

2013 DHS S&T/DoD ASD (R&E)
CYBER SECURITY SBIR WORKSHOP

MiCART™: Mixed Criticality Real-time Hypervisor

Adventium Labs

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Homeland
Security

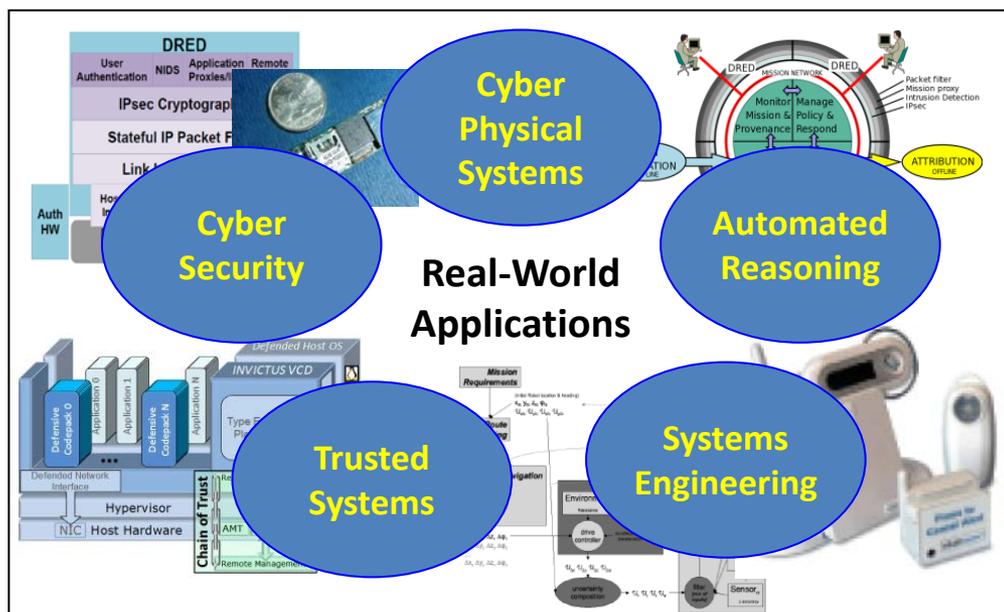
Science and Technology



Company Profile



- Scientist-owned small business, founded 2002
- Commercial and government contract research
- **Technical Staff:** Ph.D.: 50%, MS: 30%, BS: 20%
- **Fields:** Computer Science, Mathematics, Electrical Engineering, Psychology
- **Career patents:** 25 issued (3 AL), 33 pending (5 AL)
- **Publications:** 300+
- **2012 DoD commercialization score:** 95 (up from 90 in 2011)

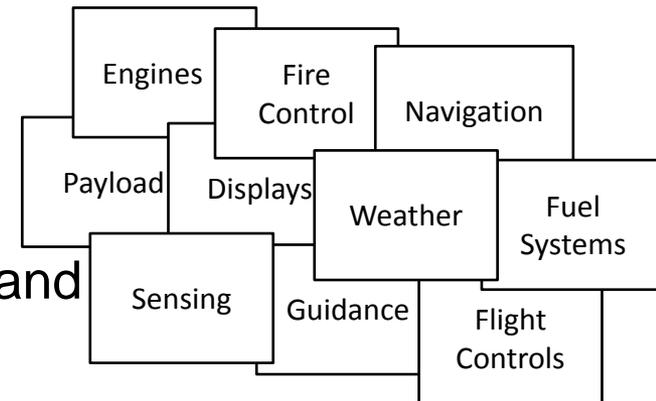


Selected Transition Successes:

- SAFEbus® for Boeing 777 and C5-AMP Integrated Modular Avionics
- Guidant LATITUDE wireless medical devices
- 3Com Embedded Firewall
- DTOS (Distributed Trusted Operating System) – foundation of SE Linux
- DEOS Real-Time Operating System (RTOS)

Customer Need

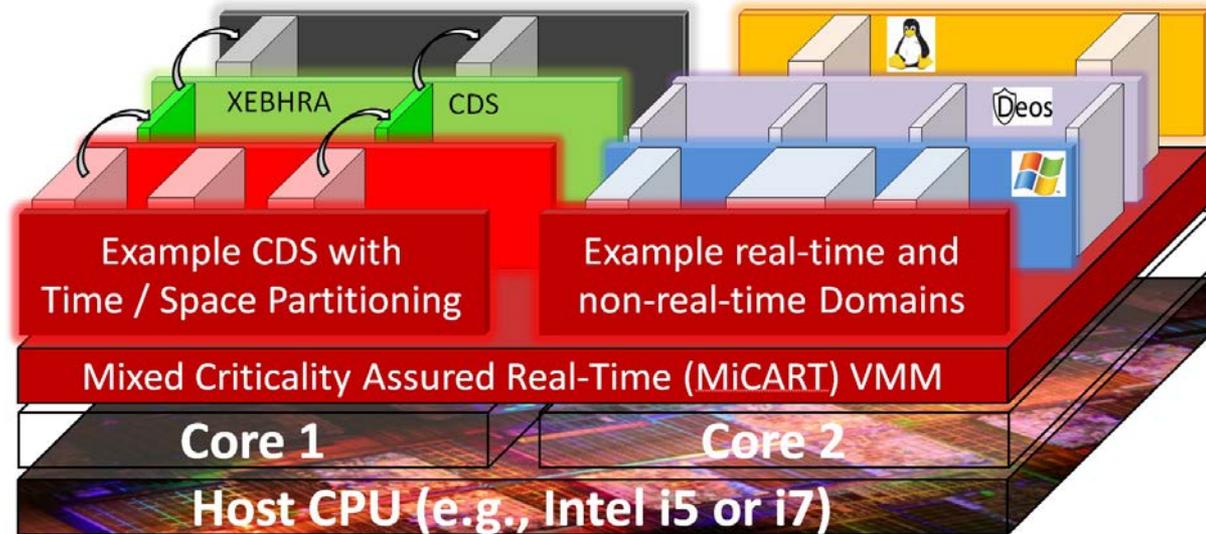
- Aircraft integrators lack good tools to predict, manage, and control avionics integration challenges.
- Increasing avionics software complexity is driving up the cost and time to deploy aircraft.
- Integration of previously federated avionics and controls architectures has saved size, weight, and power, but integration costs remain high due to:
 - High certification costs for mixed-criticality systems.
 - Constrained application architecture options.
 - Heavy development and run-time penalties.
 - Limited reasoning scope, so changes ripple.
- As a result, integration opportunities are limited, and
- It takes a long time to field enhancements and new capabilities.



Aircraft avionics integration opportunities are limited by complexity and tools

Approach

- MiCART is a time and space system integrating platform, which reduces certification costs.
- It provides architecture flexibility to host *diverse* applications.
- Primary artifacts:
 - **MiCART Xen Run-time Scheduler** satisfies rate, latency, jitter, and intra-frame application communications requirements on top of Xen, which supports rapid prototyping, development, and deployment.
 - **MiCART Hierarchical, Off-line Scheduler**, built upon standard languages, development, and analysis environments, computes hierarchical *cabinet-level* schedules, so change can be managed.



MiCART addresses hierarchical time and space partitioning from cabinet to core.

Benefits

- MiCART enables safety critical software, such as avionics, to affordably operate side by side on the same computer hardware with non critical software, such as video feeds.
- New functionality can be rapidly prototyped in inexpensive development environments and hosted alongside high criticality applications with constrained RTOSs.
- Cabinet-level scheduling permits performance integration during development, rather than on the test-bench or in flight.
- Time-to-deploy can be reduced, since time-and-space partitioning guarantees that low criticality components cannot adversely impact flight critical code.
- Timing channels can be reduced.

MiCART reduces life-cycle cost and time to integrate mixed-criticality applications.

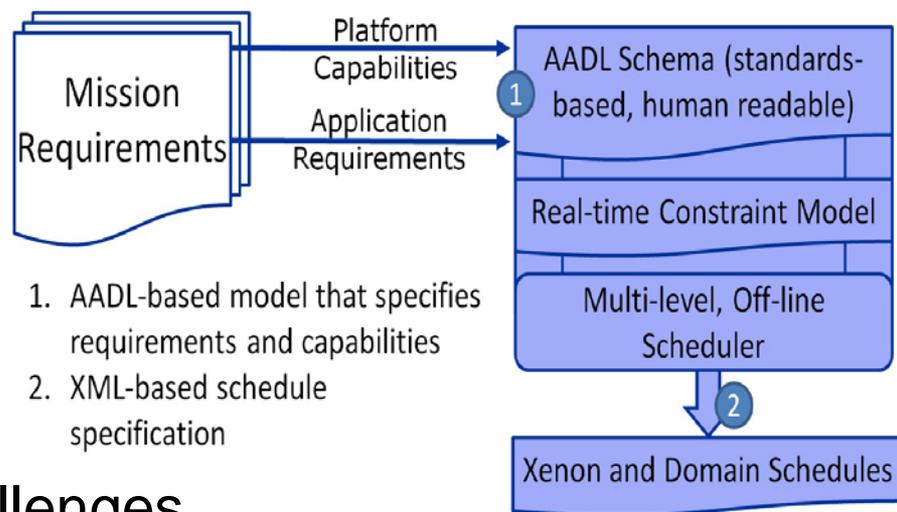
Current Status

- **MiCART Xen Run-time Scheduler**

- Demonstrated ability to host DDC-I DO-178B Certified RTOS as Xen 4 VMM guest.
- Demonstrated I/O separation with IOMMU.
- *Released Xen Scheduler open-source to Xen community.*

- **MiCART Hierarchical Off-line Scheduler**

- Currently funded under the Leading Edge Aeronautics Research for NASA (LEARN) to compute real-time schedules *at the aircraft level.*
- This off-line scheduler is independent of the Run-time Scheduler, and is intended for complex real-time integration challenges.



Phase II Complete; Currently extending off-line scheduler to aircraft level.

Next Steps

- **MiCART Xen Run-time Scheduler (already released open source)**
 - Exploring opportunities to port MiCART Xen Scheduler to space-partitioned hypervisor (e.g., AFRL TSABI/SABI* certified SecureView built on Citrix XenClient XT).
 - Transition to UAV or other controls application.
- **MiCART Hierarchical Off-line Scheduler**
 - Currently looking for an integrator needing complex aircraft-level performance guarantees to partner with for Phase II NASA LEARN.
 - Phase II LEARN will demonstrate benefits of providing performance guarantees during system design, thereby reducing down-stream integration cost spirals.

*in progress

NASA LEARN is near-term opportunity to deploy off-line scheduler.

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- <http://www.adventiumlabs.com/our-work/products-services/micart%E2%84%A2-mixed-criticality-real-time-virtualization-support> – includes a video of real-time control with Xen

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