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

CODE B18.0r1.11: April 2018
Includes ORPG Build 18.0r1.11

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.

**Start Here:**

[Overview of CODE] [System Requirements] [Change History] [CODE Documentation]
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 The PUP was the integrated product display computer and has been replaced by separate user agency systems.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 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.
Overview of CODE

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.
Overview of CODE

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*. 
Overview of CODE

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 18 - What's New?

RedHat 7 / CentOS 7, 64-bit support.
The DMD product has been adapted to use SAILS and MRLE scans.
The TRU product has been adapted to use SAILS scans.
Added support for site-specific product_generation_tables files.
Improvements to the RPG's estimator of initial system differential phase.
Removal of several legacy 8-data level products.

Build 17 - What's New?

Operational support for MESO-SAILS that enables up to 3 extra low level elevation scans in a volume scan.
Addition of the Hail Size Discrimination Algorithm to the Hydrometeor Classification Algorithm and associated products.
Addition of atmospheric model data to the level 2 data stream with playback capability.
Removal of the following legacy products (product codes): 3-bit Reflectivity (16, 17, 18), 4-bit Reflectivity (21), 3-bit Velocity (22, 23, 24), 3-bit Spectrum Width (29), 3-bit Composite Reflectivity (35), 3-bit Cross Section (85, 86), 4-bit Dual Pol (158, 160, 162, 164).

Only a Linux PC platform running Red Hat or CentOS 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.

<table>
<thead>
<tr>
<th></th>
<th>Operational Configuration</th>
<th>Development Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation</td>
<td>Dual AMD 6348 CPUs</td>
<td>Any PC with a dual core or quad core CPUs</td>
<td>1</td>
</tr>
<tr>
<td>Operating System</td>
<td>Red Hat Enterprise Linux 5 Desktop with Workstation Option (32-bit)</td>
<td>Red Hat Enterprise 5 Desktop with Workstation Option (32-bit) or CentOS 5 Desktop (32-bit)</td>
<td>2</td>
</tr>
<tr>
<td>Physical Memory</td>
<td>16 GB</td>
<td>4 GB RAM minimum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 GB recommended</td>
<td></td>
</tr>
<tr>
<td>Swap Space</td>
<td>TBD</td>
<td>1 GB minimum</td>
<td>3</td>
</tr>
<tr>
<td>Disk Drive</td>
<td>1 TB SATA III hard drives</td>
<td>1 GB plus for each ORPG account</td>
<td>4</td>
</tr>
<tr>
<td>Display Capability</td>
<td>N/A</td>
<td>24-Bit color, 1024x768 min, 1280x1024 recommended</td>
<td></td>
</tr>
</tbody>
</table>

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 5 Workstation has been selected as the operating system for the deployed ORPG. The ORPG software requires 32-bit operating systems. CentOS 5 has been tested to be a good alternative Operating System of Red Hat 5.

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 5 Desktop with Workstation option.
CODE System Requirements

Compilers used to build the Operational ORPG

- **Compilers and utilities provided with Red Hat Enterprise Workstation**
  - GCC 4.1.2 (includes gcc, g++, and gfortran)
  - GNU make 3.81-1.1
  - GNU linker in binutils 2.17.50.0.6-5
  - glibc 2.5-18
CHANGE HISTORY

What's New for CODE B18.0r1.11 (for ORPG Build 18.0r1.11)
April 2018

1. CODE Volume 1 - Guide to Setting Up the Development Environment
   o Modifications for the new version of ORPG Build 18.0r1.11 software.
2. CODE Volume 2 - ORPG Application Development Guide
   o No change
3. CODE Volume 3 - WSR-88D Algorithm Programming Guide
   o No change
4. CODE Volume 4 - CODE Utility Guide
   o No change
5. ORPG Source Code
   o Updated to ORPG Build 18.0r1.11 April 2018
6. CODE Software
   o Sample Algorithms - version 1.22a
     ▪ No change.
   o CODEview Graphics (CVG) 9.2 (integrated with ORPG B18.0r1.11)
     ▪ No change
   o CODEview Text (CVT) 4.4.3 (integrated with ORPG B18.0r1.11)
     ▪ No change.

What's New for CODE B17.0r1.13 (for ORPG Build 16.0r1.10)
May 2016

1. CODE Volume 1 - Guide to Setting Up the Development Environment
   o Modifications for the new version of ORPG Build 17.0r1.13 software.
2. CODE Volume 2 - ORPG Application Development Guide
   o No change
3. CODE Volume 3 - WSR-88D Algorithm Programming Guide
   o No change
4. CODE Volume 4 - CODE Utility Guide
   o No change
5. ORPG Source Code
   o Updated to ORPG Build 17.0r1.13 May 2016
6. CODE Software
   o Sample Algorithms - version 1.22a
     ▪ No change.
   o CODEview Graphics (CVG) 9.2 (integrated with ORPG B17.0r1.13)
     ▪ No change
   o CODEview Text (CVT) 4.4.3 (integrated with ORPG B17.0r1.13)
     ▪ No change.
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Document 4. Product Distribution with the nbtcp Tool
Document 5. Additional CODE / ORPG Tools

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