Enabling the Development and Implementation of Science through Open Systems and Development Tools

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Weather Radar Research

Outline

What are Open Systems?

Open Systems and the NEXRAD Program

Establishing the NEXRAD Operational Platforms

Establishing the NSSL Research Platforms

Research & Development Tools

What are Open Systems?

A computer and software system that exhibits the following characteristics …

- **Portability**
  - Able to move to new computing platforms

- **Expandability (Scalability)**
  - Able to add additional computing resources

- **Interoperability**
  - Able to communicate & function with other systems

- **Source code is visible and assessable**
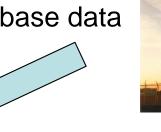 - Able to modify and improve

The Three Components of NEXRAD
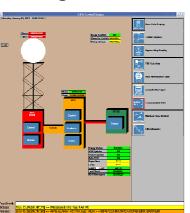
Radar Data Acquisition (RDA)

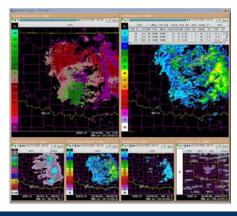- Signal processing generating the base data

Radar Product Generator (RPG)

- Processes the basedata through meteorological algorithms producing products

Principle User Position (PUP)

- The display system to view RPG products

The Need for Open Systems in NEXRAD

**National Weather Service
Office of Science & Technology
NEXRAD Product Improvement (NPI)**

Recognized the NEXRAD system was becoming obsolete

New science & techniques were being readied for operations. However …

- Inadequate computing resources (processing power, memory, storage)

- Software was implemented in a proprietary environment

- Hardware was proprietary and upgrades were expensive

NPI engaged NSSL in the role of developing open systems software for the NEXRAD System

Open Systems Radar Product Generator (ORPG)

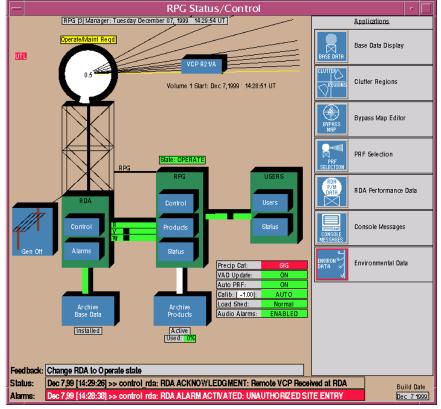## NEXRAD is a Tri-Agency Program

NSSL funding provided through NPI

NWS   FAA   USAF

ORPG Project

Government Lead Design, Development and Testing

- **NWS OS&T NPI**
  - Program Management

- **NWS Radar Operations Center (ROC)**
  - Hardware Engineering, Integration & Testing

- **NSSL**
  - **Software Engineering**

- **Contractor (RSIS)**
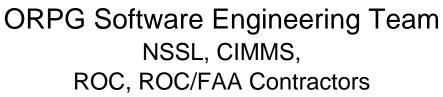 - Deployment

Open Systems Radar Product Generator (ORPG)
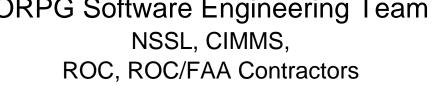
Technology Transfer Success Story

- Deployed to all 158 NEXRAD sites

- Over 25 new meteorological algorithms, products or enhancements since 2002

- Contributed to decreasing ROC software build release from 12-18 months to 6-12 months

- ORPG hardware: Inexpensive, high-performance commercial-off-the-shelf components

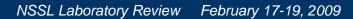- Continues to evolve and meet the operational requirements of its users

ORPG Software Engineering Team
NSSL, CIMMS,
ROC, ROC/FAA Contractors

DOC Bronze Medal

ROC Commendation

Open Systems Radar Data Acquisition (ORDA)

ORDA took a different development path …

NSSL developed a fully functional prototype

- Resolved many difficult engineering issues
- Demonstrated an Open Systems solution was viable for the Radar Data Acquisition component

Operational implementation awarded to a contractor

- OS&T NPI Program Manager
- ROC Technical Oversight
- **NSSL provided the prototype and consultation expertise**
  - **Concepts learned from the NSSL prototype as well as some software components were incorporated into the Operational ORDA by the contractor**

ROC Commendation

The Open Systems Projects: Extending the Operational Lifetime of NEXRAD

Open Systems **Research** Radar Data Acquisition

The ORDA Prototype was retained to support NSSL research

- Provides greater flexibility and capacity to perform specialized data collection and scientific research
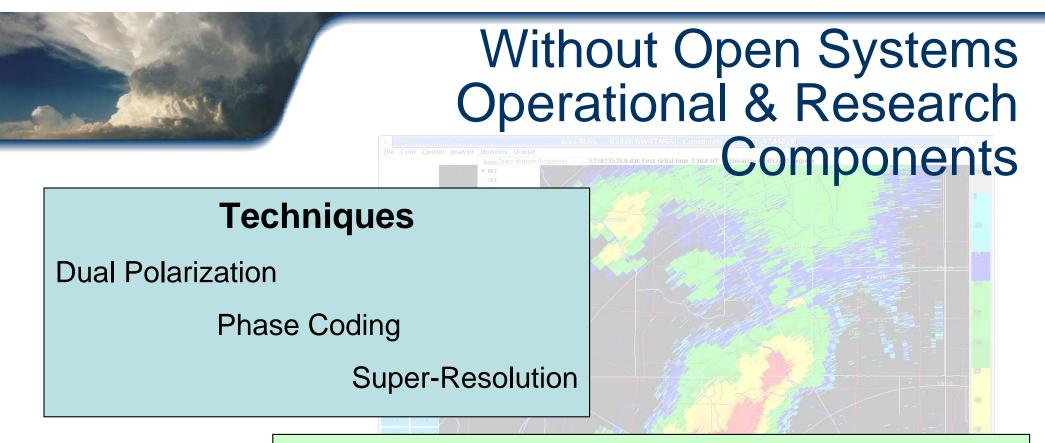

Used for research and proof-of-concept evaluations of …

- Phase Coding (tech transfer complete)
- Dual Polarization (tech transfer underway)
- Staggered PRT (final stages of development)
- Range Oversampling (under development)

Without Open Systems Operational & Research Components

Techniques

Dual Polarization

Phase Coding

Super-Resolution

Benefits

Improved Precipitation Estimation

Improved Data Quality

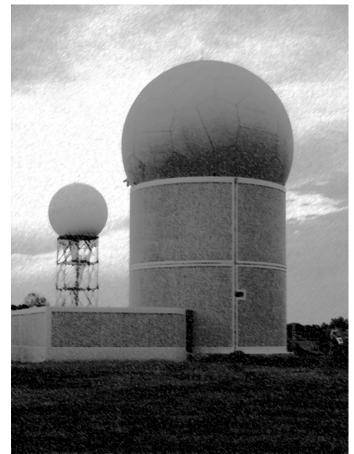Improved Severe Storm Detection

Would not be possible!

Open Systems and the Phased Array Radar (PAR)

PAR encountered similar situation as NEXRAD system

- Insufficient processing power
- Expensive hardware components
- Increasing maintenance costs
- Was not easily or affordably scalable

Leveraged successful ORPG software architecture & infrastructure

Replaced Digital Signal Processing component of the PAR by extending the distributed processing technology of the ORPG software infrastructure

Open Systems and the Phased Array Radar (PAR)

Provides us with a highly scalable platform

- Computing resources are added as required (inexpensive PC technology)
- Reduced hardware costs by order of magnitude (~$200k to ~$20k)
- Increased computing capacity by >150x
  - Easily & economically scalable.
    - For ~$6k can double the current signal processing capacity to >300x

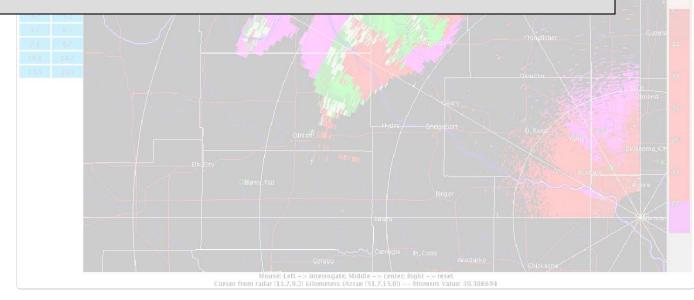"Opens" the door for new resource demanding digital signal processing techniques

- Ground clutter detection and suppression (Clean AP)"
- Range Oversampling

Warning Decision Support System – Integrated Information
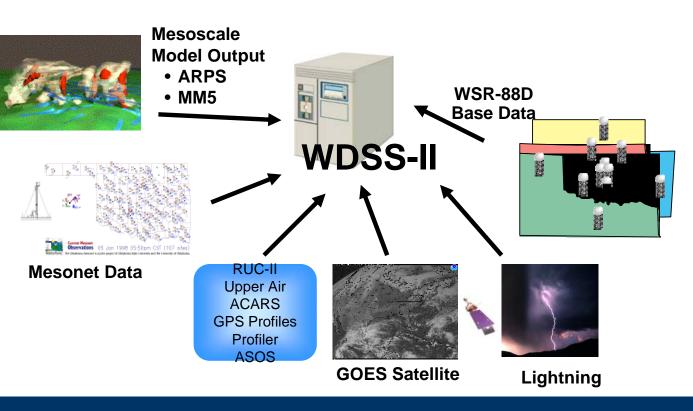## (WDSS-II)

Warning Decision Support System – Integrated Information (WDSS-II)

Multi-Radar Multi-Sensor Research and Development Environment

- Powerful application development tool
- Developed, managed and maintained by NSSL
- Used by NSSL, SPC, universities, research institutions, private sector

Mesoscale Model Output
- ARPS
- MM5

WDSS-II

WSR-88D Base Data

Mesonet Data

RUC-II
Upper Air
ACARS
GPS Profiles
Profiler
ASOS

GOES Satellite

Lightning

NOAA Technology Transfer Award

Summary

The Open Systems effort has produced operational and research platforms that facilitate the effective development and transfer of new science and technologies to operations

Regarding research to operations …

… the combination of Open Systems

& Development Tools gets you …

… more science … in less time

"Develop and infuse research results and new technologies more efficiently to improve products and services, streamline dissemination, and communicate vital information more effectively."

NOAA 2006-2011 Strategic Plan

Weather and Water Strategies

Questions?