FX-Net
Product Distribution System

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What is FX-Net?

- Internet access to NOAAPort products
- Access to specialized and local data
- User interface emulates AWIPS GUI
- Client runs on modest PC hardware
- Works with low or high-speed connection
FX-Net Overview
FX-Net User Interface

Imitates the AWIPS User Interface

Functionality:
- Load
- Animation
- Overlay/Toggle
- Zoom
- Swap
- Data Time Matched
FX-Net and the WWW

• Web-based “Pull” Product Retrieval
  - Information in ONE Java application window instead of multiple windows and no data or time matching capability.

• FX-Net Strengths
  – Product Representation (Graphics, Raster Images)
  – Precision Controlled Compression (Wavelet)
  – User Interface
  – Client Cache
  – Flexible, Time-Matched Combinations of Products
  – User Defined Products (e.g., Vertical Cross Sections)
Product Representation

- Product vs Data
- Compressed Satellite Data – Visible 20:1, WV 100:, IR 50:1
- Compressed Model Grids – 20:1
- Model Graphics and Observations
- Compressed Radar – Lossless (GIF)
- Model Imagery - (Wavelet Transform)
FX-Net Client Requirements

- Windows 2000 / XP Pro
- >=1024 x 768 display resolution
- 500 MHz PC with min 256 MB RAM
- Three button or “wheel” mouse
- Bandwidth >= 56 Kbps
Satellite Direct Readout Conference 12/04

Forecast Systems Laboratory

Wavelet-based Data Compression Technique with Precision Control

- lossless and lossy data compression
- compression for imagery data and scientific data
- lossy data compression with precision control

Original, file size 250 KB

20:1 Compression, file size 12.5 KB
Procedure for wavelet-based data compression

Wavelet Transform → Quantization → Entropy Encoding
Wavelet Transform Compression Ratios - $W^4$

• For Satellite Images:
  Water Vapor Image ------ 80:1
  Infrared Image ------------ 50:1
  Visible Image -------------- 25:1

• For Weather Forecast Models:
  Smooth Field (e.g., Temp) ------- 300:1
  Non-smooth Field (e.g., RH) ------ 40:1
Example: Satellite Visible Image

• Data : Hurricane Floyd, September 13, 1999

• File size: 500 x 500, 8bits/pixel, 250 kb

• Compression ratios tested: 10:1, 20:1, 30:1, 50:1, and 100:1
Compression:
Original 1:1
Compression:

10:1
Compression:

30:1
Compression:

100:1
Our compression v.s. JPEG (I)

Original                  30:1 compression
Our compression v.s. JPEG (II)

Original

JPEG compressed
FX-Net Applications

- University Teaching and Research (Plymouth State University, University of New Hampshire, U. of N. Iowa)
- Salt Lake City Olympic Games 2002
- Support of Field Experiments (NEAQS, IHOP, BAMEX, NOAA/NCAR/NCEP WRF Winter Forecast Experiment)
- Experimental Data Sets (GPS-IPW, Air Quality forecast models, AQ observing systems)
- Real-time Air Quality Forecasting
- Operational NWS and BLM Fire Weather Field Forecasting
Forecast model graphics and images
RUC 10km: 3hr Forecast: 850mb Wind & Temp &RH
Local Radar display and Radar Chooser Window
GOES Water Vapor/IR satellite image overlaid with the NWS Convective outlook product.
FX-Net Cross Section Display of the WRF/CHEM Ozone Forecast with Geostrophic Winds

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FX-Net Display of WRF/CHEM Ozone Forecast and Air Quality Surface Observations

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FX-Net Display of WRF/CHEM Ozone forecast, ETA Temp Forecast and EPA Obs
World Wide Weather
Workstation
WorldWide Weather Workstation

Headquarters/Central Site

Satellite

Offsite

Satellite Dish

PC

Satellite Dish

PC

Satellite Dish

PC

Raw Data

Server
Data Distribution

• “Push technology” to Central Site
• “Pull technology” Offsite (Internet, low bandwidth)
• Forecast procedures (i.e. product sets) tailored to local forecast needs
• Local observations ingested at Central Site
• FX-Net clients at Central Site and Offsite
WorldWide Weather Workstation

Data Currently Included

- Satellite Data - all NESDIS products provided to AWIPS (GOES, Meteosat, INSAT, GMS)
- Numerical Weather Forecast Data – all NOAAPort data sets (GFSLR, NOGAPS, ECMWF, GFS, Eta, etc.)
- Global Telecommunication System (GTS) Observation Data Set
- Local observations, experimental and specialized models and products.
Central American, Caribbean and Upper South American Localization
Value of $W^4$

- Transmit large amounts of data and images to regional offices or remote sites
- Minimal loss of resolution with transmitted data or images
- Improved forecasts/warnings can:
  - save lives and property
  - aid agriculture
  - contribute to economic development
W⁴ Objective

To allow forecasters anywhere in the world to prepare:
  – Synoptic scale weather forecasts
  – Meso-alpha scale weather forecasts

That are:
  – Accurate
  – Timely

With a phase 2 objective:
  – To provide local dissemination capabilities
What are the Ideas that make $W^4$ a Valuable Concept?

- **$W^4$:**
  - Uses sophisticated data compression techniques
    (Patent protection is being sought)
  - Provides most AWIPS forecast capabilities

- **FSL has:**
  - Expertise in tailoring forecast products & procedures to local forecast needs
  - Understanding of forecaster needs & the forecaster thought process
Where Does $W^4$ Fit in the Forecast Community?

• $W^4$ forecast capabilities equal all but the best weather services

• Requires:
  – Little national infrastructure
  – Low capital costs
  – Low staffing requirements
  – Few local observations to support forecasting

• 100+ countries can benefit from $W^4$
Expandable $W^4$

• **Add:**
  - GMS & METEOSAT data
  - Local data input
  - Addition of dissemination capabilities

• **Incorporate:**
  - Local forecast modeling capability
  - Unique forecast tools for new users
Summary

- Image compression 20:1 to 50:1
- Grid data compression with precision control 20:1 to 100:1
- Average storage and transmission time reduction 95% to 98%
  Example: Eta 12 transmission at T1 bandwidth (1.4 Megabit/sec)
  Orig. file size: ~12 GB vs Compressed (50:1): 240 MB
  Transmission time: 25 hours vs 30 min
- Concept to transmit gridded data to a W4 workstation
What Forecast Data will W4 use?

- Full resolution satellite imagery
- NWP forecasts tailored to appropriate region (MRF & AVN models initially)
- Observation data available internationally (Surface, upper air, ship, buoy & ACARS)
- Observations entered locally (radar & rain gauge)