

# An Introduction to BlackBerry QNX

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# BlackBerry QNX at-a-Glance

Headquarters: Ottawa, Canada

Global presence: North America, Europe, Asia

**Markets** Aerospace & Defence, Automotive, Commercial Vehicles, Heavy Machinery, Industrial Controls, Medical Devices, Rail, Robotics & Automation

**Offerings** **Foundational products:** QNX Neutrino RTOS, QNX Momentics Tool, QNX Software Development Platform (SDP), QNX Hypervisor

**Safety-Certified products:** QNX OS for Safety, QNX Hypervisor for Safety

**Security Solutions:** BlackBerry Jarvis, BlackBerry QNX OTA

**Middleware:** QNX technology for ADAS, Multimedia, Acoustics Management Platform (AMP)

## Professional Services and Training

<https://blackberry.qnx.com/en/professional-services/services-overview>

<https://blackberry.qnx.com/en/professional-services/training-and-education>



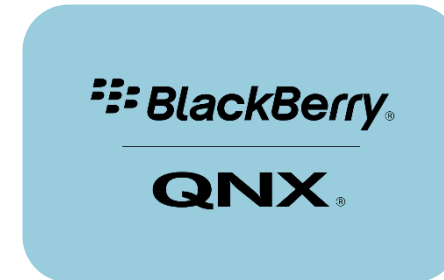
# QNX is in the Class of *Unix-like* Operating Systems

## Different OS architecture compared to Linux, but based on open standards

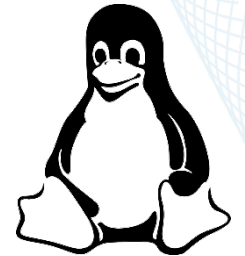
- Full POSIX API implemented from the ground up (PSE54)
- From a developer perspective, it is a lot like Linux/Unix
- Drivers and OS services architected as Resource Managers, creating a distinct client/server relationship

## Mastering Complexity

- No need to touch the OS kernel to change/enhance OS functionality
- No kernel debugger needed – work with standard application APIs and tools
- Access hardware registers without having to link code into the kernel

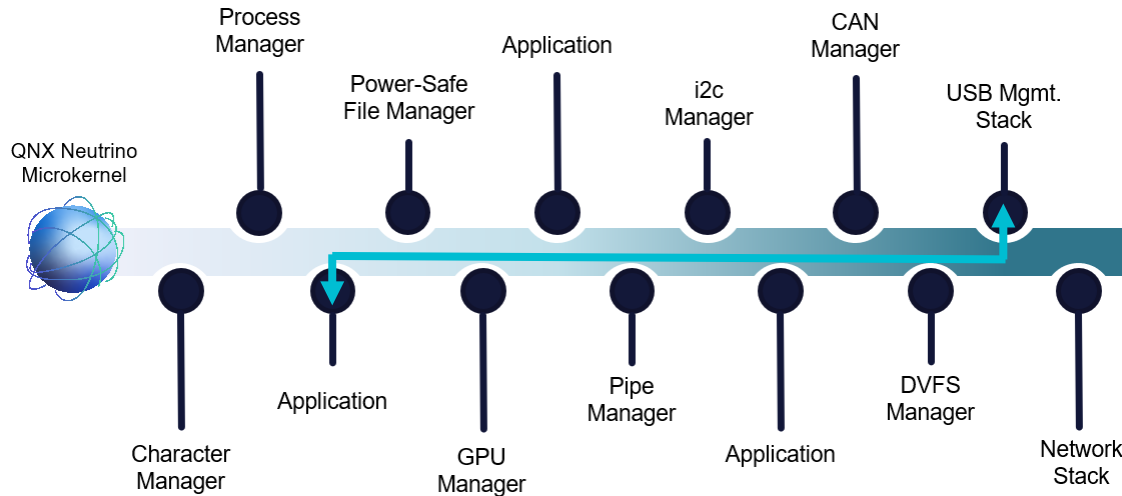


VS

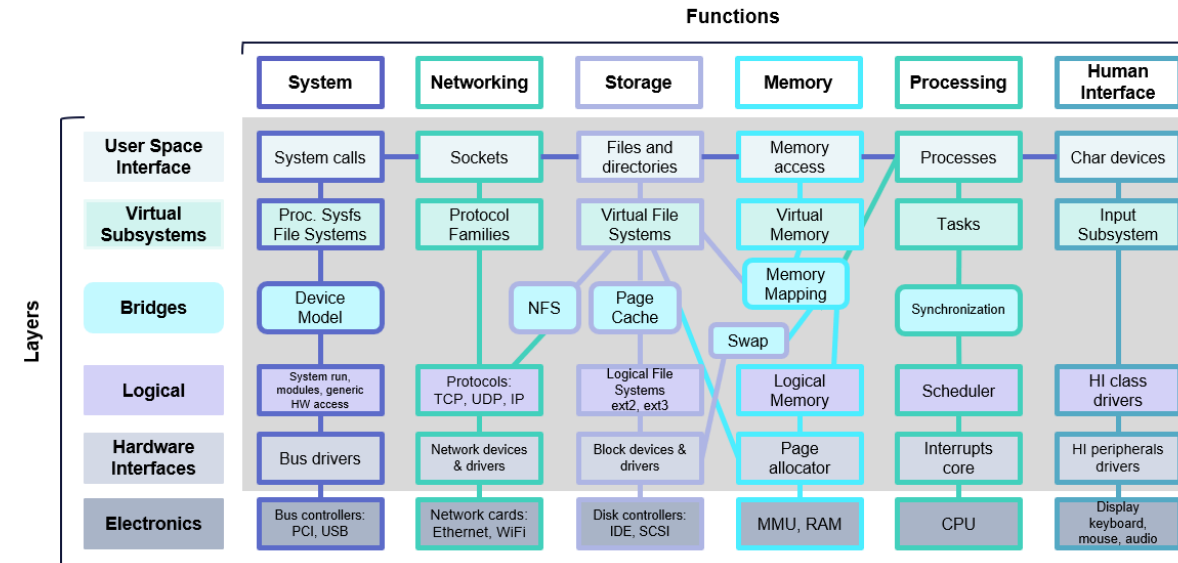


***More focus on application development – you do not become your own OS vendor***

# QNX vs. Linux: Similar, yet very different



Linux Kernel Diagram



- QNX is Unix-like, but not built on top of Linux. Its architecture is fundamentally different: it's a Microkernel
- With the QNX Microkernel, every software component is isolated as a process : Drivers, Stacks, OS Services, Applications
- All processes can use the same APIs: POSIX PSE54 and C11, C++11/14/17 – greatly simplifies Embedded development

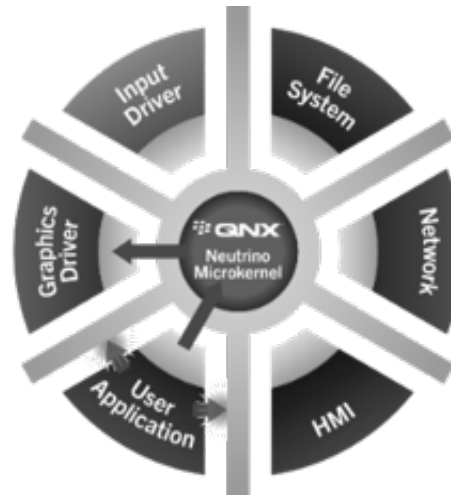
Best of both worlds – Leverage advantages of open standards API, open source porting, in combination with proprietary protection mechanism for superior safety and security

# Spatial Separation Memory Protection

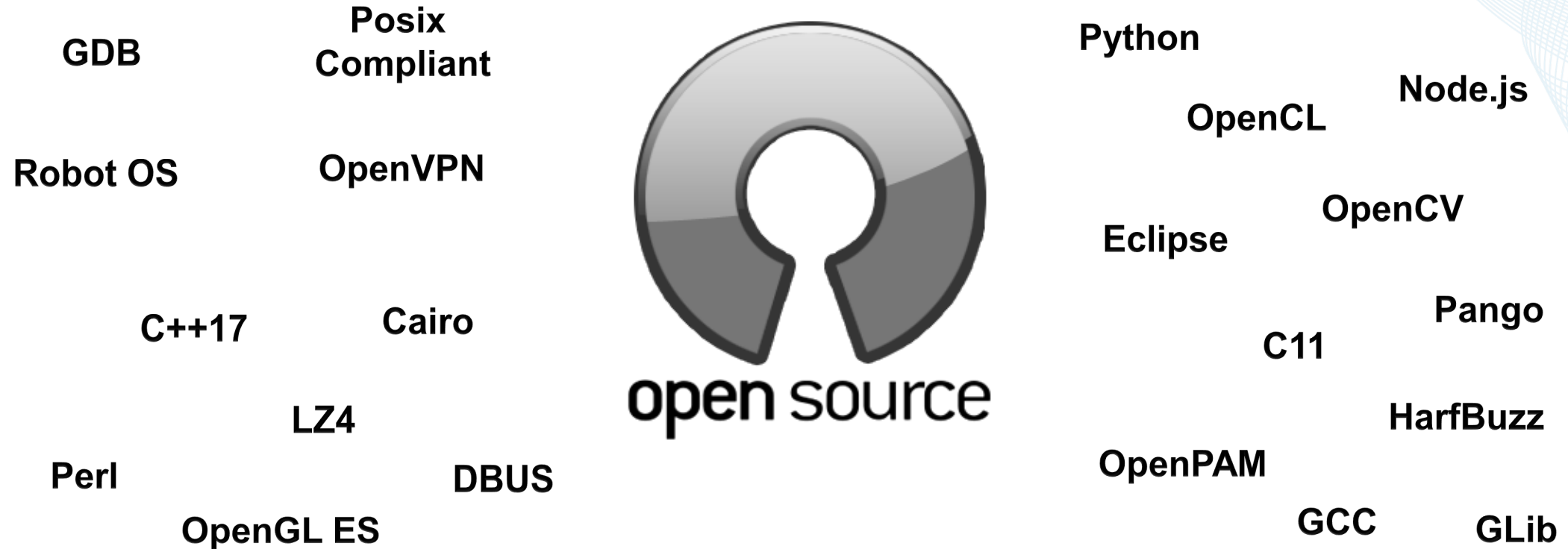
- **QNX OS provides spatial separation for all processes through the use of the MMU**
- No software component incl. OS services, drivers etc. can access or even overwrite another component or the kernel
- Each process has its own private address space
- Exploiting the MMU, QNX implements guard pages at the end of each thread's stack to protect against stack overflow
- Provides limitation of system resources to prevent rogue process from robbing critical processes of resources, such as:  
Memory usage, file descriptors, number of threads, stack size, number of child processes, ...

# Temporal Separation Preemptive Realtime Scheduling

- **Through preemptive realtime priority scheduling, the QNX OS provides temporal separation.**
- Additionally, multiple scheduling algorithms help managing ready queues.
- This enables clean isolation from a scheduling perspective between components with different criticalities.



# QNX compared to Linux - Different, yet very similar



Porting open source to QNX is very easy.  
In most cases, it's simply a download and compile exercise.

# QNX Momentics Tool Suite

Pre-integrated development environment based on open standards

# QNX Software Development Platform at a glance

## Comprehensive development suite

- Develop, debug, analyze and optimize from a common tool set.
- Choose Eclipse IDE or command line tools
- Common-industry-standard interface
- Open extensible platform for seamless tool integration from third-parties



## Familiar development environment

- Develop using C/C++, HTML5, Qt, Python, etc.
- Ramp up quickly. QNX Neutrino looks and feels like Unix
- Port code over easily. QNX Neutrino is certified POSIX compliant



## Intuitive & secure software updates

- Software Delivery Integrity
- Proactive Security Update Process
- Centralized discovery, delivery and dependency management

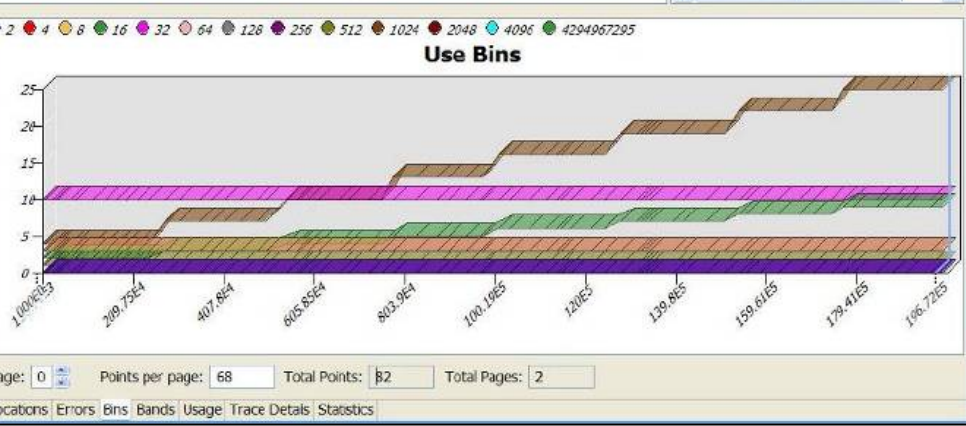
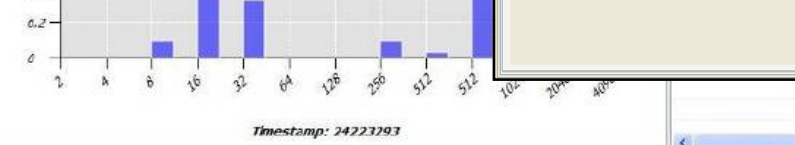
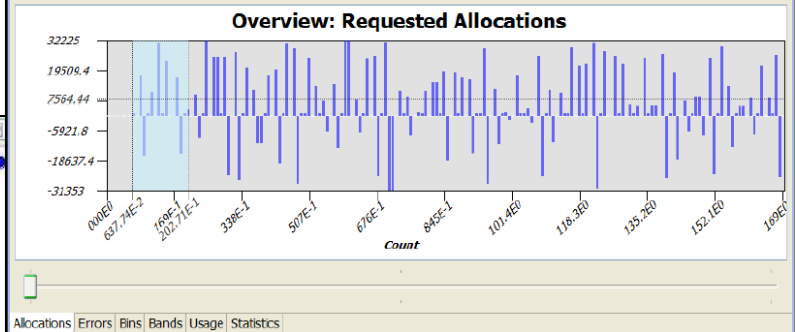
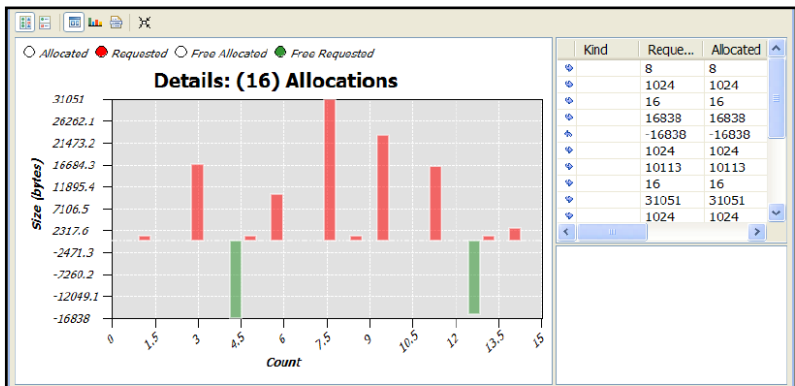




# QNX Momentics IDE - Accelerate Development Cycles

Edit and Build Code	<ul style="list-style-type: none"><li>• Syntax Highlight, Code Formatter, Cross References</li></ul>
Debug Remotely	<ul style="list-style-type: none"><li>• Remote Launch, Attach, Postmortem Debugging</li></ul>
Unit Test	<ul style="list-style-type: none"><li>• Unit Testing, Code Coverage</li></ul>
Detect Runtime Errors	<ul style="list-style-type: none"><li>• Valgrind, Memory Analysis, Address Sanitizer</li></ul>
Profile Memory	<ul style="list-style-type: none"><li>• Memory Leaks, Heap Usage</li></ul>
Profile CPU Usage	<ul style="list-style-type: none"><li>• Sampling, Function Instrumentation, System Profiler</li></ul>
Monitor Targets	<ul style="list-style-type: none"><li>• System Information, Remote Terminal &amp; File System Navigator</li></ul>
Build Target Images	<ul style="list-style-type: none"><li>• Visual System Builder Editor</li></ul>



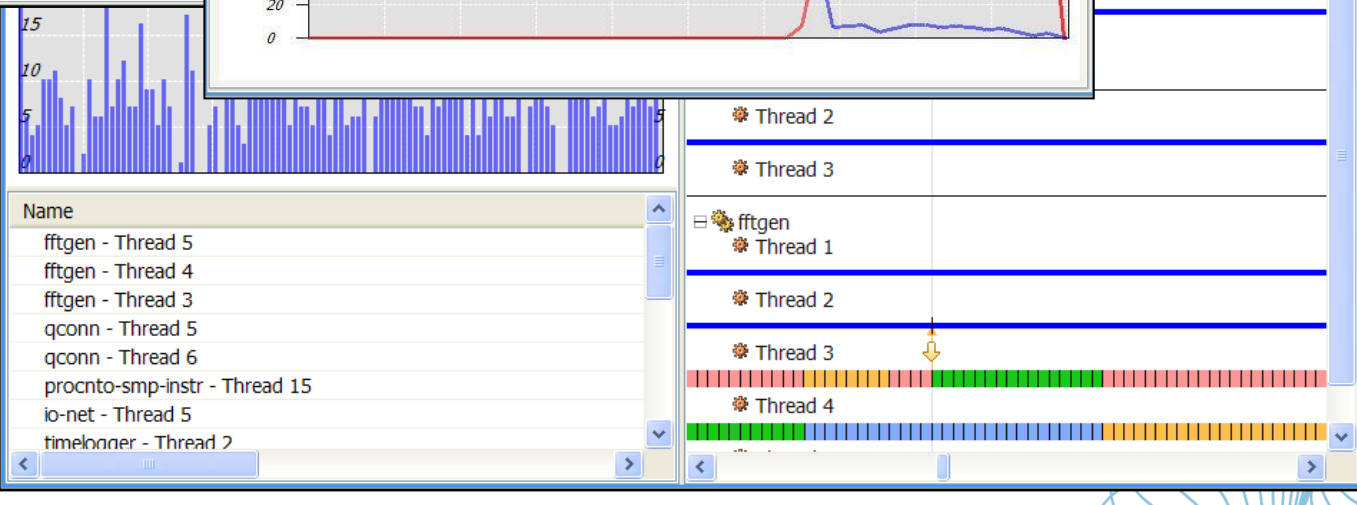
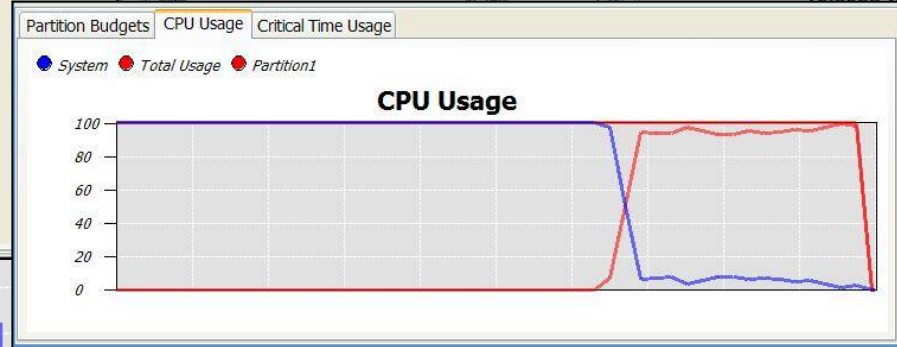
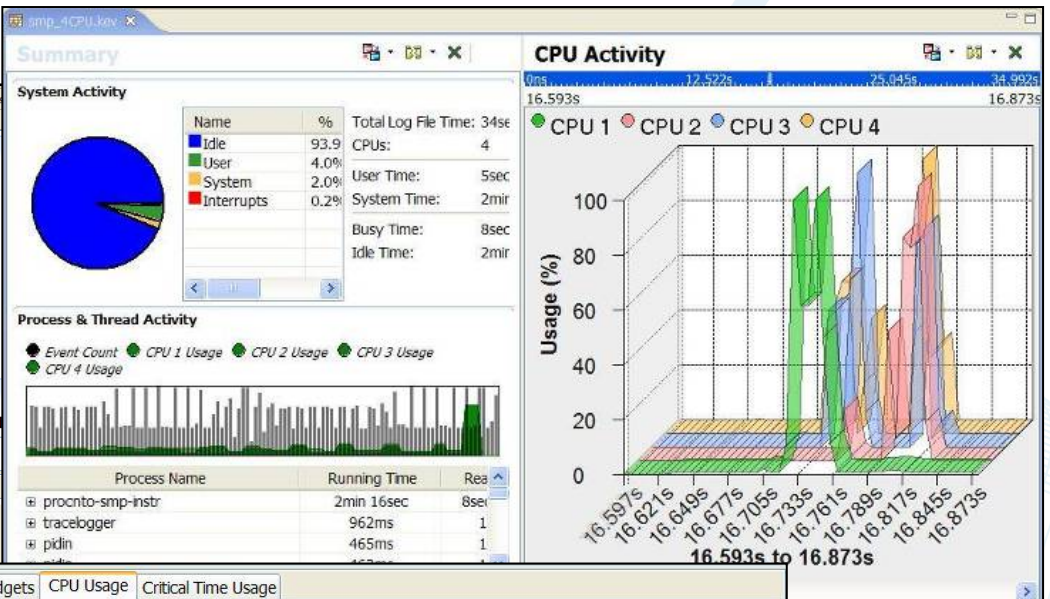
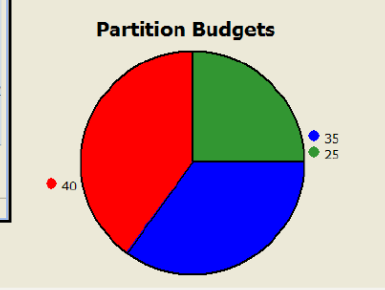


System Stats:

- % idle over 1.0s: 99.53%
- Idle time over 1.0s: 995.33ms
- % idle over 10.0s: 95.50%
- Idle time over 10.0s: 9.55s

Partition Child Processes and Threads

Budget %	Critical Bud...	System	Network
25.00%	100%		



# FYI - For deeper dive on System Analysis check out:

On the Web, simply search for: **QNX Resource Center**

Under our Resources link:

<https://blackberry.qnx.com/en/resource-center/resources>

Register for and have a look at:

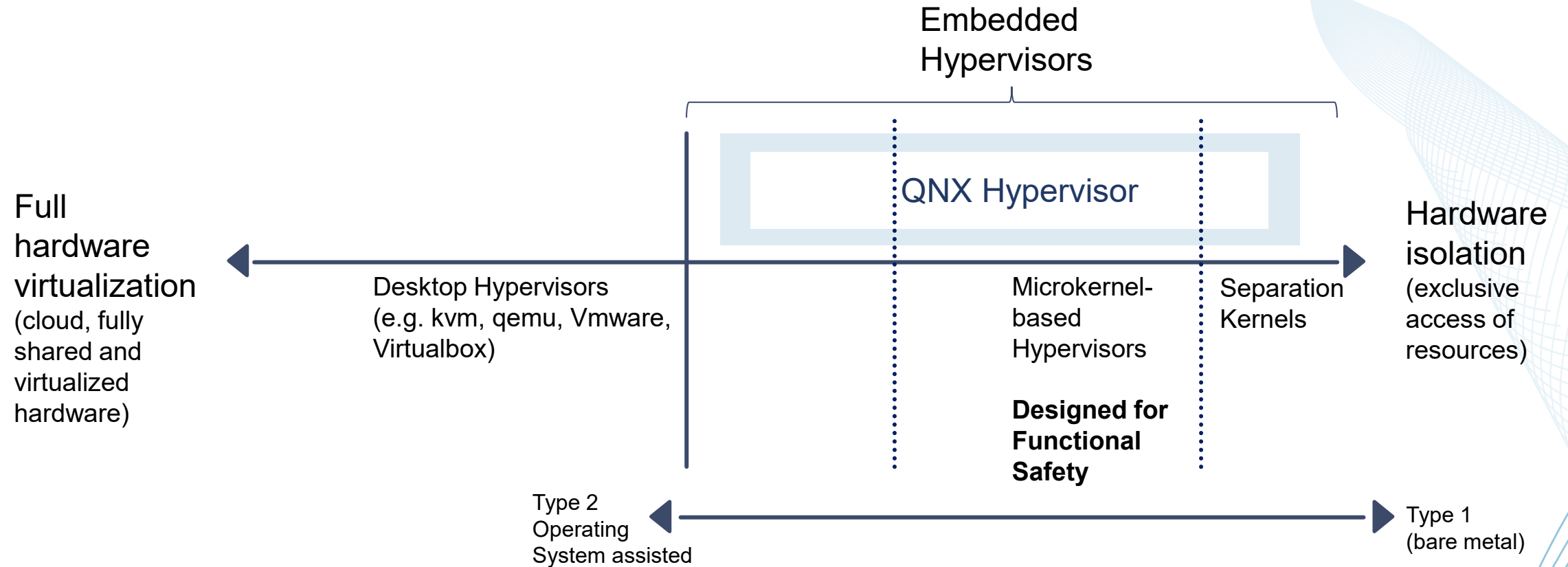
Using Kernel Event Tracing to Uncover Performance Issues

<https://blackberry.qnx.com/en/forms/using-kernel-event-tracing-to-uncover-performance-issues>

# QNX Hypervisor

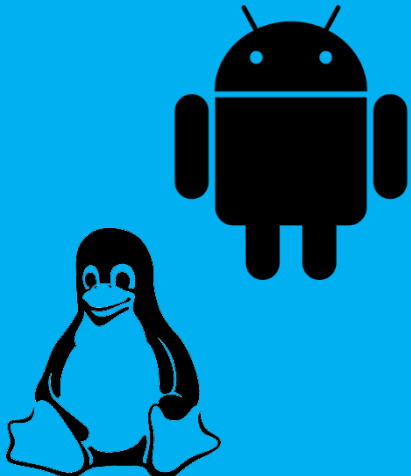

Powerful and flexible – to meet your needs

# QNX Hypervisor Positioning



QNX Hypervisor scales from Type 1 to Type 2 (its foundation is Type 1)  
QNX Hypervisor can act as separation kernel and also reach up to desktop level features

# QNX Virtual Machine Environment

Guest OS	Virtual machine
 	<b>Emulated Devices</b> <ul style="list-style-type: none"><li>• Memory controller</li><li>• Interrupt controller: GICv2/V3, posted interrupts (x86)</li><li>• Timers</li><li>• Watchdogs (IB700, SP805)</li></ul>
	<b>VirtIO Device Support</b> <ul style="list-style-type: none"><li>• Block / Net / Console / Shared memory</li></ul>
	PCI device discovery
	8250 serial Entropy (random numbers)
	<b>X86 specific</b> <ul style="list-style-type: none"><li>• High precision timers</li><li>• Realtime Clock</li><li>• Keyboard</li></ul>
	<b>ARM specific</b> <ul style="list-style-type: none"><li>• PL011 serial</li></ul>
	Advanced Virtualization Frameworks for sharing Graphics, Audio, USB ...

A separate QNX virtual machine manager (qvm) is launched for each guest.

Each instance of qvm:

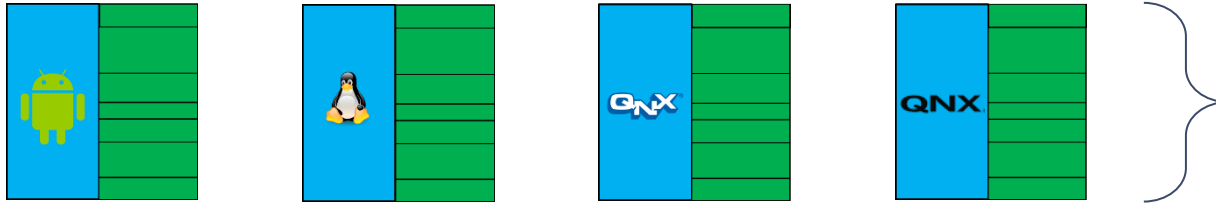
- Has one or more virtual CPUs
- Supports VirtIO and Pass-Through devices
- Implements a discrete security policy
- May have multiple shared memory and peer network connections to other virtual machines

Guest support includes:

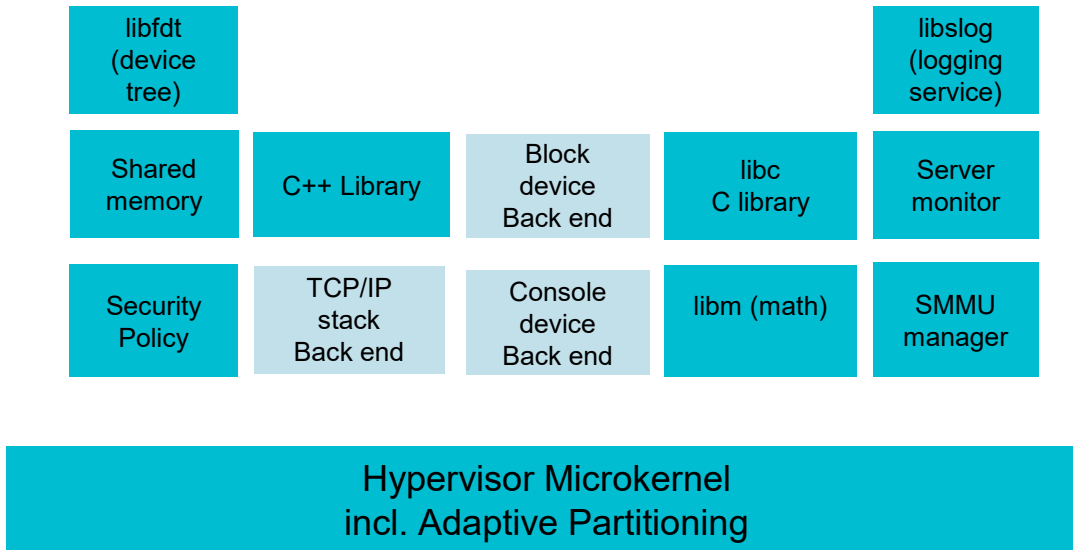
- unmodified Android guests
- Linux guests
- QNX guests
- other specialized 64-bit and 32-bit guest software

 Safety-certified version available

# Hypervisor Host Environment



Guest Domain – Virtual Machines, for example Android, Linux, QNX 6.x, QNX 7.x, ...



Host Domain – environment includes:

- The QNX Hypervisor Microkernel
- POSIX runtime environment
- C/C++ and math library
- Back-end drivers and stacks (from QNX BSP)
- Support for IOMMU/SMMU
- VirtIO and non-VirtIO devices
- Timeout detection and recovery

Type 1 or Type 2 – it's yours to choose

Safety-certified version available 

# FYI - For more information on the Hypervisor

On the Web, simply search for: **QNX Resource Center**

Under our Resources link:

<https://blackberry.qnx.com/en/resource-center/resources>

Register for and have a look at:

5 Ways Virtualization Keeps Your Embedded Tech Competitive

<https://blackberry.qnx.com/en/forms/5-ways-virtualization-keeps-your-embedded-tech-competitive>

Tuning Your Hypervisor for Better Performance

<https://blackberry.qnx.com/en/forms/hypervisor-performance>



# QNX Safety and Security

# QNX Safety Measures

## Spatial Passing Separation

- The QNX OS for Safety microkernel architecture separates critical OS components into their own protected memory partitions, unlike a monolithic OS that places them all together. Reduces attack surface.



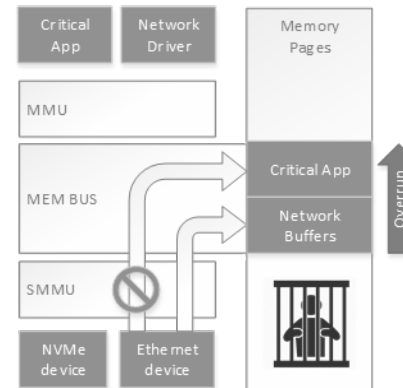
## Temporal Separation

- The QNX OS for Safety Adaptive Partitioning Scheduler (APS) supports CPU time partitions to limit CPU usage from misbehaved or rogue applications and/or services to starve safety critical applications.



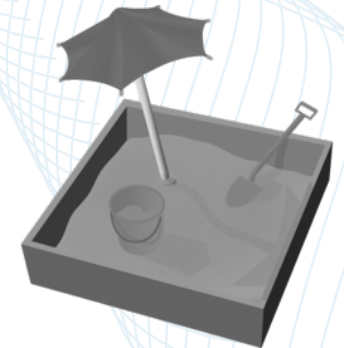
## Bus Master Caging

- QNX OS for Safety integrates SMMU support and allow bounding of memory accesses by bus-mastering device, preventing unintentional or malicious access to safety critical memory.



## Virtualization

- QNX Hypervisor for Safety allows OSES to run inside a VM container. Provides freedom from interference between guests and host, the ability to virtualize safety critical devices and implement a Local Design Safe State (DSS).



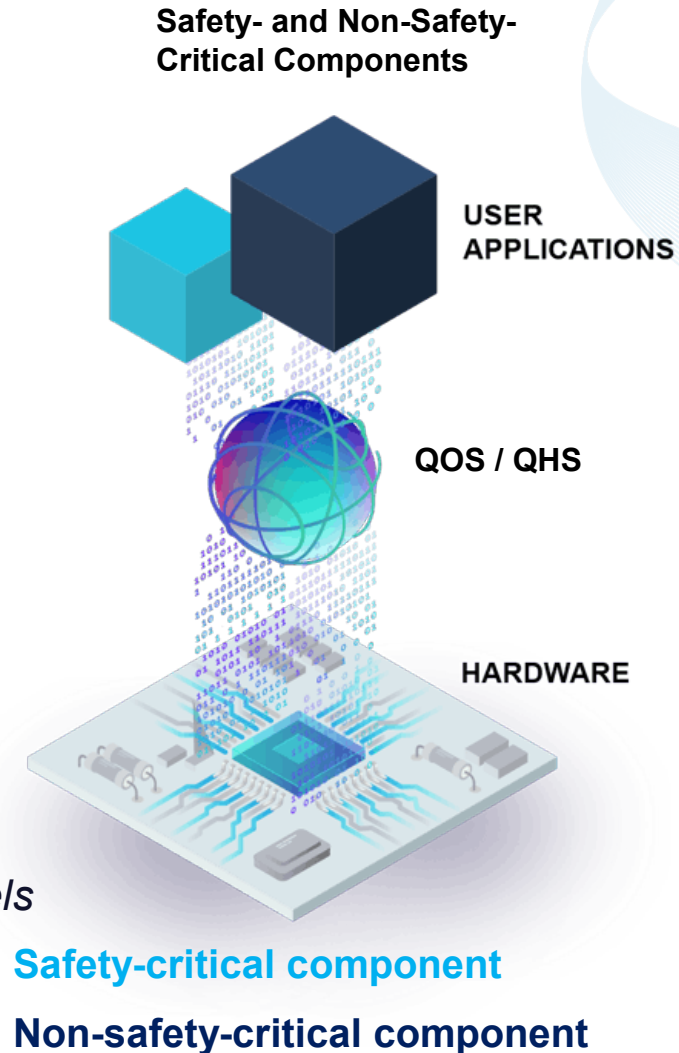
# Designed for FuSa and Consolidation

When adjacent functions and OSES are consolidated into a single controller, these become requirements:

- Separation, Isolation, Security, Resource Budgeting, Resilience, Real-time  
→ QNX core OS
- Virtualization, diversity in OSES, updates, support mixed software supply chain or legacy software, additional isolation  
→ QNX Hypervisor
- Most importantly mixed criticality and Functional Safety  
→ QNX OS for Safety (QOS)  
→ QNX Hypervisor for Safety (QHS)

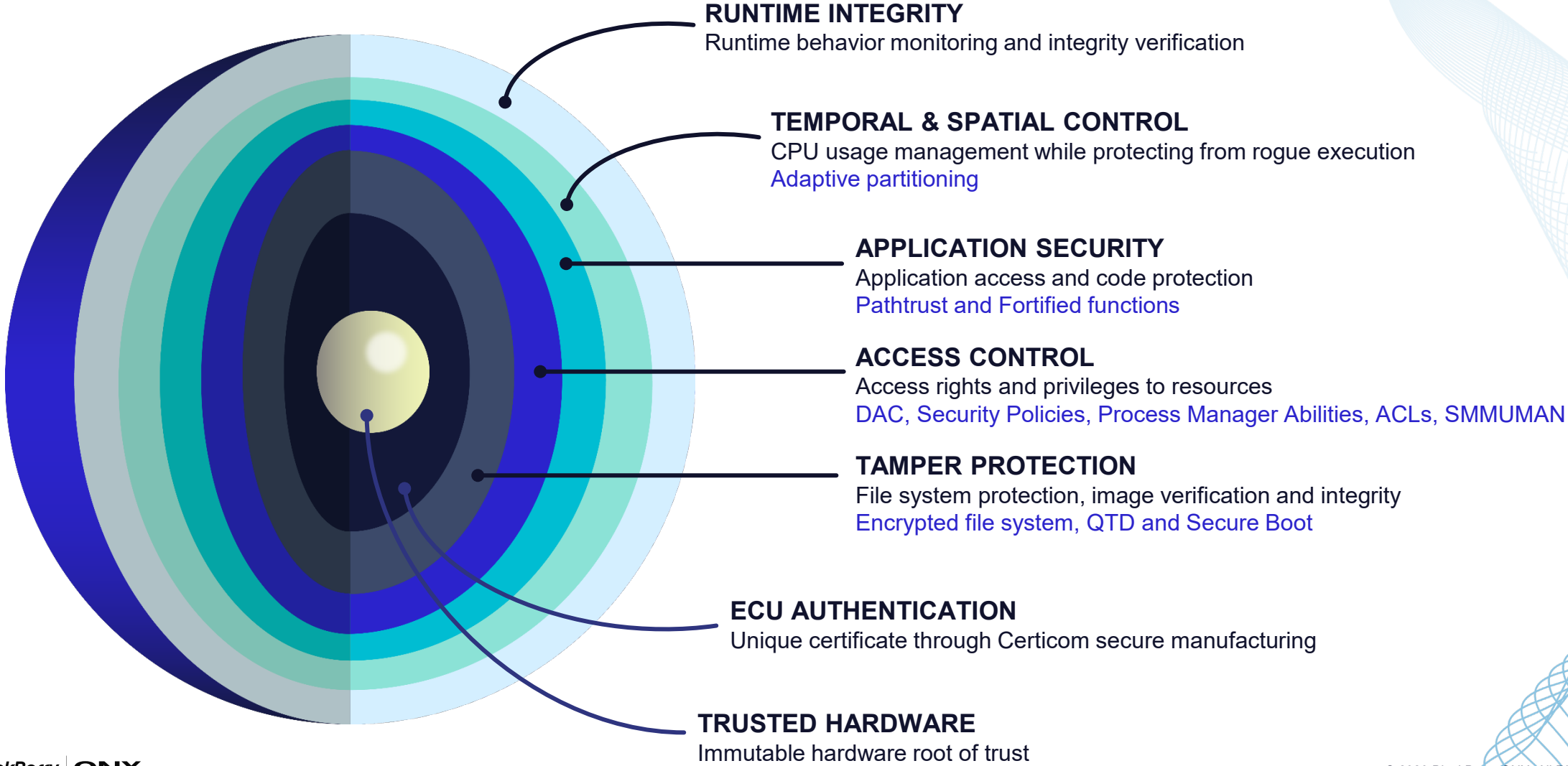
*Our certified products are certified to the highest Safety Integrity Levels*

*IEC61508 SIL 3, ISO26262 ASIL D, IEC62304 Class C*



Separation of Mixed Criticality Components Can Facilitate Certification Efforts

# QNX Operating System Runtime Security Defenses



# FYI – More resources on Safety and Security

Again, check out the **QNX Resource Center**

No matter what market you are in:

<https://blackberry.qnx.com/en/embedded-system-security/ultimate-guide/>

<https://blackberry.qnx.com/en/safety-certification/functional-safety/>

Under: <https://blackberry.qnx.com/en/resource-center/resources>

*By the way!*

Did you know that a lot of QNX SDP 7 documentation is readily viewable on-line?

<http://www.qnx.com/developers/docs/>

Check out the actual product Security Guide!

<http://www.qnx.com/developers/docs/7.1/#com.qnx.doc.security.system/topic/manual/about.html>

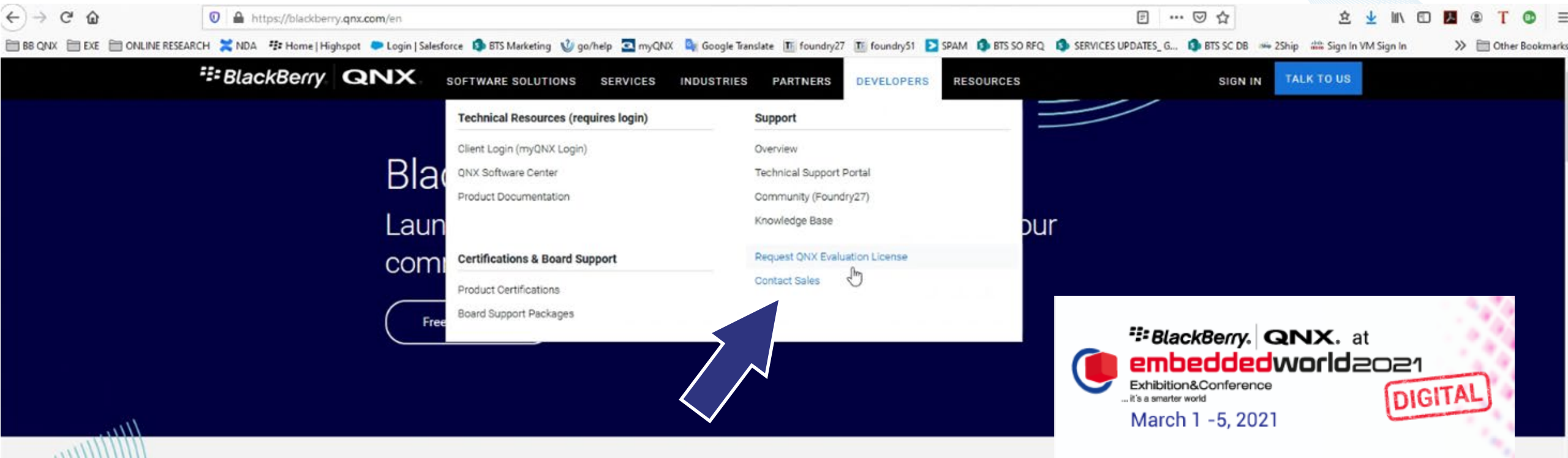
# How to get in touch with us?

The screenshot shows a web browser with the URL <https://www.toradex.com/operating-systems/qnx>. The page features the Toradex logo and navigation links for Products, Developers, About Us, and Shop. The main content area is a dark blue banner with the BlackBerry QNX logo and the text: "A Safety-Certified and Secure Operating System". Below this, it states: "QNX is an operating system well suited for applications requiring functional safety, high security, and hard real-time. QNX combined with Toradex hardware, is a winning solution for mission-critical applications in medical devices, robotics, transportation, and industrial automation." The banner includes three images: a medical monitor, a robotic arm, and a tractor. At the bottom of the banner, there is a navigation bar with links for SOFTWARE SOLUTIONS, SERVICES, INDUSTRIES, PARTNERS, DEVELOPERS, and RESOURCES, along with SIGN IN and TALK TO US buttons.

<https://www.toradex.com/operating-systems/qnx>  
<https://blackberry.qnx.com/>

The screenshot shows a web browser with the URL <https://blackberry.qnx.com/en>. The page features the BlackBerry QNX logo and navigation links for SOFTWARE SOLUTIONS, SERVICES, INDUSTRIES, PARTNERS, DEVELOPERS, and RESOURCES, along with SIGN IN and TALK TO US buttons. The main content area is a dark blue banner with the text: "BlackBerry QNX Launch your critical embedded systems faster with our commercial RTOS, development tools and services". Below this, there is a button for "Free 30-Day Trial". A large blue arrow points towards the "Free 30-Day Trial" button.









# How to get an Evaluation license



The screenshot shows the BlackBerry QNX website with a navigation menu. The 'DEVELOPERS' menu is open, and a blue arrow points to the 'Request QNX Evaluation License' link. The website header includes the BlackBerry QNX logo and navigation links: SOFTWARE SOLUTIONS, SERVICES, INDUSTRIES, PARTNERS, DEVELOPERS, RESOURCES, SIGN IN, and TALK TO US. The 'DEVELOPERS' menu is divided into 'Technical Resources (requires login)' and 'Support'. The 'Support' menu includes: Overview, Technical Support Portal, Community (Foundry27), Knowledge Base, Request QNX Evaluation License, and Contact Sales. The 'Request QNX Evaluation License' link is highlighted in blue. The 'Technical Resources' menu includes: Client Login (myQNX Login), QNX Software Center, Product Documentation, Certifications & Board Support, Product Certifications, and Board Support Packages. The 'Certifications & Board Support' menu includes: Product Certifications and Board Support Packages. The 'Request QNX Evaluation License' link is highlighted in blue. The 'Contact Sales' link is also visible. The website background features a dark blue banner with the text 'BlackBerry QNX. at embeddedworld2021' and 'Exhibition & Conference ... it's a smarter world March 1 -5, 2021'. A red stamp with the word 'DIGITAL' is visible on the right side of the banner.

Trusted in Embedded Systems Everywhere

# BlackBerry QNX Product Portfolio - Investment and Innovation

<b>Platform Enablement</b>	Medical Devices	Industrial Controls	Robotics & Automation	Aerospace & Defense	Heavy Machinery	Rail	Over-The-Air Software Update	Secure Gateway	Provisioning and Key Management
<b>Middleware</b>	QNX Screen Graphics	Multimedia Frameworks	SOME/IP ROS2.x	Wireless Connectivity Solutions	Embedded Browser	SDK for Crypto and Security	Sensor Framework	Secure Encrypted Filesystem	... from QNX Ecosystem
<b>Certified Foundations</b>	Certified OS for Safety	Certified OS for Industrial	Certified OS for Medical	Certified Hypervisor	Certified Black Channel Comms	Certified C++ and Math System Libraries	Certified OS for Rail*	Certified Filesystem*	Certified Graphics Monitor
<b>Virtualization</b>	Hypervisor	Advanced Virtualization Frameworks							
<b>Operating System and Tools</b>	QNX Operating System	QNX Momentics IDE & Tools	WITTENSTEIN SAFERTOS Integration	AUTOSAR Adaptive Stack	BlackBerry Jarvis Binary Scanning Tool				
<b>Professional Services</b>	Porting Assessment	Architecture Assessment	Functional Safety Training	Functional Safety Consulting	Open Source Software Assessment	Software Security Assessment	Penetration Testing	OS, Tools, BSP dev. Training and more...	Custom Services Plans



# TOTAL COST MANAGEMENT FOR CUSTOMERS PRODUCT LIFECYCLE

- It is fully understood that selecting an operating system is a very complicated process
- To properly assess the overall cost of a technology, many factors must be assessed, including:
  - Initial investment, ongoing service and support, target system royalties
- The fundamental QNX business model is based upon three factors:
  - Upfront purchase of development tools, support and training
  - Ongoing, annual support plans – access to bug fixes, patches, latest software releases
  - A cost effective, per kernel royalty
- The royalty model means that QNX Software Systems has to establish a true partnership with its customers

**If our customers' products are not successful, BlackBerry QNX will not be successful**

# Thank You