



AEE Workshop

ARINC 653 RTOS for Multi Core Certification

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Agenda

- **ARINC History**
- **ARINC 653 Concepts**
- **Core Software Considerations**
- **ARINC 653 multicore**
- **ARINC 653 Graphical Demo**
- **Questions**

ARINC History

The ARINC logo is displayed in a blue, sans-serif font within a white rectangular box.

- **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 664

ARINC 665

ARINC 615

ARINC 429

SYSGO
EMBEDDING INNOVATIONS

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 its 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

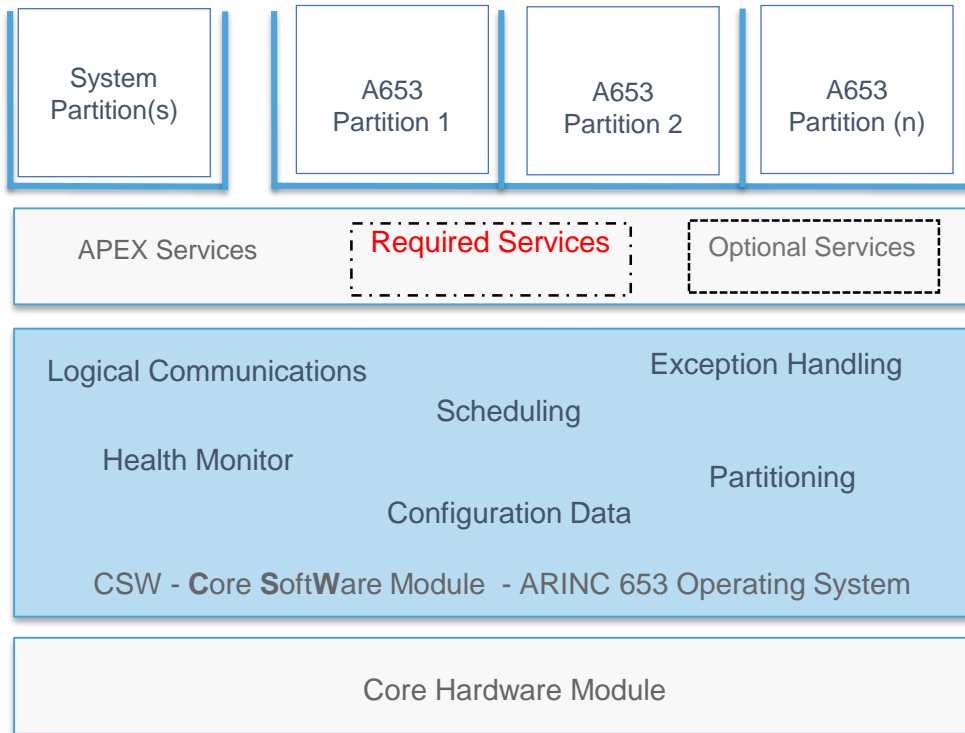


- **FAA and EASA**

- 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**:

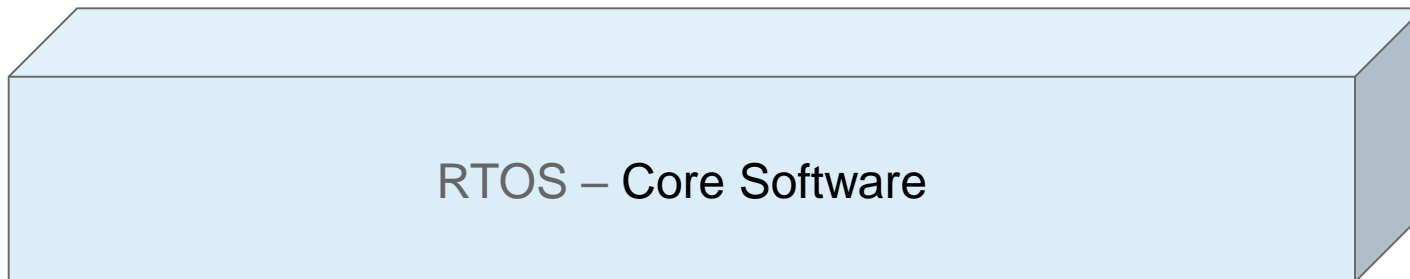
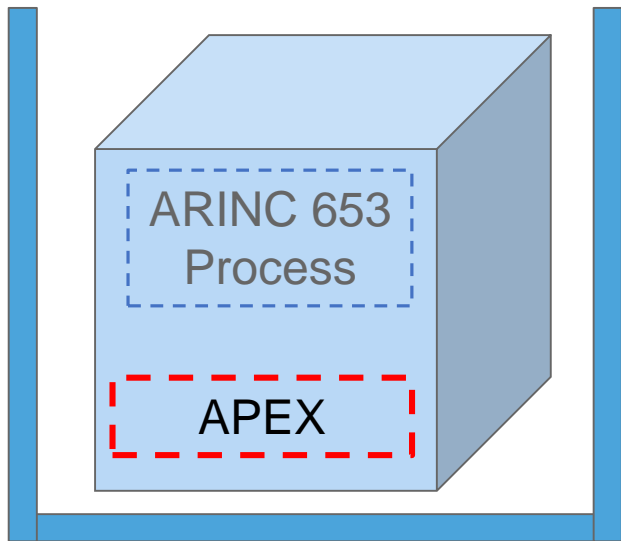
- Partition Management
- Process Management
- Time Management
- Memory Management
- Inter-Partition Communication
- Intra-Partition Communications
- Health Monitor

ARINC 653 Concepts - APEX

ARINC 653 Applications are **segregated** or **Partitioned** from the RTOS or Core Software by use of an **AP**plication **Ex**ecutive known as **APEX**.

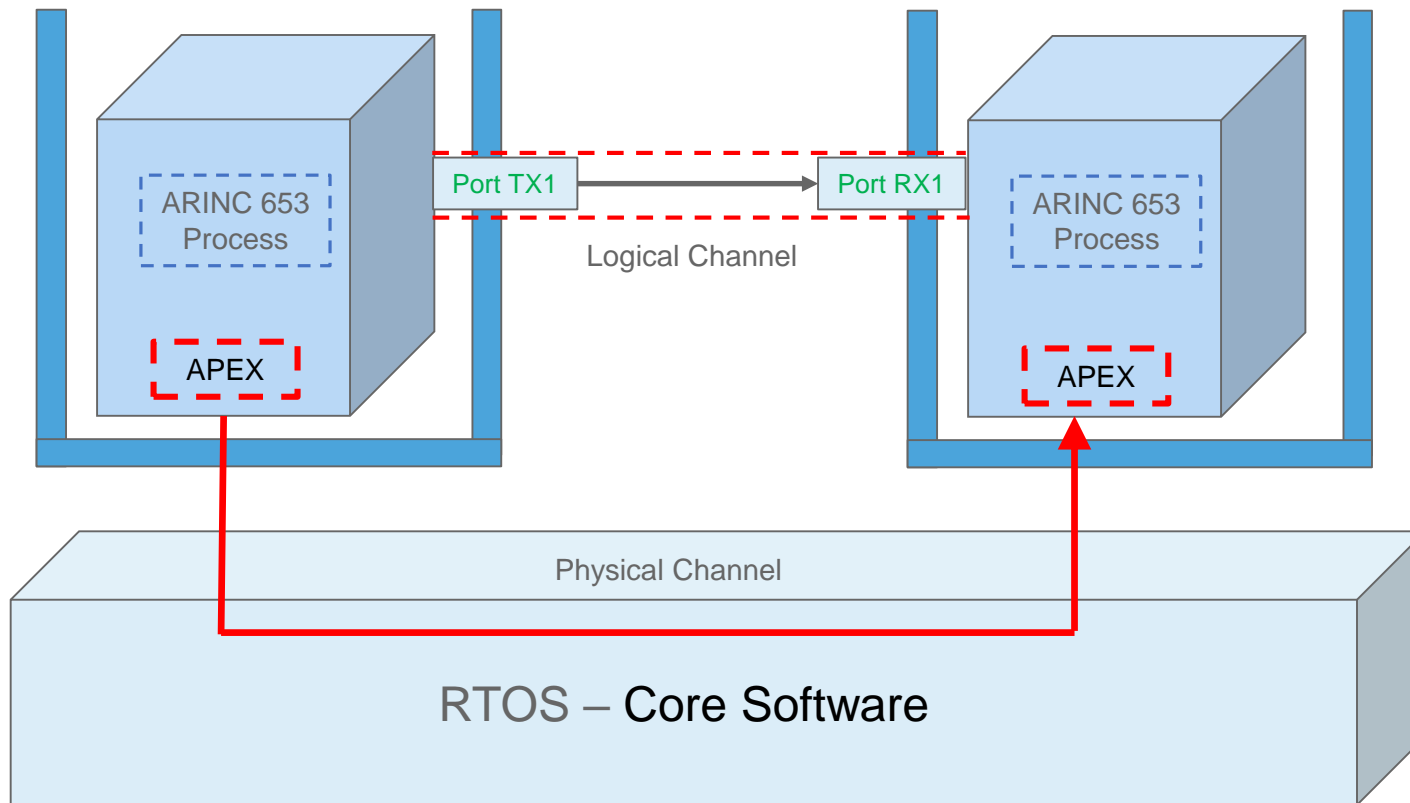
APEX defines the API of the ARINC 653 application, ensuring portability between different Core Software where the APEX API hides the RTOS implementation.

The ARINC 653 Application is held within a Robust Partitioned environment, provided by the Core Software.



ARINC 653 Concepts – Communications (Inter*)

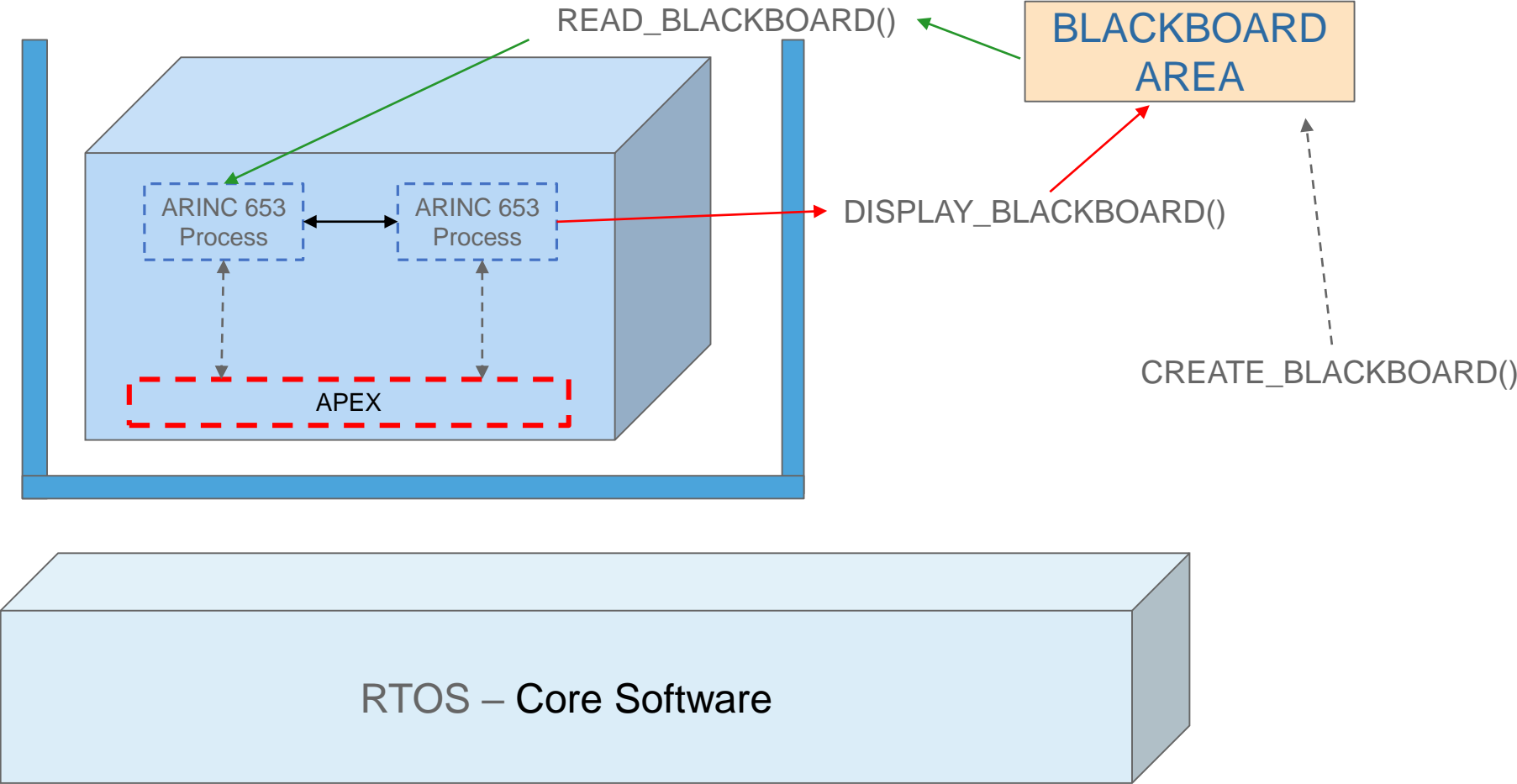
ARINC 653 Communications uses Message Queues or Sampling Ports with the concept of point to point uni-directional channels. Channels, Queues and Ports are defined at design time.



Channels are Uni-Directional Messages must Arrive in the order that they are sent.

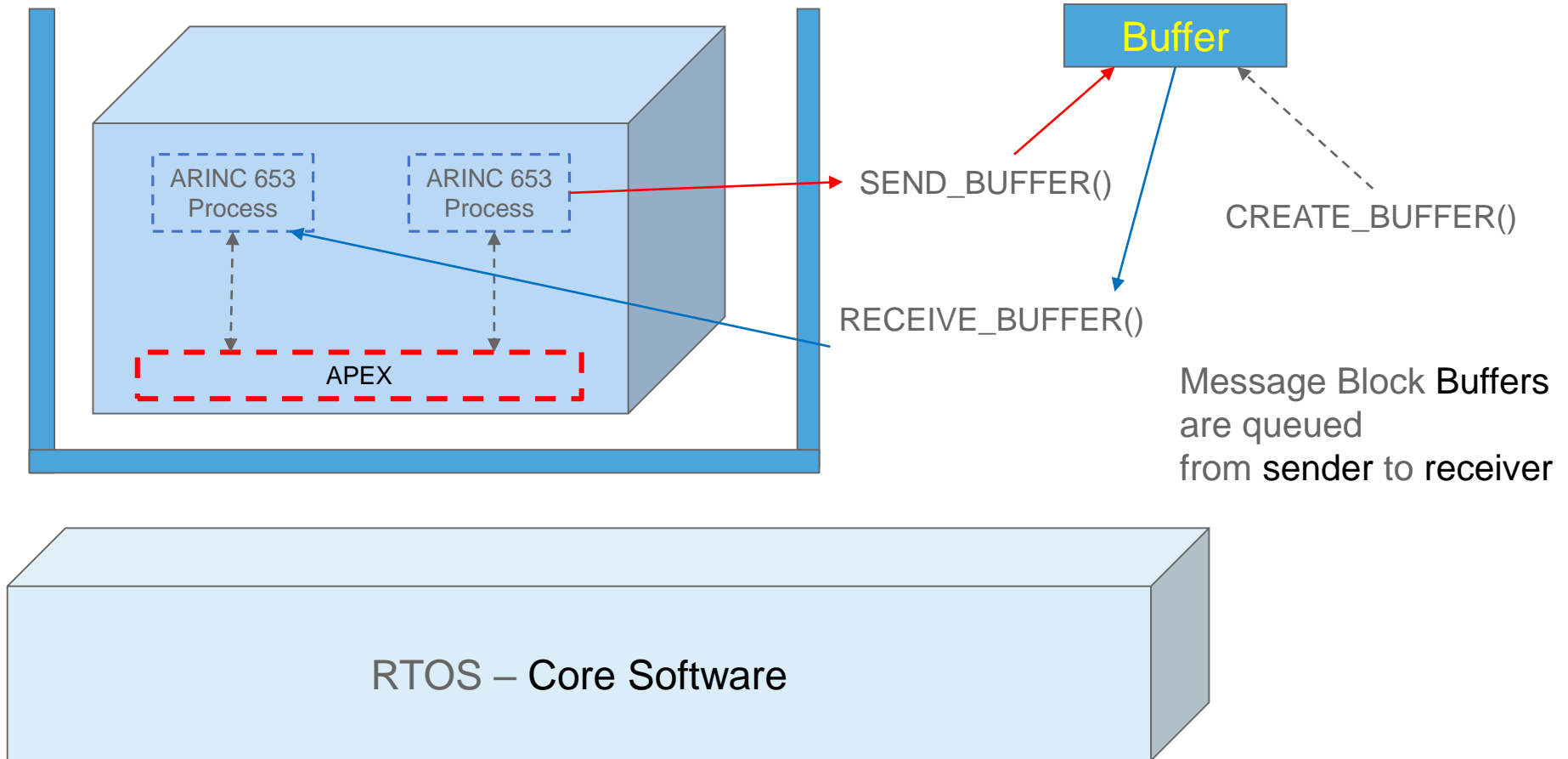
ARINC 653 – Communications (Intra*) Blackboard

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.



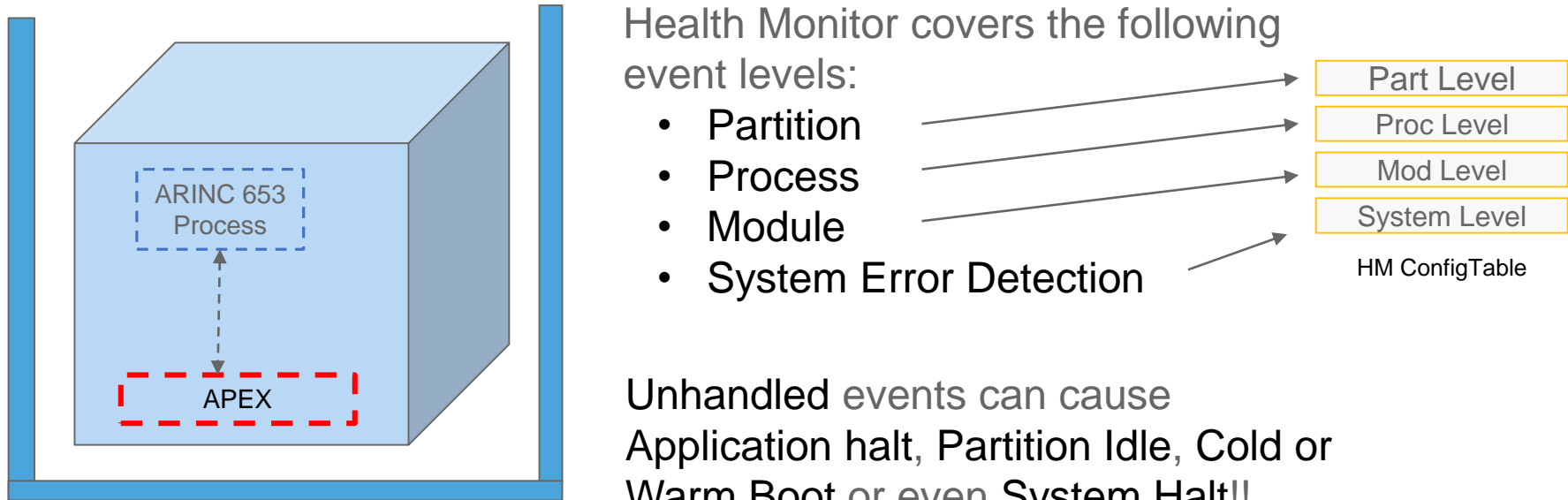
ARINC 653 – Communications (Intra*) Buffers

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.



ARINC 653 Concepts – Health Monitor

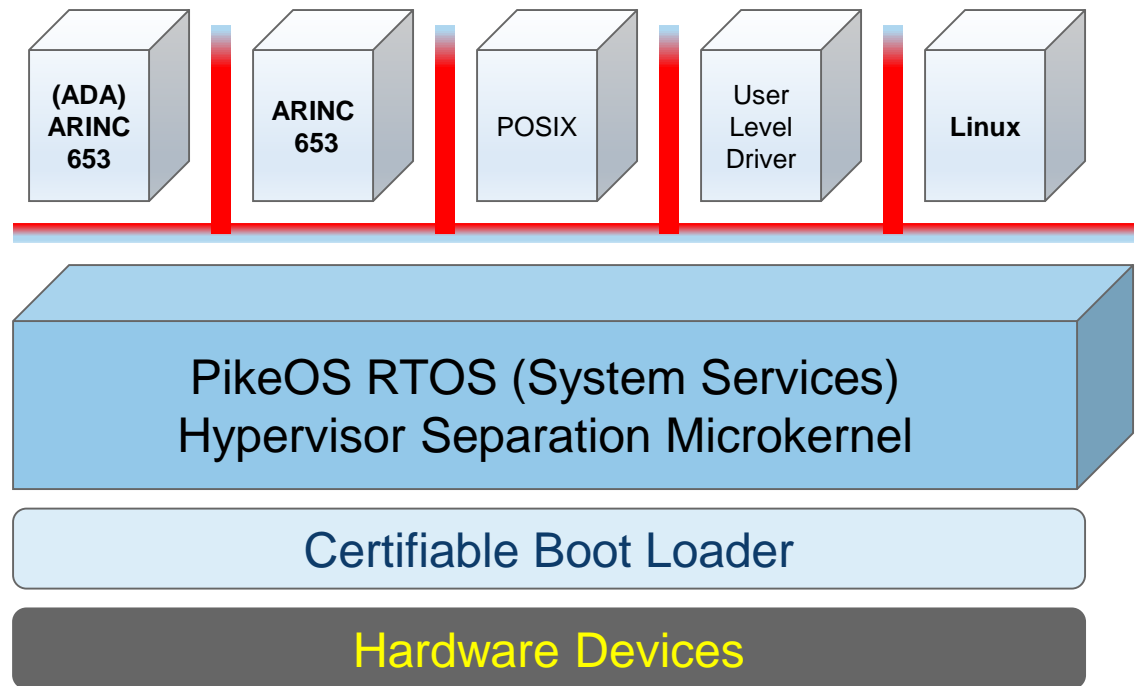
The ARINC 653 Health Monitor defines a number of error levels, supported by HM configuration Tables and Error Handlers set by Applications.



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.

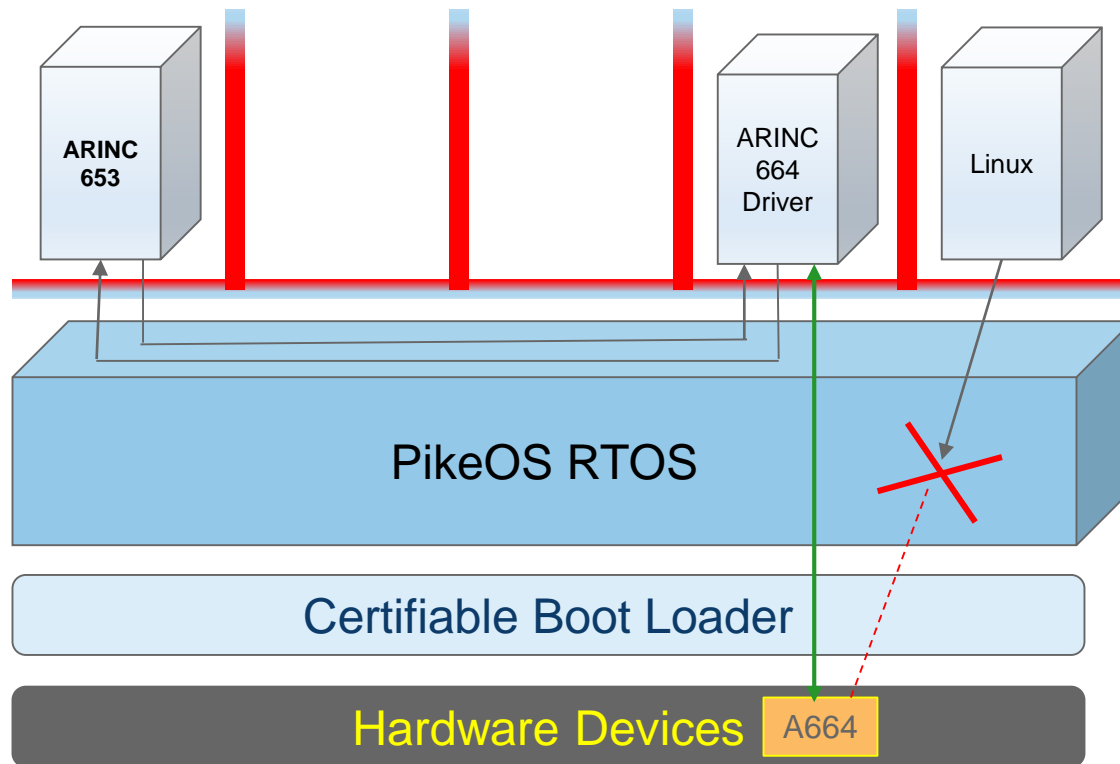
ARINC 653 RTOS Consideration– PikeOS

- 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

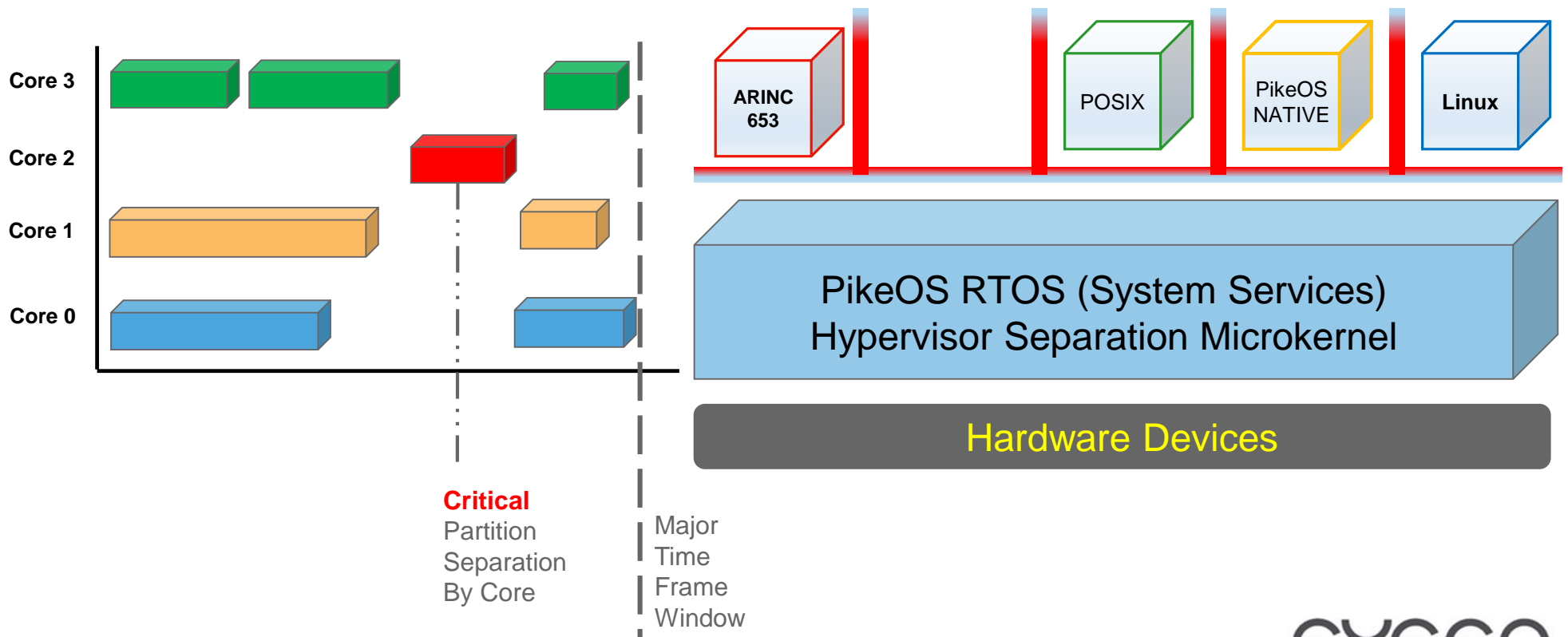
PikeOS provides a Safe and Secure ARINC 653 Platform

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>

