The Common Operations and Development Environment (CODE) for the WSR-88D Open RPG

CODE B23.0r1.9 November 2024

Includes ORPG Build 23.0r1.9

CODE Introduction

CODE is produced in two versions:

1. The **U.S. Government Edition** of CODE is the complete version. Distribution is limited to within the United States Government.
2. The **Public Edition** of CODE is intended for public release. Certain Copyrighted material has been removed to permit release outside the U.S. Government.

CODE provides:

- Instructions for setting up the development environment (includes ORPG source code)
- Guidance for compiling software and configuring new ORPG tasks & products
- Instructions for definition and use of algorithm adaptation data and algorithm dependent parameters
- API Programming Guide and the structure of WSR-88D algorithms (with sample algorithms)
- WSR-88D specific analysis tools
- A set of WSR-88D Archive II Data files and other special test case data.

CODE User provides:

- An Intel PC with Red Hat Enterprise Workstation Linux.

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Overview of CODE

> The objectives of the Common Operations and Development Environment (CODE) are to greatly enhance the process of meteorological application development, testing, technology transfer, and maintenance for the NEXRAD program.

Introduction

The WSR-88D radar consisted of three subsystems. The RDA includes the radar antenna, transmitter/receiver, and the signal processing computer. The RPG is the radar product generating / distribution computer. The PUP was the integrated product display computer and has been replaced by separate user agency systems.
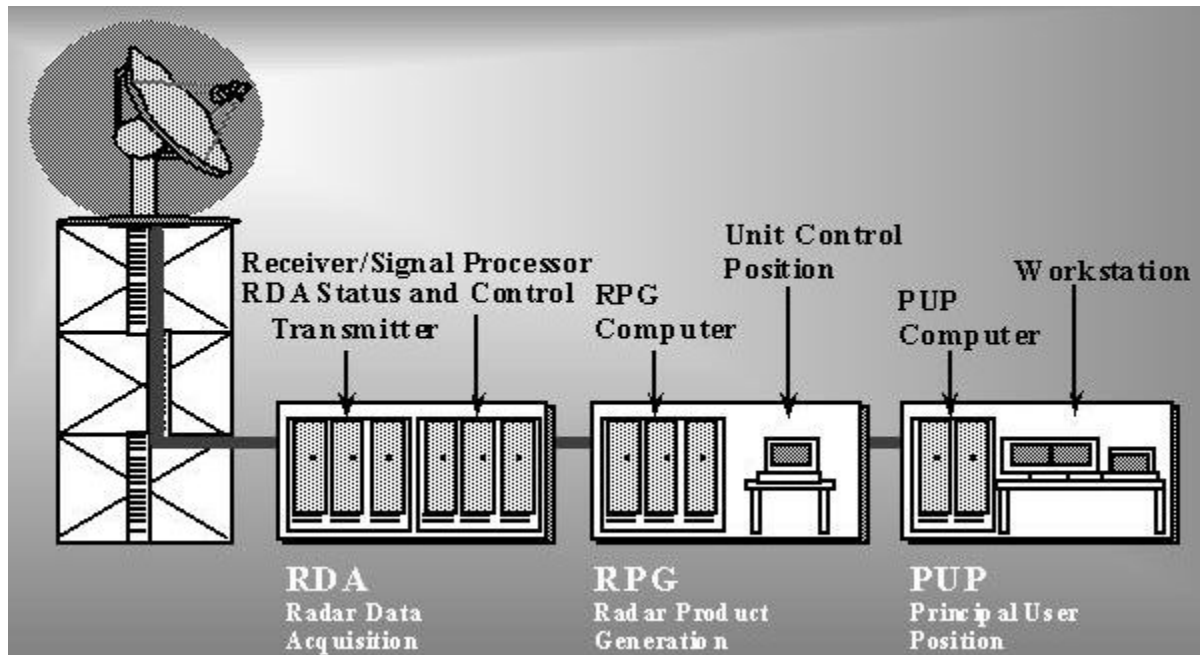
The RPG, the radar product generation subsystem of the WSR-88D radar, was the first portion of the radar to be redesigned into an open systems architecture and is called the Open RPG (or ORPG).

CODE for the WSR-88D is based upon the capabilities provided by the Open Systems Radar Product Generator (ORPG). ORPG software can be installed and run on a single desktop Intel PC running Red Hat Enterprise Workstation Linux. This "clone" of an operational ORPG does not distribute products to operational users nor control a radar. However, using one of several methods of radar data input, the

Overview of CODE

algorithms running on the ORPG clone utilize services identical to the operational ORPG and can produce products identical to those distributed by an operational system.

New algorithms developed on the clone ORPG (assuming these services are used correctly) are much easier to integrate onto the operational system. With the appropriate guidance, new techniques can be more thoroughly tested prior to submission to the NWS Radar Operations Center (ROC). In addition, if the clone is based upon a workstation configured similarly to the operational ORPG hardware, run time performance of new algorithms can be evaluated by the developer.

> **WSR-88D CODE is targeted for programmers with software development experience in a Unix environment and an appropriate background in Radar Meteorology.**

What is CODE?

The Common Operations and Development Environment (CODE) is the primary algorithm development and implementation environment for new science intended for integration into the WSR-88D radar. CODE supports the development and maintenance of WSR-88D algorithms; NOT the ORPG as a whole.

The ORPG design:

- supports ease of expansion and modification,
- includes a layered service architecture that provides a robust but narrow interface between the product algorithms and the rest of the system services, and
- can be run on a single POSIX compliant UNIX workstation.

These design characteristics facilitate an algorithm development environment based on the ORPG itself. CODE is a collection of generic and NEXRAD specific development tools, detailed guidance and documentation that can be used to support both early stages of the algorithm development life cycle (analysis, experimentation, & prototyping) and the later stages of the life cycle (production development, testing, & integration). This development environment is depicted visually below.

Production Development & Integration Environment

Basic Development Tools
- Compilers, linkers, etc.
- Debugging Tools
- Documentation tools

NEXRAD Specific Tools
- WSR-88D Data & Product Display
- Test Tools
- Radar Data Ingest (including test cases)
- Other

ORPG Clone on Desktop Workstation

- WSR-88D ANSI-C API Services:
- The Algorithm API
- The Common Calculations Library

Documentation & Guidance
- Vol 1 Installation & Configuration Guide
- Vol 2 Algorithm Development Guide
   Compiling Software
   Configuring ORPG for new
Algorithms
- Vol 3 Algorithm Programming Guide
   Algorithm API Reference
   Structure of Algorithms
- Vol 4 CODE Utility Guide

Guidance for Formal Integration
(under development)
- ANSI-C Coding Standards
- Documentation & Test Requirements

Some of the listed components of CODE are the responsibility of the individual user to obtain (e.g., the workstation and basic development tools beyond generic compilers). The most important components of CODE are

- The capabilities provided by the ORPG algorithm programming interface. Algorithms & products produced with CODE are identical to operational system.

- The extensive documentation and guidance tailored to support algorithm developers rather than ORPG SW maintenance staff or ORPG operators.

- Product display and data analysis tools specifically for NEXRAD products. These utilities provide a convenient means for decoding specified portions of a product as well as providing a graphical display of geographic products.

- Archived Level 2 radar data is available for use. This consists of standard data streams used in formal tests, special artificial test cases, and collections of data containing various meteorological conditions (storms, tornadoes, snow, etc.).

The WSR-88D Algorithm API is complete in that all services are provided for a fully functional operational algorithm. This API is being improved with each build. Documentation for the API is provided with the CODE Guide Volume 3, *WSR-88D Algorithm Programming Guide*.

How do I get CODE?

CODE is available on CD-ROM from the NPI Development manager. The development environment consists of the *ORPG Software Distribution*, a four volume *WSR-88D CODE Guide*, and the *CODE Software Distribution*. The *ORPG Software Distribution* is a recent release obtained from ROC configuration management.

CODE is produced in two versions:

1. **National Weather Service Edition** - This is the complete version of CODE. Distribution is limited to within the National Weather Service and other U.S. Government Agencies.

2. **Public Edition** - This version of CODE is intended for public release. Certain proprietary software components have been removed to permit release outside the U.S. Government.

The Public Edition of CODE using the latest operational ORPG release is also posted on the following web site:

http://www.weather.gov/code88d/

If you have visited this site in the past and you do not see the current distribution, you may need to hit the Refresh/Reload button on your web browser.

CODE System Requirements

Build 22 - What's New?

Requires Red Hat Enterprise 8 or equivalent operating system.
Improved velocity dealiasing.
Super-resolution velocity product (154) is now generated at all elevation angles but only contains super-res data at the lower elevation angles as in previous releases.
RPG's estimate of Initial System Differential Phase is applied to the data stream by default.
Long-term average reflectivity data retention and efficiency improvements.
Numerous bug fixes.

Only a Linux PC platform running Red Hat 8 or CentOS Stream is currently supported for CODE.

Workstation Platform

The *Operational Configuration* provides a development platform that is essentially the same as the operational system. This is not required for algorithm development or implementation. The *Development Configuration* provides an acceptable platform for running an ORPG clone and developing ORPG algorithms but does not match the performance criteria of the operational system.

Performance Testing. Any desktop PC with a current processor and 2 GB of RAM would be sufficient in order to determine the relative performance of an algorithm.

	Operational Configuration	Development Configuration	Notes
Workstation	Dual AMD 6348 CPUs	Any PC with a dual core or quad core CPUs	1
Operating System	Red Hat Enterprise Linux 8 Desktop with Workstation Option (64-bit)	Red Hat Enterprise 8 Desktop with Workstation Option (64-bit) or CentOS Stream Desktop (64-bit)	2
Physical Memory	16 GB	4 GB RAM minimum 16 GB recommended	
Swap Space	TBD	1 GB minimum	3
Disk Drive	1 TB SATA III hard drives	1 GB plus for each ORPG account	4
Display Capability	N/A	24-Bit color, 1024x768 min, 1280x1024 recommended	

Note 1: With the amount of overhead in the operational system there is little reason to replicate it for development. Any recent quality desktop PC with 4 GB of RAM can be used to obtain a good idea of an algorithms relative performance.

Note 2: Red Hat Enterprise 8 Workstation has been selected as the operating system for the deployed ORPG. The ORPG software requires 64-bit operating systems. CentOS Stream has been tested to be a good alternative Operating System of Red Hat 8.

Note 3: Currently 1 GB of swap space is sufficient for the CODE development environment.

Note 4: Does not include space for compilers and other development tools.

Software Language Compilers

The CODE Linux platform uses libraries and software development tools that are provided with the basic distribution of Red Hat Enterprise 8 Desktop with Workstation option.

Compilers used to build the Operational ORPG

- **Compilers and utilities provided with Red Hat Enterprise Workstation**
    - GCC 4.8.5 (includes gcc, g++, and gfortran)
    - GNU make 3.82-24
    - GNU linker in binutils 2.27-43
    - glibc 2.17-307

CODE DOCUMENTATION

1. **CODE Volume 1 - Guide to Setting Up the Development Environment**
    - Modifications for the new version of ORPG Build 22.0r1.8 software.
2. **CODE Volume 2 - ORPG Application Development Guide**
    - No change
3. **CODE Volume 3 - WSR-88D Algorithm Programming Guide**
    - No change
4. **CODE Volume 4 - CODE Utility Guide**
    - No change
5. **ORPG Source Code**
    - Updated to `ORPG Build 22.0r1.8 October 2023`
6. **CODE Software**
    - CODEview Graphics (CVG) 9.2 (integrated with ORPG B22.0r1.8)
        - No change
    - CODEview Text (CVT) 4.4.3 (integrated with ORPG B22.0r1.8)
        - No change.

CODE Guide

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ORPG Specific Development Utilities