAVO TEDServices GateWay VNE	Cumulative Data “pushed” to Pearl Harbor TEDServices GateWay VNE
MODAS	31.91 MB	255.26 MB	91.20 MB	
NCOM	369.91 MB	2,959.25 MB	1,160.00 MB	
Totals	401.82 MB	3,214.51 MB	1,251.20 MB	554.69 MB

100%

38.9%

17.3%

* FBE-K duration = 8 days

Representation & Transport Metric

- Data Extraction – VNE Atmosphere (class)
 - Type: GRID
 - Size: 31 x 31 (27km and 9km nest), 30 levels, 25 TAUS
 - Volume: 34.6MB
 - Legacy TEDS (Informix), using reach back (SIPRNET): 18:06 (mm:ss)
 - TEDServices, local access: 1:22 (mm:ss)

(*) Performed on Dell PowerEdge 6600 Server w/ four 1.9GHz processors, four 1GB RAM modules, OS: Red Hat

Summary

- TEDServices has demonstrated a 70%+ reduction in bandwidth utilization
 - Combination of OO representation, smart ordering agents and transport efficiencies
- TEDServices utilizes COTS web service software to facilitate HTTP/HTTPS data transfer
- TEDServices offers a new paradigm in Internet-based deliver of MetOc data to warfighters, thanks in part to SEDRIS

Summary

- Lead developer:
 - Naval Research Laboratory – Stennis Space Center, Mapping, Charting and Geodesy Branch, Code 7440
 - POC: Dr. Roy Ladner

Thank you for your time and attention.

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