Some Considerations for CPS Architectures

Dr. David Corman
CPS Architectures

• Do they exist today?
  – Yes, some exist. Were quite useful in the past. Middleware based to provide hardware and OS independence.
  – Standards from pre-competitive groups

• Should there be standard architectures?
  – Perhaps, but many obstacles to adoption
  – Domain specificity
  – Start anew each time?

• What should the critical features be?
  – This is the most important question
Some CPS Architectures

• Many “mandated” architectures with re-usable components did not survive long past initial utilization
  – Portability, Performance, Maintenance of architecture and components

• Some original product-line architectures arose from Boeing Bold Stroke initiative in late 90’s

• Open Control Platform for Unmanned Air Vehicles from DARPA represented a next generation – 2004
Some CPS Architectures Were Created By Industry to Support DARPA / DOD Programs

**Features**
- Middleware abstraction layer for hardware and OS independence

---

**Bold Stroke Product Line Architecture**
- (F/A-18, F-15, T-45) – circa 1995

**Open Control Platform for Autonomous Systems – circa 2005**
CPS Architecture Considerations

• Hardware and OS Portability
• Product line
• Real-time
• Support for control at multiple levels
• Support fault tolerant
• Network abstraction
• Time coordination
• Support for periodic and aperiodic
• Time triggered or event based
• Low overhead latency
• Predictability
• Security
CPS Architectures – Desirable Path

• Component model library with product line architecture
  – Contains behavioral and physical models of application components and infrastructure components
  – Supports model based development and design
    • Enable rapid design, simulation, and verification of behaviors
  – Scalable and extensible
What are Gaps

• What are the compositional principles that enable creation of verified systems out of verified components

• Where do “common” application or infrastructure components come from
  – Can some be pre-competitive?
  – Can some originate from “industrial strength” testbeds

• Maturing tool environments – converting research tools into capabilities that are transitioned to practice