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# **OpenVPX**™ Tutorial and Common Practices

Updated to reflect what is expect to be 2017 revision of OpenVPX  
(ANSI/VITA 65.0 and 65.1)

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# Outline

- **Introduction**
- **Cooling, form factors and copper connectors**
- **Blind mate optical and coax connectors**
- **Utility Plane including radial clocks and VITA 62 power supplies**
- **Slot, Backplane, Module Profiles**
- **Slot Profile and Backplane Profile examples**
- **Summary**

**Note: A new version of OpenVPX (ANSI/VITA 65.0 and 65.1) expected to be complete the standardization process in the first half of 2017. Most of this Tutorial is written as if it already has.**

This tutorial along with some others is available at: <http://www.vita.com/Tutorials>

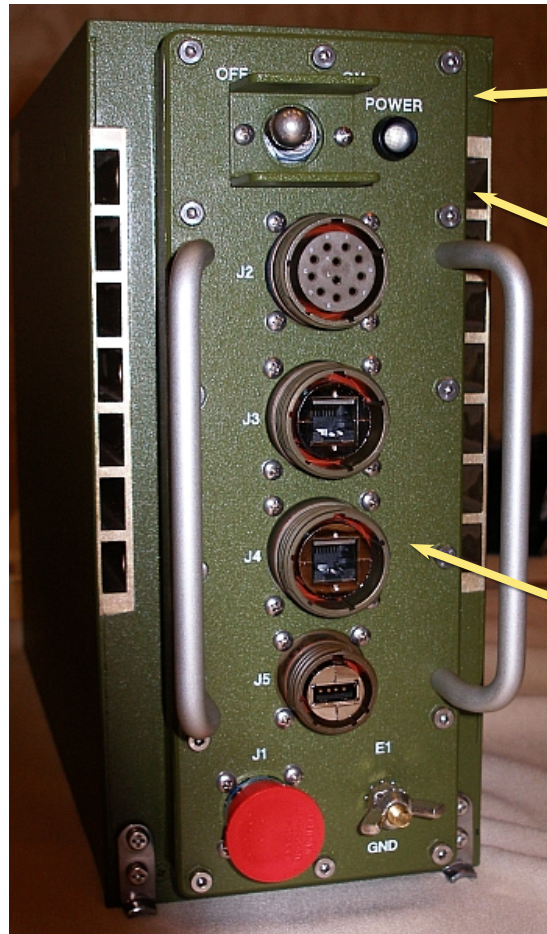


# Subsection Outline: Introduction

- **Introduction**
  - Overview
  - Brief history of VME, VXS, VPX, and OpenVPX
  - Mezzanine Cards
  - Rear-Transition Modules (RTMs)
  - Terminology
  - Two-level maintenance
- Cooling, form factors and copper connectors
- Blind mate optical and coax connectors
- Utility Plane including radial clocks and VITA 62 power supplies
- Slot, Backplane, Module Profiles
- Slot Profile and Backplane Profile examples
- Summary



# OpenVPX and Associated Standards

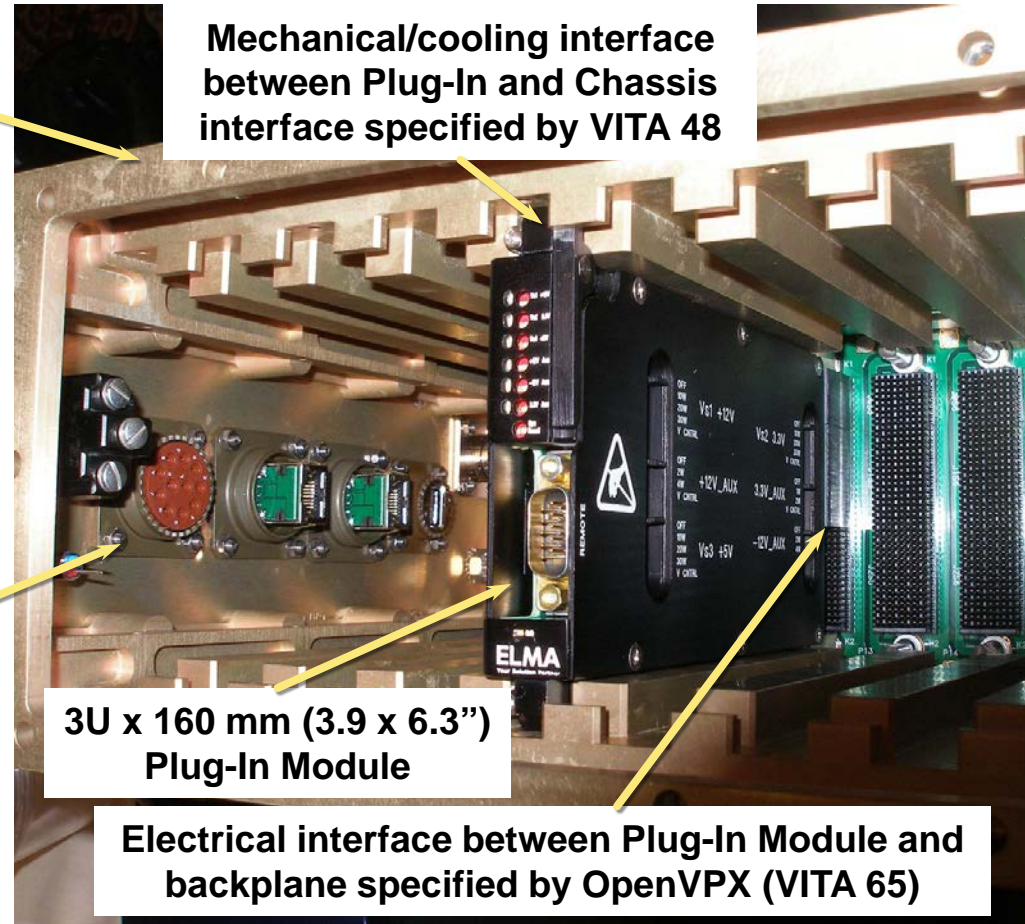


Conduction cooled chassis

Channels for cooling air

Chassis front panel

*Pictures courtesy of Elma*



Mechanical/cooling interface between Plug-In and Chassis interface specified by VITA 48

3U x 160 mm (3.9 x 6.3") Plug-In Module

Electrical interface between Plug-In Module and backplane specified by OpenVPX (VITA 65)

- These standards define interfaces between Plug-In Modules and chassis for products intended to be deployed in harsh environments



# OpenVPX Widely Used In Embedded Systems



Military & Aerospace Sept 11, 2013:  
Northrop Grumman orders airborne radar  
signal processors from Curtiss-Wright for Joint  
STARS



The Aviationist April 5, 2015:  
Photo Shows A U.S. reaper drone carrying  
"Gorgon Stare" wide area airborne Surveillance  
system pod in Afghanistan



Military & Aerospace Nov 25, 2012:  
Massive October ballistic missile defense test  
used Mercury's OpenVPX embedded  
computing



VITA Technologies Aug 3, 2012:  
OpenVPX platform delivers horsepower  
needed to revolutionize helicopter flying



COTS Journal Dec, 2013:  
Mercury to Provide Radar Subsystems for  
Patriot Air and Missile Defense Systems



COTS Journal July 2014:  
Figure caption: Project Missouri demonstrations  
successfully implemented and tested two data links  
between an F-22 and the F-35 Cooperative Avionics  
Test Bed (CAT-B) (shown).

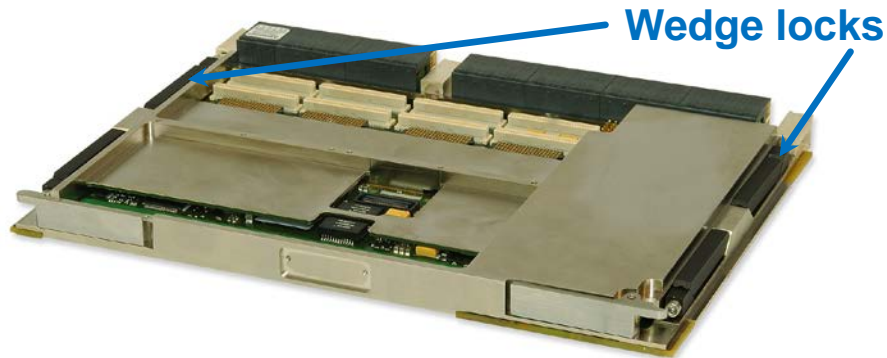


# Goals of This Tutorial

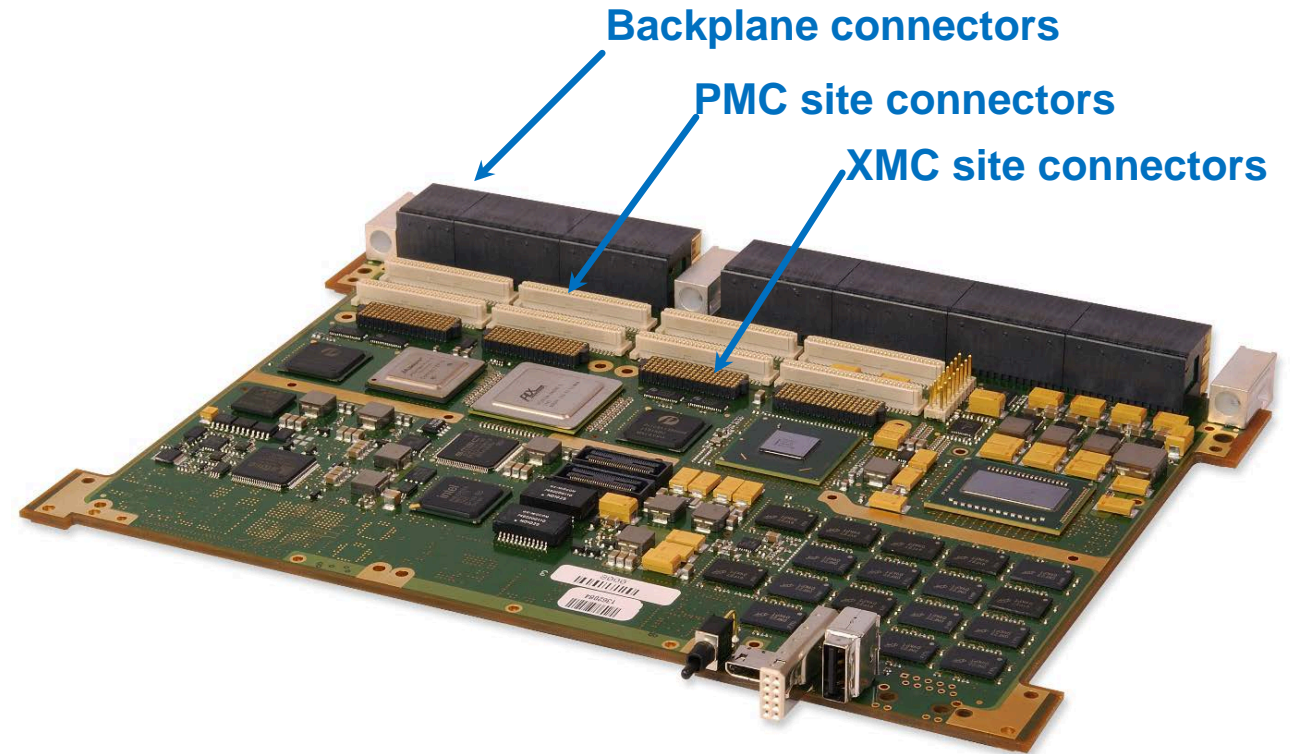
- **If think of the OpenVPX specification as like a reference manual**
  - Think of this material as a user's manual
  - Help sort through the large number of options in the specification
- **Further lock in common industry practices**
  - This will help build a more consistent eco-system
- **Give some suggestions for practices in emerging areas**



# Conduction Cooled OpenVPX Module



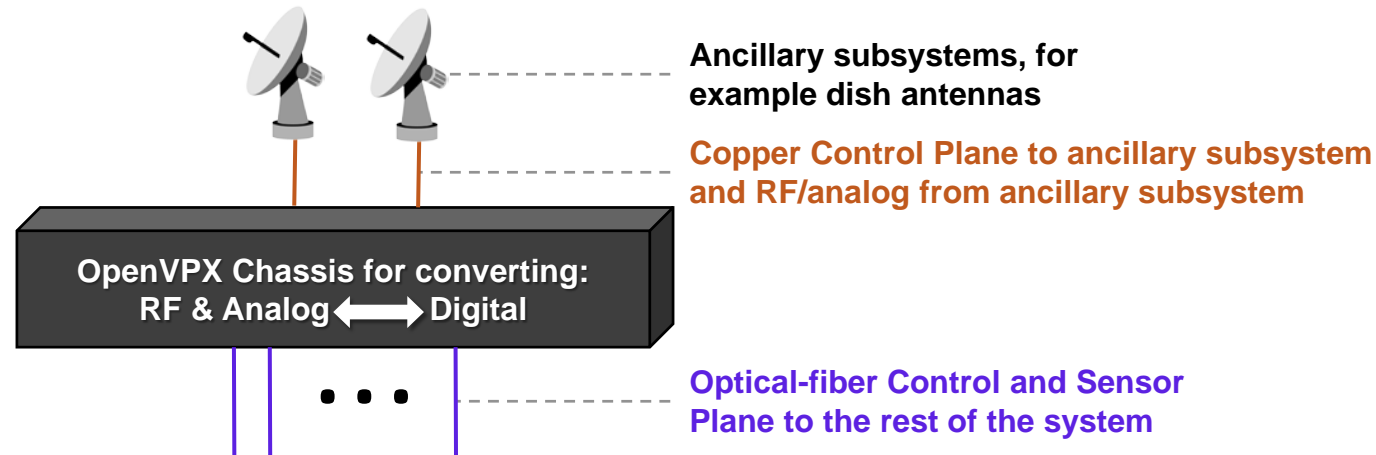
Abaco Systems SBC624 OpenVPX  
6U Intel based processing Module  
with 2 PMC/XMC sites



- **6U x 160 mm – 233.35 mm x 160 mm or 9.187” x 6.299” module shown**
  - Other module size is 3U x 160 mm – 100 x 160 mm or 3.937 x 6.299” inches
- **Module shown is designed for conduction cooling (ANSI/VITA 48.2)**
- **Two mezzanine sites for either PMCs or XMCs**



# Vision for Data Conversion Subsystem

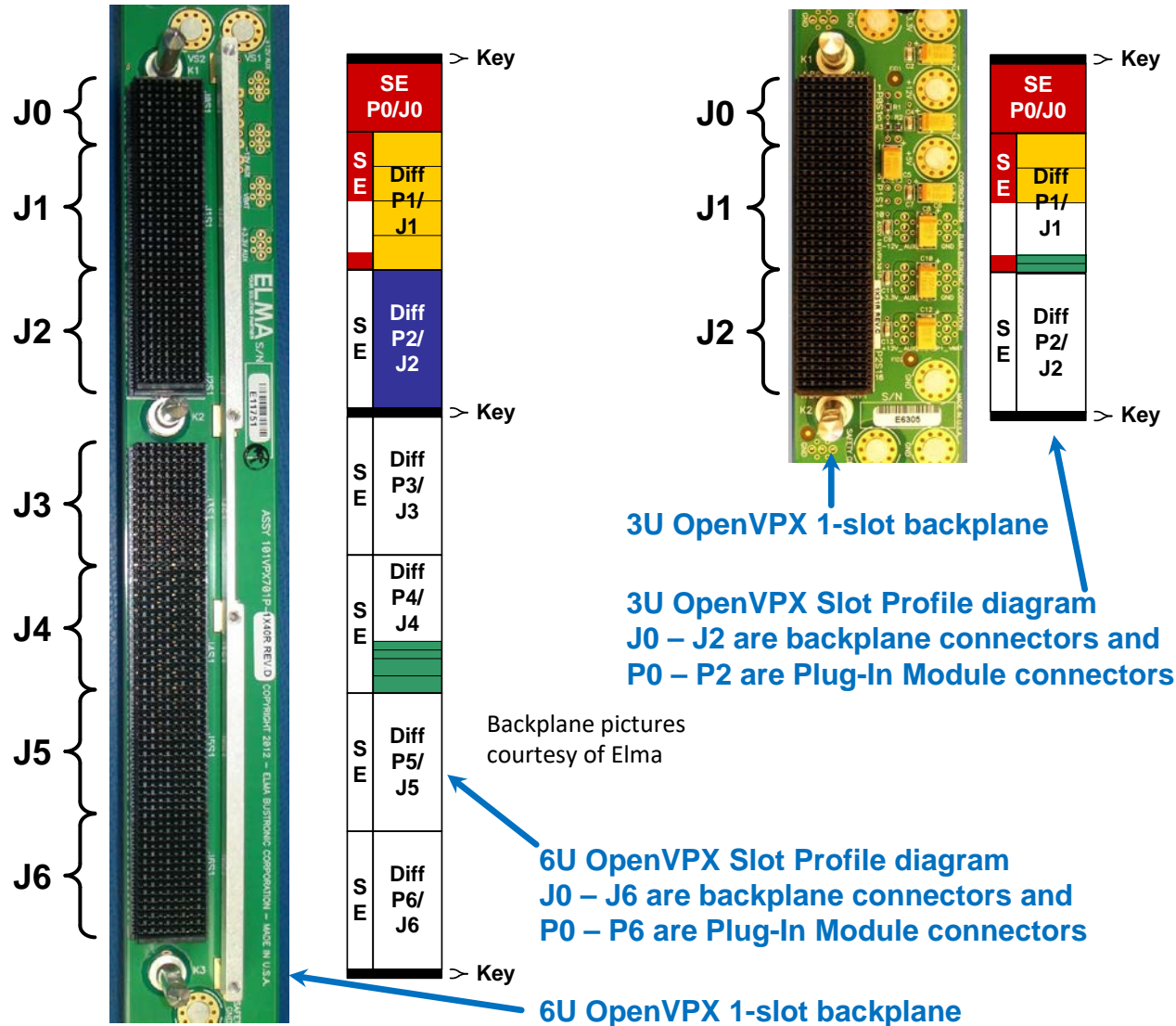


- **Changes in 2017 version of OpenVPX to support this vision**
  - Radial clocks for high precision clocking of A/Ds and D/As
  - **Optical (VITA 66.x) and coax (VITA 67.x) portions of backplane connectors**
    - Organizational changes to handle significant expansion (2012 rev only has 2 coax Slot Profiles)
  - **Control Plane Switch Profiles to support mix of:**
    - Copper connections within the chassis – 1000BASE-KX and 10GBASE-KR
    - Copper connections to local ancillary devices – 1000BASE-T and 10GBASE-T
    - Fiber connections to rest of system – 10GBASE-SR
  - **Data Plane Switch Profiles to support mix of:**
    - Copper connections within the chassis – 40GBASE-KR4
    - Fiber connections to rest of system – 40GBASE-SR4





# OpenVPX Profiles



## • Slot Profiles specify

- Pins associated with a backplane slot
- Pins associated with a Plug-In Module's connector to backplane
- Pins assigned to particular ports
- Example Slot Profile name: SLT6-PAY-4F1Q2U2T-10.2.1

## • Backplane Profiles specify

- Which Slot Profiles a particular backplane has
- How its Slot Profiles are interconnected
- Example Backplane Profile name: BKP6-CEN16-11.2.2-n

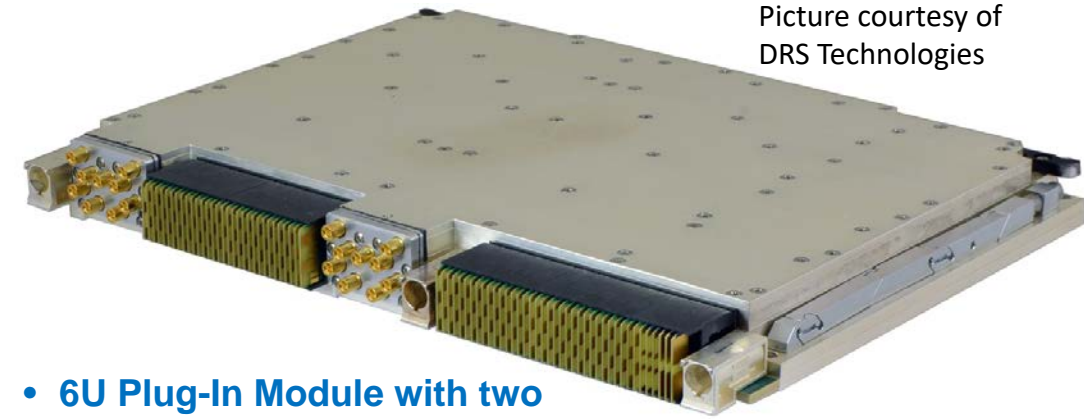
## • Module Profiles specify

- The protocols and number of lanes to be mapped to the ports defined by the Slot Profile (e.g. 1000BASE-KX Ethernet)
- Example Module Profile name: MOD6-PAY-4F1Q2U2T-12.2.1-n



# Slot Profiles Now Have Dash Options

- **2012 version of OpenVPX has tables of dash options for:**
  - Backplane Profiles – baud rates of channels
  - Module Profiles – protocols mapped to Slot Profile's ports
- **2017 version will add dash options for Slot Profiles**
  - Slot Profiles can include aperture for optical/coax – for example: VITA 67.3 type C Connector Module
  - “-0” version of Slot Profile has aperture empty
  - Below are examples of Connector Modules that can go in a VITA 67.3 type C aperture. Each can be a dash option for Slot Profile.



Picture courtesy of DRS Technologies

- **6U Plug-In Module with two VITA 67.3 Connector Modules**
  - 9 SMPM contacts each
  - Mate with connector below (flipped vertically)



Image courtesy of TE Connectivity

- **Backplane connector using VITA 67.3C footprint**
  - Can mate with Plug-In Modules with VITA 66.4 (optical) and 67.1 (coax) connectors



Picture courtesy of SV Microwave

- **VITA 67.3C backplane connector**
  - 9 SMPM contacts
  - Side which mates with Plug-in Module shown



# VITA 65.0 and 65.1 Partitioning

- **Adding dash options to Slot Profiles also increases dash options for Backplane and Module Profiles as well as adding tables for Slot Profiles**
- **What is currently VITA 65 becomes VITA 65.0 without the tables of dash options**
- **Tables of Backplane & Module Profile dash options move from 65.0 to 65.1**
  - Associated text stays in VITA 65.0
  - With VITA 65.0, instead of referencing tables in VITA 65.0, reference VITA 65.1
- **VITA 67.3 standardizes Connector Module footprints but not contact locations**
  - VITA 65.1 includes tables of contact locations
- **VITA 65.0 and 65.1 section numbers are be consistent with each other**
  - VITA 65.1 has lots of skipped sections
- **VITA 65.1 written using Microsoft Excel in order to make dealing with tables easier**
  - Many of the tables are wider than what will nicely fit in the width of a page
  - Available in both Excel and .pdf



# VITA 65 Working Group Cultural Changing

- **With 2012 version of OpenVPX profile dash options were put in even if no immediate plans to implement them**
  - Done for consistency among profiles
  - Put in if someone thought they might implement
    - Due in part to how long the standardization process can take
- **Planning to revise 65.1 more frequently than 65.0**
- **Have put in place a streamlined process for adding to 65.1**
  - Slot Profiles with different Connector Modules
  - Backplanes Profiles with Slot Profiles using different Connector Modules
  - Backplanes Profiles with higher baud rate channels
  - Module Profiles with newer protocols

- **Encouraging culture where dash options are only added when there is a plan to implement soon**



# Overview Wrap-Up

- **OpenVPX and associated standards define interfaces between Plug-In Modules and chassis**
  - For products intended to be deployed in harsh environments
- **ANSI/VITA 65 becomes 65.0 with profile tables moving to 65.1**
  - ANSI/VITA 65.0; OpenVPX™ System Standard
  - ANSI/VITA 65.1; OpenVPX™ System Standard – Profile Tables
- **The next version of OpenVPX is expected to be completed in 1H2017**
  - Most of this Tutorial is written as if 65.0 and 65.1 have already been completed
- **Changes to support data acquisition and RF subsystems**
  - Radial clocking for high precision clocking of A/D and D/As
  - Bind mate backplane optical and coax connectors to support 2-level maintenance
- **Encouraging culture where dash options are only added when there is a plan to implement soon**