



EE|Times

eBOOK

Designing for the Intelligent Edge



windriver.com

Abstract

The intelligent edge presents a wide variety of new opportunities and challenges for virtually every industry. Wind River has been providing advice, tools, and consulting services to the makers of embedded systems for decades. No other organization has a comparable level of depth and breadth in embedded design as Wind River. Our professional services organization can help you define new opportunities, overcome design challenges, and quickly leverage these emerging technologies into paradigm-breaking products and solutions.

CONTENTS

Introduction	2
Wind River and Professional Services Overview	2
How the Intelligent Edge is Impacting Embedded Systems	2
How Wind River Professional Services Partners with You at the Edge	3
Our Process & Approach	3
The 7 Design Dynamics at the Intelligent Edge You Should Be Aware Of	4
Product-Focused Projects	4
Assessments	4
Operations, Execution, & Integration	4
Lifecycle Management	5
Security	5
Certification	5
Board Support Packages (BSPs)	6
Managed Services and Wind River Support Packages	6
Customer Success Stories	7
Exxon Mobil Refining and Chemicals Business	8
Hyperloop	9
Ersules	10
The Soon-to-be-Here Future of Embedded Systems at the Intelligent Edge	11
Conclusion	11
About Wind River	11

Introduction

Embedded systems are playing new roles in what the industry has dubbed “the intelligent edge”—devices built on open standards and operating far outside of traditional environments. The intelligent edge creates opportunities as well as challenges. Embedded system makers across multiple industries will have to adapt to changes in customer expectations. The Wind River Professional Services organization has the experience and breadth in embedded design to help you navigate this potentially challenging technological shift.

We have been providing advice, tools, and consulting services to makers of embedded systems for decades. We work with embedded systems engineering teams on a variety of missions, including product-focused projects, operations and execution, lifecycle management, Board Support Packages (BSPs), and more. Our Professional Services can help you define new opportunities and overcome design challenges. Working together, we can help you quickly leverage these emerging technologies into paradigm-breaking products and solutions.

Wind River and Professional Services Overview

Wind River has been a leader in the embedded systems software field for over 35 years. Our technology powers generation after generation of the safest, most secure devices, built by the largest companies around the world. When you set out to build something that must work, you turn to us.

We augment our product offerings with professional services. The Wind River Professional Services organization is comprised of a team of experts in project management and embedded software engineering in addition to naturally being experts in the use of our own product portfolio. We have a long

track record of creating custom solutions to solve our customers’ problems by integrating our products with third-party, open-source custom software, and hardware. It’s a deep collaboration, a true partnership where our role as trusted advisor has proven itself in many customer success stories over the years.

How the Intelligent Edge is Impacting Embedded Systems

The phrase “the intelligent edge” has gotten somewhat hyped, which obscures the simplicity and importance of the paradigm it represents. While it varies greatly in implementation, the intelligent edge is about pushing computing and data management to the periphery of traditional networks and architectures. The compute (intelligence) is no longer in the data center. It’s at the edge, often way outside the normal spaces where you would expect to find it.

In practical terms, moving the edge also usually means migrating away from proprietary systems. Building for the intelligent edge involves the use of standards-based, open, and interoperable technologies. It may also imply process automation.

The intelligent edge affects the core design and functioning of embedded systems. To work effectively at the intelligent edge, an embedded system must be able to connect more broadly than it did in earlier generations. It has to interact with new types of compute and networks. These include cloud service providers—with a host of enhanced security features that compensate for the increasing openness of the edge.

An estimated

**41
billion+**

connected devices will be in operation by 2025, generating 80 zettabytes of data.



1/3_{RD}

of all developers are currently building cloud-native architectures, and another 30% plan to do so within the next year.

How Wind River Professional Services Partners with You at the Edge

Our Professional Services organization works side-by-side with your team. We engage for the full lifecycle. From initial discovery through solution development and long-term support, we partner with you to craft solutions that meet the criteria of the intelligent edge.

Our Process & Approach

If there were one word that could capture the essence of our diverse, deep professional services program, it would be “balance.” Our approach is all about finding the right balance between consulting and mentoring, between the level of detail in requirements and the expected pace of execution and, of course, budget.

We focus on aligning requirements with the design process, implementation, and testing. Our teams are rated for Capability Maturity Model Integration (CMMI-DEV 3). CMII is a program for process level improvement training and appraisal. It’s administered by the CMMI Institute, a subsidiary of ISACA. The strength of our approach arises partly from the assignment of a highly experienced single point of contact for the project from start to finish.

Every professional services project starts with solutions assessment or architecture study. This is typically a small engagement. We gather functional requirements, market requirements, and specifications. From there, we devise an optimal design process and engage in project planning. The goal is to map out a path to the successful realization of a concept.

After the assessment, we proceed to a Proof of Concept (PoC). In some cases, this might be a Minimum Viable Product (MVP) or a complete architecture study. Either way, the purpose is the same. We want to collaborate on verifying the embedded system’s feasibility as well as your team’s assumptions about usability and so forth.

We tend to concentrate on specialized issues like improving and optimizing products and processes. We generally do not develop the embedded systems applications ourselves. Rather, our focus is on training and empowering your team to achieve this objective on their own as the process moves from PoC to operationalization and production. Our approach is open and we do not always recommend our own products.

We often modify the scope of the project as we move into the productization and optimization of the PoC or MVP. We oversee coding and schematics along with systems integration, including defect management. There’s a great deal of work to be done ensuring that the product is safe and secure. We work with you to debug and fix issues as well as complete security patching. In the latter workload, we often dig into our connections with first responders and the Common Vulnerabilities and Exposures (CVE) system.

Long-term support is available if necessary. Generally, our approach emphasizes preparing the client to assume complete ownership of the product lifecycle. However, there are a variety of support options available to meet a range of organizational needs.



We're not a "Body Shop"

Our professional services organization is oriented toward advisory and mentorship. We generally don't engage with your organization as a "body shop" to fulfill routine functions. Instead, our approach is to help your team members' skillsets grow so they can take on more sophisticated work. If we are no longer needed, that means we have succeeded.

The 7 Design Dynamics at the Intelligent Edge You Should Be Aware Of

Our professional service offerings vary and are seldom ever the same. However, they tend to fall into recognizable categories, like BSPs and certifications. In the case of the intelligent edge, the projects are often a blend of multiple services.

Product-Focused Projects

Many of our projects focus on a specific product, such as VxWorks®, the #1 real-time OS, according to VDC Research. A project-focused project might involve system design, including architecture, design of data flows, and system performance analytics. We get involved in memory usage analysis and driver optimizations. In some cases, our team will assess the impact of a multi-core architecture for a VxWorks use case.

Alternatively, a project may work with other open-source code components. With its community inputs and ready-to-go nature, open source software can accelerate time to market. The velocity of intelligent edge projects makes open source software a desirable system component in many cases.

Product-focused engagements may also deal with your in-house processes, versus the creation of an actual product. In the case of Wind River Simics, our Professional Services team helps establish a role for this simulation tool in your development and testing workflows. Our approach could include developing metrics and analytics for your Simics project or jointly building models to meet your roadmap needs. We often engage in "fault injection," where we transfer knowledge to your team with hands-on fault building to test in Simics. These are just a few of the many potential variants in our product-focused project portfolio.

Assessments

The questions "where do we stand?" and "what's the best path forward?" can be difficult to answer, even for highly experienced embedded systems teams. The world has changed. Building devices that work at the intelligent edge means thinking differently about most, if not all, aspects of an embedded system's design and functionality. Our assessments can help you work through new and unfamiliar parameters.

For example, we can collaborate in the investigating and architecting of solutions. We can jointly explore ways to effectively tune software performance for your unique hardware requirements. This might involve an evaluation of whether bare metal or virtual machines will provide the best solution for your security, deployment, maintenance, and performance needs. We can examine ways to increase system reliability, redundancy, maintainability, and so forth.

Operations, Execution, & Integration

We are doers. When our clients need help with project execution, we get to work. We are able to conduct architecture requirements gathering. We can design systems, and then test them. Our Professional Services team can also manage projects from start to finish.

System Integration is another capability. We have extensive experience connecting embedded systems to other platforms. Or, our work might mean coordinating with a third-party system integrator to ensure that they are meeting requirements and project-related expectations.

Lifecycle Management

Our Professional Services organization has experience supporting embedded systems as they age. Lifecycle management is a constant in the world of devices, though it’s gotten more complicated with the advent of the intelligent edge. Embedded systems are more widely integrated and they have more processing and data management functions built-in. These factors affect the product lifecycle.

One lifecycle management issue we see today has to do with the maintenance of a “frozen branch.” As new generations of devices adapt to new intelligent edge requirements, it is often still necessary to maintain earlier versions of an embedded system—a branch of the development tree that’s frozen, so to speak. In this type of engagement, we might be maintaining older VxWorks code for a particular board, fixing bugs, and installing security patches on the reference hardware. This continues until the system reaches end of life.

Security

Security measures have always been part of the embedded systems engineering process. However, in today’s market, device makers face pressure from customers, certification, and standards bodies to make their products more secure. This is due to the vast attack surface that Internet-connected embedded systems present to malicious actors. Embedded systems have become network endpoints that are vulnerable to compromise, exposing users to significant risks.

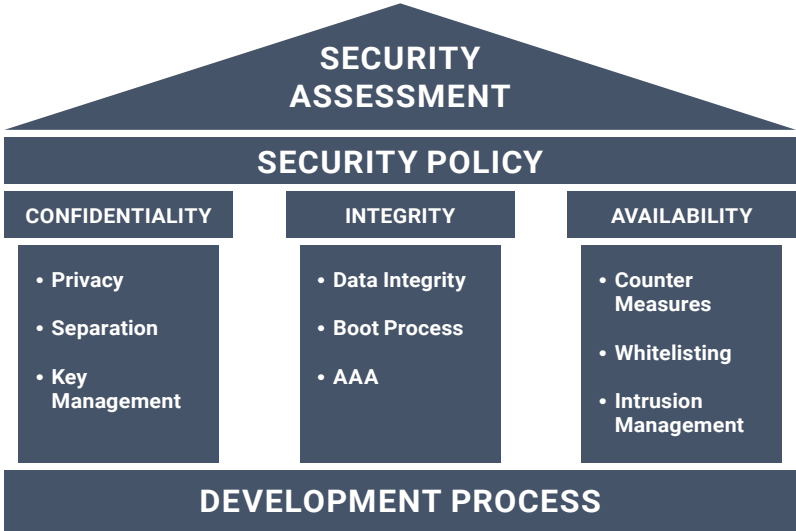
We have developed a complete methodology to help your engineering team assess and protect its digital assets. It’s based on the industry-standard “CIA Triad” of confidentiality, integrity, and availability. Taking a systematic approach, we facilitate confidentiality by advising on privacy, separation of dev, test, and production environments along with key management. Our services for integrity stress boot processes and data integrity measures. For availability, we focus on whitelisting, countermeasures, and intrusion management.

Where relevant, our security services offerings draw upon our experience with security regulations such as the Common Criteria / FIPS 140-2, SP 800-53/82/117/147, NERC CIP, ISA99, Wurldtech Achilles, and IEC 62443. We engage in continuous threat monitoring and maintain an active role in worldwide threat intelligence efforts. As we become aware of CVEs that affect our products, we continually notify users and issue updates to remediate any risk exposure.

Certification

Achieving certification for a new embedded system, or recertifying one, can present unique challenges to a product development team. Our Professional Services team is able to supplement in-house knowledge and provide the expertise required to gain certification on a timely basis.

We recently helped an EMEA-based maker of pipeline valve controllers get a product certified for the International Electrotechnical



Commission (IEC) 61508 standard. This project, one of the dozens like it, leveraged our knowledge of VxWorks along with our deep experience with the IEC’s expectations for device design and deployment. We have comparable insights into DO-178B, Def Stan 0056, and many others.

A certification project goes beyond the basics of meeting the needs of the certifying body. We almost always engage with you to make certification part of a broader assessment process. We work with your team to evaluate future plans and current pain points in your organization. We offer a qualitative assessment that shows how you can make meaningful improvements in cost, schedule, and quality—along with a suggested plan for implementation.



Board Support Packages (BSPs)

Many clients come to us needing support for circuit boards. A variety of needs arise from a new board, some requiring specialized attention. For example, our BSPs may include the development of device drivers for custom hardware. We can advise on the use of direct access ports or pseudo port drivers, depending on the client's use case.

Other issues common to BSP engagements relate to system initialization processes, kernel virtualization, memory space allocation, caching, and so forth. These are areas of embedded system development that tend to be beyond the skillsets of most development teams. We can help, providing expertise in these specialized subjects. As the board comes to life in an embedded system, we are able to follow through with testing and lifecycle support.

Managed Services and Wind River Support Packages

We often leave a client team to manage on their own after an engagement, when we are sure they are in good shape. In some cases, however, the client wants us to stay with the project. We have several ways of doing this. We offer a variety of support services and managed services. Some are short term. Others are long term or even permanent.

Managing binary releases is one example of the kind of support services we provide. In this case, we maintain custom Wind River Linux or VxWorks code for a customer and release fully tested binary images ready for deployment. We can support custom software and hardware when necessary. We can also perform bug fixes and security patch monitoring. In a fully-managed service, we take care of the client's code throughout the entire product lifecycle.

Gartner claims that

80%

of all data will be processed at the edge as soon as 2025

Customer Success Stories

Exxon Mobile, Hyperloop, and Ersules provide good examples of our Professional Services approach in action. They reveal how the client experiences the value of the engagement. In each case, we fostered a partner relationship that produced beneficial outcomes.

The WIND logo consists of the word "WIND" in a bold, white, sans-serif font, positioned to the right of a red square. The red square has a small white horizontal line segment on its left side, creating a stylized 'W' or a checkmark-like shape.



Exxon Mobil Refining and Chemicals Business

Exxon Mobil faced a disruptive challenge when it realized it had to replace three-quarters of its distributed control systems due to obsolescence. Wishing to avoid a recurrence of this type of problem, the engineering team responsible for these control systems decided to undertake a major shift in their approach to system architecture. Rather than relying on proprietary systems, they set out on a “Controls Systems Replacement Project” that would be based on open standards and interoperability.

Wind River’s Professional Services organization got involved in the project at the research stage. “They really knocked our socks off,” said Don Bartusiak, Exxon Mobil’s Chief Engineer for Process Control. “They come from adjacent industries, so they were able to think outside the box.” Working with the Exxon Mobil team, Wind River helped them develop an interoperable process automation architecture based on an RTOS. From this foundation, they were able to build fit-for-purpose, deterministic systems to solve specific manufacturing problems.



Hyperloop

Hyperloop is a next-generation mode of transportation based on the use of air pressure in tubes to move vehicles at extremely high speeds. The technology has promise, though realizing Hyperloop will mean addressing a range of embedded systems challenges. These include safety and certification issues as well as performance reliability.

Wind River was brought into the Hyperloop project based on its experience with real-time embedded software, safety, and certification. Our team performed an architecture assessment that helped the Hyperloop engineers make trade-offs between various hardware and software options. The work examined factors such as security, pricing, power usage, CPU horsepower, and future roadmap.



WIND



Ersules

Dublin-based Ersules is a smart lighting system integrator. They engaged with Wind River for the production roll-out of what they called “the world’s smartest building.” The eight-story structure contains 1,800 lights, 125 gateways, a cloud solution, and a back-end control system. Our Professional Services team drove all requirements capture and project management processes. We integrated three distinct hardware components and communications technologies with third party presentation and automatic blind systems. The project involved the use of multiple open source solutions, including Zigbee, Wi-Fi, MQTT, and Yocto Project-compatible Linux.

The Soon-to-be-Here Future of Embedded Systems at the Intelligent Edge

The current work we are doing at the intelligent edge represents what is likely to be the earliest stage in a long cycle of technological advancement. As 5G networks come online, there will be a huge increase in the amount of data traveling on wireless networks. Much of the traffic will involve embedded systems. This will lead to big increases in data management and analytics capabilities at the edge or in the cloud. Many functional changes are coming to embedded systems as the intelligent edge becomes a major segment of the market.

Conclusion

The work of building embedded systems never stops changing. Today, with the advent of the intelligent edge, embedded systems engineering teams are being challenged as never before. Our Professional Services organization partners with you for success in the intelligent edge and across the entire embedded systems space. With decades of experience, we can guide your team in product-based projects, BSPs, security advisory, and beyond. Our approach to professional services is based on mentorship. If your team comes out of the engagement with new competencies, we consider that a win.

As a result of these trends, we expect our Professional Services organization to be involved in many edge-related projects. These will include over-the-air firmware updating, containers, orchestration, virtual machines at the edge, and more. We will probably be working with more AI solutions at the edge as well. The 5G edge will be so complex that human beings alone will not be able to manage it without the use of machine intelligence. The upcoming challenges will be significant, but we are prepared to meet them.

In situations where you need more long-term support, we can deliver managed services and a variety of support packages. The intelligent edge means rethinking many of the traditional, proprietary architectural modes of embedded systems. As we have demonstrated with clients like Exxon Mobil, our experience gives us insights into the optimal solutions to complex embedded systems challenges.

Interested in what our Professional Services organization can do for you? Contact Us

About Wind River

Wind River is a global leader in delivering software for the intelligent edge. The company's technology has been powering the safest, most secure devices in the world since 1981 and is found in more than 2 billion products. Wind River offers a comprehensive portfolio supported by world-class global professional services and support and a broad partner ecosystem. Wind River software and expertise are accelerating the digital transformation of critical infrastructure systems that demand the highest levels of safety, security, and reliability.

TO LEARN MORE, VISIT WWW.WINDRIVER.COM.

The Wind River logo, featuring the word "WIND" in white capital letters on a red rectangular background. The background of the entire right side of the page is dark blue with a white geometric pattern of interconnected lines and dots, resembling a network or data flow.