Agenda

• ARINC History
• ARINC 653 Concepts
• Core Software Considerations
• ARINC 653 multicore
• ARINC 653 Graphical Demo
• Questions
ARINC History

- **Aeronautical Radio Inc (ARINC)**
  - Rockwell Collins acquired ARINC Dec 23rd 2013
  - United Technologies acquired Rockwell Collins in 2018…

- **ARINC Standards**
  - 600 Series is the reference standards for avionics equipment specified by the the ARINC 700 series
  - 700 Series details the form, fit and function of avionics equipment predominately on transport aircraft.

**ARINC 651** complements **ARINC 653** with to respect form, fit and function of ARINC computer systems.
ARINC 653 Concepts

- **ARINC 653** is firmly defined for the highest level of criticality for civilian Aerospace
- ARINC 653 is intended for use with Integrated Modular Avionics*
- RTCA DO-178C is the primary consideration for ARINC 653
- Military systems use ARINC 653 because of it’s partitioning and strict scheduling capabilities
- MultiCore Processing (MCP) is supported
- CAST32A provides the guidelines for MCP*

“The IMA concept proposes an integrated architecture with application software portable across a range of hardware modules”
ARINC 653 Concepts
Aviation Safety and ARINC

• FAA and EASA
  • These organisations provide all safety coverage for aviation safety including Air Traffic Management
  • There are rules and regulations governing any aircraft, even military, that fly within civil aerospace.
  • DO-254 and DO-178C provide a safety framework for systems within Aircraft, whether manned or unmanned.
  • CAST32A defines recent multicore concepts for the use of System On Chip (SoC) devices as well as RTOS requirements.
ARINC 653 Concepts – System Architecture

ARINC 653 does allow other types of partitions to co-exist with ARINC 653 Partition types, these are known as System Partitions. Parts 1-4*

The **CSW or Core Software** must provide **required services**:

- Partition Management
- Process Management
- Time Management
- Memory Management
- Inter-Partition Communication
- Intra-Partition Communications
- Health Monitor
ARINC 653 Concepts - APEX

ARINC 653 Applications are segregated or Partitioned from the RTOS or Core Software by use of an Application Executive known as APEX.

APEX defines the API of the ARINC 653 application, ensuring portability between different Core Software where the APEX API hides the RTOS implementation.

The ARINC 653 Application is held within a Robust Partitioned environment, provided by the Core Software.
ARINC 653 Concepts – Communications (Inter*)

ARINC 653 Communications uses Message Queues or Sampling Ports with the concept of point to point uni-directional channels. Channels, Queues and Ports are defined at design time.

Channels are Uni-Directional
Messages must Arrive in the order that they are sent.
ARINC 653 – Communications (Intra*) Blackboard

ARINC 653 Intra Partitions Communications may use Message Queue or Sampling Ports. However, Message Blocks and Blockboards may be used instead for intra Partition communications.
ARINC 653 – Communications (Intra*) Buffers

ARINC 653 Intra Partitions Communications may use Message Queue or Sampling Ports. However, Message Block Buffers and Blockboards may be used instead for intra Partition communications.

Message Block Buffers are queued from sender to receiver.
ARINC 653 Concepts – Health Monitor

The ARINC 653 Health Monitor defines a number of error levels, supported by HM configuration Tables and Error Handlers set by Applications.

Health Monitor covers the following event levels:
- Partition
- Process
- Module
- System Error Detection

Unhandled events can cause Application halt, Partition Idle, Cold or Warm Boot or even System Halt!!

NOTE: Health Monitor should not be confused by Health Monitoring, HM is really dealing with actions to be performed on exceptions or system level Errors to protect and recover the system.
ARINC 653 RTOS Consideration– PikeOS

- PikeOS Hypervisor
  - RTOS with Separation Microkernel (MMU only)
- Time and Space Separation
- Robust Partitioning
- ARINC 653 Guest OS
  Supported across X86 / PPC / ARM
- Enhanced HM
- By core Scheduling
  Multi-Core Management
- One PikeOS for all
  Market Verticals
  Avionics, Rail, Automotive, Medical Security

- ARINC 653 compliant for Required and Optional Services
ARINC 653 RTOS Consideration– PikeOS

PikeOS allows both User and Kernel level drivers. However, User level drivers cannot affect the kernel space.

PikeOS memory requirements are defined at design time providing guaranteed access at runtime.

No memory requirement means no access at runtime.

PikeOS provides a Safe and Secure ARINC 653 Platform

ARINC 664 is Avionics Full Duplex Switched Ethernet
Multicore Management of PikeOS

- **Time Partition Scheduling by Core**
  - Core Minor Time Partitions are defined at Design time
  - **Critical** processes may separated by Time, Resource and Core.
  - Cache clearance is possible with each partition type.
PikeOS Graphical Demo – ARINC 653

• PikeOS is ideal for IMA Glass Cockpit systems
  • Come and see our Avionics demo
  • PikeOS
  • CoreAVI
  • ANSYS
  • Curtiss Wright VPX-133

• SYSGO Booth A53b
• CoreAVI, ANSYS and Curtiss Wright Booth A17
Corresponding Whitepaper is available here:
https://www.sysgo.com/services/knowledge-center/whitepapers