REVEAL: Software Documentation and Platform Migration

Mike Wilson
Victoir Veibell

Embry-Riddle Aeronautical University
USRP Interns – Summer 2008
Outline

- Background
- Internship Objectives
- Project Foundation
- Platform Migration
- Field Test
- Next Steps
- Project Status
• Research Environment for Vehicle-Embedded Analysis on Linux

• Implemented on MontaVista Linux

• “Data acquisition and distribution system”

• Primarily used in aircraft
Suborbital Telepresence

- Hardware platform for REVEAL
- PC/104 Form Factor
- Configurable acquisition, processing, recording

Components:
- Network
- Satellite Links
- Internal Sensors
- Configurable Components
- External Sensors
- Digital I/O
- Analog I/O
Internship Objectives

• Grow REVEAL’s support for multiple developers
  • modern version control system
  • modern software documentation

• Verify implementation flexibility
  • implement on different CPUs
  • demonstrate end-to-end functionality
Project Foundation: Subversion

• Version Control Software
• Motivation
  – Multiple people working with same files
# ViewVC

## Browser based repository

### Index of /

Files shown: 14
Directory revision: 77 (of 77)
Sticky Revision: [Set]

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<thead>
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*Site Admin*
Powered by ViewVC 1.0.5
### Highlighted differences

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<td>CC = gcc</td>
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<td>CFLAGS = -I$(IXML) -I$(INOVAS) -I$(IARINC) -I$(IDSCUD) -D$(OS)</td>
<td>CFLAGS = -I$(IXML) -I$(INOVAS) -I$(IARINC) -I$(IDSCUD) -D$(OS)</td>
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<td>REVEAL = /Users/mjm/Reveal</td>
<td>REVEAL = ..</td>
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<td>LDADS = $(REVEAL)/Revealv1.1a</td>
<td>OBJ = $(REVEAL)/lib</td>
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<td>OBJ = $(LDADS)/LIB</td>
<td>BIN = $(REVEAL)/bin</td>
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<td>BIN = $(LDADS)/BIN</td>
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<td>IXML = /usr/include/libxml2</td>
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<td>OS = OSX</td>
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<td>THIRDPARTY = $(REVEAL)/ThirdParty</td>
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<td>LD_LIBRARY_PATH=$LDADS/BIN:$LDADS/LIB:/usr/lib</td>
<td># LD_LIBRARY_PATH=$LDADS/BIN:$LDADS/LIB:/usr/lib</td>
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Doxygen

• Visual Interactive Code Documentation
• Motivation
  – Easy to find and interpret code
  – Parses files, functions, variables, definitions
  – Useful comment structure
Validates ARINC-429 parity

**FUNCTIONAL DESCRIPTION:**
The Condor card has already checked parity and set a bit in the 32-bit parameter word to let us know, we just look at the bit.

**REVISION HISTORY:**
- 11/24/04 Carl Sorenson Created
- 01/31/08 Carl Sorenson From 2 to 4 channels

If the channel is in "raw mode" parity is not checked by card or us.

```c
int checkParity(int chan, uint32_t word)
{
    int okay = FALSE; // return code
    uint32_t ptest; // parity test value

    switch(chan)
    {
        case ARINC_CHAN0: ptest = ARINC_CHAN0_PARITY; break;
        case ARINC_CHAN1: ptest = ARINC_CHAN1_PARITY; break;
        case ARINC_CHAN2: ptest = ARINC_CHAN2_PARITY; break;
        case ARINC_CHAN3: ptest = ARINC_CHAN3_PARITY; break;
        default: jobMsg(LOG_BYE, "checkParity: unknown channel: %i\n", chan);
    }

    if (working) switch(ptest)
    {
        case AR_ODD: if (!(word & ARINC_PARITY_BIT)) okay = TRUE; break;
        case AR_EVEN: if (word & ARINC_PARITY_BIT) okay = TRUE; break;
        case AR_RAW: okay = TRUE; break;
        default: jobMsg(LOG_BYE, "checkParity: internal error: %i\n", ptest);
    }

    return(okay);
}
```

**NOTES:**
If the channel is in "raw mode" parity is not checked by card or us.

**Returns:**
- TRUE if it checks valid, otherwise false

**Parameters:**
- chan the channel index
- word the 32-bit ARINC-429 parameter word, via the Condor API
Doxygen - GraphViz

- File dependency graphs
- Clickable links
Doxygen – GraphViz (cont.)

- Functional dependency graphs
- Flow visualization
- Easy code debugging
Platform Migration

• Three considered platforms:
  – VersaLogic EPM-5 “Puma”
  – Lippert “Cool FrontRunner”
  – eBox-2300 (“NorhTec MicroClient”)
• Puma and Lippert suspended due to time constraints
eBox-2300

• Motivations for choice
  – Built-in Compact Flash interface
  – Passive Cooling
  – Low Power Consumption (15W)
  – Self Contained
  – Two Serial Ports
• Finally: small size
eBox Modification

- Added 2nd Compact Flash interface
  - Usability: separates system and data
  - Makes one complete package
Testing REVEAL

- Data Source: Piccolo II Autopilot
  - Generates useful, verifiable data
  - Communicates over serial
  - Existing data acquisition software
Testing REVEAL (cont.)

- Network Link: Iridium 9505A Satellite Phone
  - Globally accessible
  - Allows data transmission
  - Serial accessory
Field Test

• Proof of Concept

Truck Setup

Terminal
Physical Network Architecture

- Iridium
- Ground Station
- Internet
- 9505A
- Piccolo II
- REVEAL
- Vehicle
- California Team
- New Hampshire Team

NASA

Emory-Riddle Aeronautical University
Field Test (cont.)
Next Steps

• Further documentation
  • XML configuration files
  • Data flow
  • Accessibility to a broader audience
• Further miniaturization of REVEAL hardware
  • Current size is restrictive
• Expanded applications of REVEAL software
Project Status

- Implemented multi-developer capability for REVEAL
  - Created interactive REVEAL documentation.
- Became first users
- Migrated REVEAL to low-cost hardware (eBox-2300)
  - Field tested system
  - Verified end-to-end operation
Acknowledgments

• Larry Freudinger
• Brent Bieber
• Sky Yarbrough
• Jim Murray
• Shari Olson
• Miriam Rodon-Naveira
• Matt Miller & John Wilson
• Professor Gary Gear
Questions?