



5G

SOLVING 5G'S BIGGEST CHALLENGES

FOR COMMUNICATIONS SERVICE PROVIDERS



ABSTRACT

5G promises exciting advances for Communications Service Providers (CSPs), but the 5G rollout is going to be challenging. CSPs must rapidly build out dense, low-latency edge networks in ways that are affordable, secure, and easily maintainable. CSPs are looking toward open-source, container-based network infrastructures that meet the 5G latency, reliability, and flexibility requirements while being inexpensive to deploy and maintain. This eBook explores the technologies that will power this next wave of telecommunications.

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I INTRODUCTION

5G, the fifth generation of wireless telecommunications, is making its debut across the globe. Communication Service Providers (CSPs) are in a race to be the first to offer complete 5G service. The stakes are high, but so are the potential business benefits. The technology promises faster connections, more reliable data streaming, and a host of new capabilities that bring new opportunities.

It won't be an easy process to deploy 5G. These new networks are dense and complex and have potentially high operating and maintenance costs. For certain applications, like connected cars, the latency must be ultra-low and deterministic, i.e., totally predictable. Plus, CSPs must also consider potential security implications.

One area that 5G will directly affect is the design and architecture of the Radio Access Network (RAN). Simply put, the RAN is a collection of edge located functions that connect a mobile device to the CSP's core network. But there is nothing simple about it. The latency requirements and network load of 5G will put a great deal of strain on the RAN, and the traditional ways of deploying RAN equipment are not well suited for the new needs. A new, cloud-based Virtual RAN (vRAN) approach will be required, as enabled by the Wind River Cloud Platform. This solution provides the necessary functionality for 5G; performance, flexibility, and cost-efficiency that isn't available in existing fixed-function RAN equipment.

CHALLENGES TO A SMOOTH 5G ROLLOUT:

- 1 Building out dense, complex networks
- 2 Keeping a lid on operating and maintenance costs
- 3 Meeting ultra-low, deterministic latency requirements
- 4 Addressing new security issues

5G CHALLENGES AND WIND RIVER'S SOLUTIONS

Wind River is currently engaged with CSPs and Telecom Equipment Manufacturers (TEMs) making the 5G transition—and has been for decades. Our suite of products addresses the challenges of 5G, including network complexity, expense, latency, and security.



#1 MITIGATING THE COMPLEXITY OF 5G DISTRIBUTED NETWORKS

THE NEED FOR INCREASED DENSITY

5G networks will be categorically more complex than anything currently in production. Many factors contribute to this situation. For one, 5G networks promise to be incredibly dense compared to 4G. A single standard 4G macrocell can serve an area of approximately 25 square kilometers, whereas with 5G, it will take 20 or more cells, with their respective antennas and RAN hardware, to cover the same area. When 5G traffic goes indoors, the coverage requires even greater density.

The density of the 5G network thus drives an increased need for switching and associated traffic management. It also requires a lot of compute power at the edge due to the following:

- MIMO works through algorithms at both the base station and UEs.
- “Beamforming” optimizes bandwidth use but further stresses compute resources.
- 5G duplex (two-way) data traffic architecture and high speeds create volumes of data that dwarf those in 4G.

MASSIVE MIMO APPROACH

The Massive Multiple In Multiple Out (Massive MIMO) approach to wireless networking allows for the use of multiple antennas in data transmission. Massive MIMO gives 5G networks greater speed per antenna. It increases the number of transmitting antennas at the base station and mobile user endpoints (UEs). The result is the maximization of data transfer through simultaneous sending and receiving.

WIND RIVER CLOUD PLATFORM

All of these changes in design and added stress levels on compute at the edge make 5G difficult to realize using traditional hardware-based RAN equipment. One solution that's gaining traction in the industry is to virtualize the RAN. Virtualized RAN (vRAN), as realized through the Wind River Cloud Platform, enables consolidation of RAN management and savings on equipment.

The Wind River Cloud platform provides a flexible foundation for network-wide configuration, deployment, and management of edge applications and infrastructure. Running vRAN through the Wind River Cloud Platform creates a physically distributed virtualized infrastructure that hosts core network functions along with applications that are part of the 5G ecosystem. For telecommunications companies, this geo-distributed virtualization approach is an industry first.

The Cloud Platform features an open-source, containerized design. It's an end-to-end cloud solution that rises to the challenges of a geo-distributed network architecture. The Kubernetes platform supports Docker, Armada, and Helm, among other leading-edge open-source projects. Its containerized approach enables 5G network managers to deploy and change vRAN instances quickly and easily. The high-availability platform also provides unified edge cloud management and network-wide orchestration—with the flexibility a 5G network needs to scale across a small footprint, from low-cost/power single-node servers all the way up to full data center configurations.



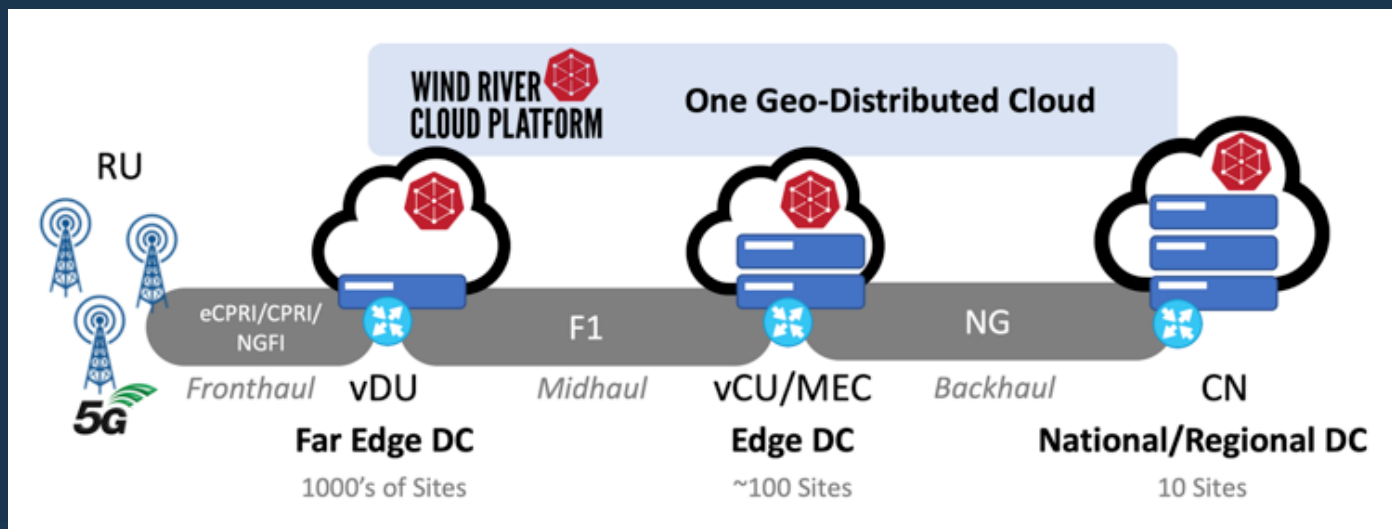


Figure 1 – Wind River Cloud Platform, functioning as a single geo-distributed cloud to support multiple elements of 5G networks.

In practical terms, putting the Wind River Cloud Platform to work in 5G means separating the virtual Base Band Unit (vBBU) into two functions. As shown in Figure 1, these are the virtual Distributed Unit (vDU), which is close to the Radio Unit (RU), and the virtual Central Unit (vCU), which sits closer to the core. From there, the compute nodes that host the vDU 5G functions have to be geolocated at the far edge, close to the RU. The vCU can then aggregate thousands of vDU units.

The Wind River Cloud Platform is designed specifically for this 5G workload. It can scale up or down, while also supporting the ultra-low latency and onboard accelerators required for real-time radio applications. All of this is managed through an intuitive Single Pane of Glass (SPoG) interface.



KEEPING OPEX COSTS UNDER CONTROL IN THE 4G TO 5G TRANSITION

As one might imagine, adding 20X or more pieces of hardware to a network generates significant operating expenses (OpEx). Beyond the equipment itself, there are cost centers that span configuration work, network testing and management, and software updating. Wind River offers solutions that enable CSPs to keep OpEx under control in the transition from 4G to 5G.

WIND RIVER SIMICS

Wind River Simics is an advanced simulation software solution that enables network architects and anyone involved in designing 5G networks to simulate how the network will perform without having to wire up a physical test network.

Simulation scenarios span a wide range of equipment types, operating systems, software applications, and network configurations/loads. The tool can even simulate the performance characteristics of hardware that hasn't been manufactured yet. It can model how the hardware will perform based just on the circuitry "tape up" designs.

Simics is able to model a nearly infinite variety of network scenarios.

Through this adaptable modeling technique, Wind River Simics eliminates a significant amount of time and effort out of the network design process. 5G network architects can use Simics to test:

- Usage scenarios and deployment patterns
- Designs for flaws and simulate outages to measure failover performance

WIND RIVER CLOUD PLATFORM

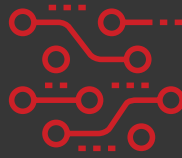
Wind River Cloud Platform is an open-source, production-grade distributed Kubernetes solution for managing edge cloud infrastructure. Based on the OpenStack StarlingX project, Cloud Platform represents a compilation of best-in-class open source technology that delivers the features needed to effectively deploy and manage distributed 5G networks.

Wind River Cloud Platform enables:

- Management, maintenance, and expansion of 5G infrastructure from single-node servers up to full data centers... even while they have applications running
- Relocation of workloads using a “zero-touch,” fully autonomous mode
- Activation of remote controllers
- Enrollment of new worker nodes
- Ability to roll back updates as needed without interrupting network operations

Wind River Cloud Platform delivers a unified edge cloud management and network-wide orchestration platform.





MEETING ULTRA-LOW, DETERMINISTIC LATENCY REQUIREMENTS

5G networks need low latency to function and some emerging edge devices in the 5G network will require **ultra-low deterministic** latency.

This new market of devices are defined by their need for ultra-reliable and low-latency communications (URLLC). These requirements only allow a single millisecond for one-way communications across the entire network infrastructure. That's much faster than legacy systems can accommodate. Examples of applications with these criteria include those used for autonomous vehicles, industrial robotic control, and safety.

The CSPs that can successfully support the needs of URLLC devices stand to dominate the markets of the future.

WIND RIVER LINUX

Wind River Linux was built expressly to meet such low-latency targets. It is open-source (based on the Yocto project) and has a tunable kernel that provides highly reliable, ultra-low deterministic latency. Wind River's Linux already has a proven history in delivering extreme reliability and low-latency in embedded applications. It is the OS of choice for edge applications like those in the RAN and powers the majority of 5G RAN equipment today worldwide.

I NEW CAPABILITIES MEANS NEW MARKETS

One exciting aspect of 5G is its potential to transform whole industries beyond telecommunications. These industries will become huge new CSP customers.

For example, 5G is expected to form the backbone of autonomous vehicles and vehicle-to-vehicle (V2V) applications. It's also poised to transform the way industrial sensors and other Internet of Things (IoT) devices function and communicate. 5G is even envisioned as playing a role in "augmented reality," which could, in turn, influence the "smart city" phenomenon.

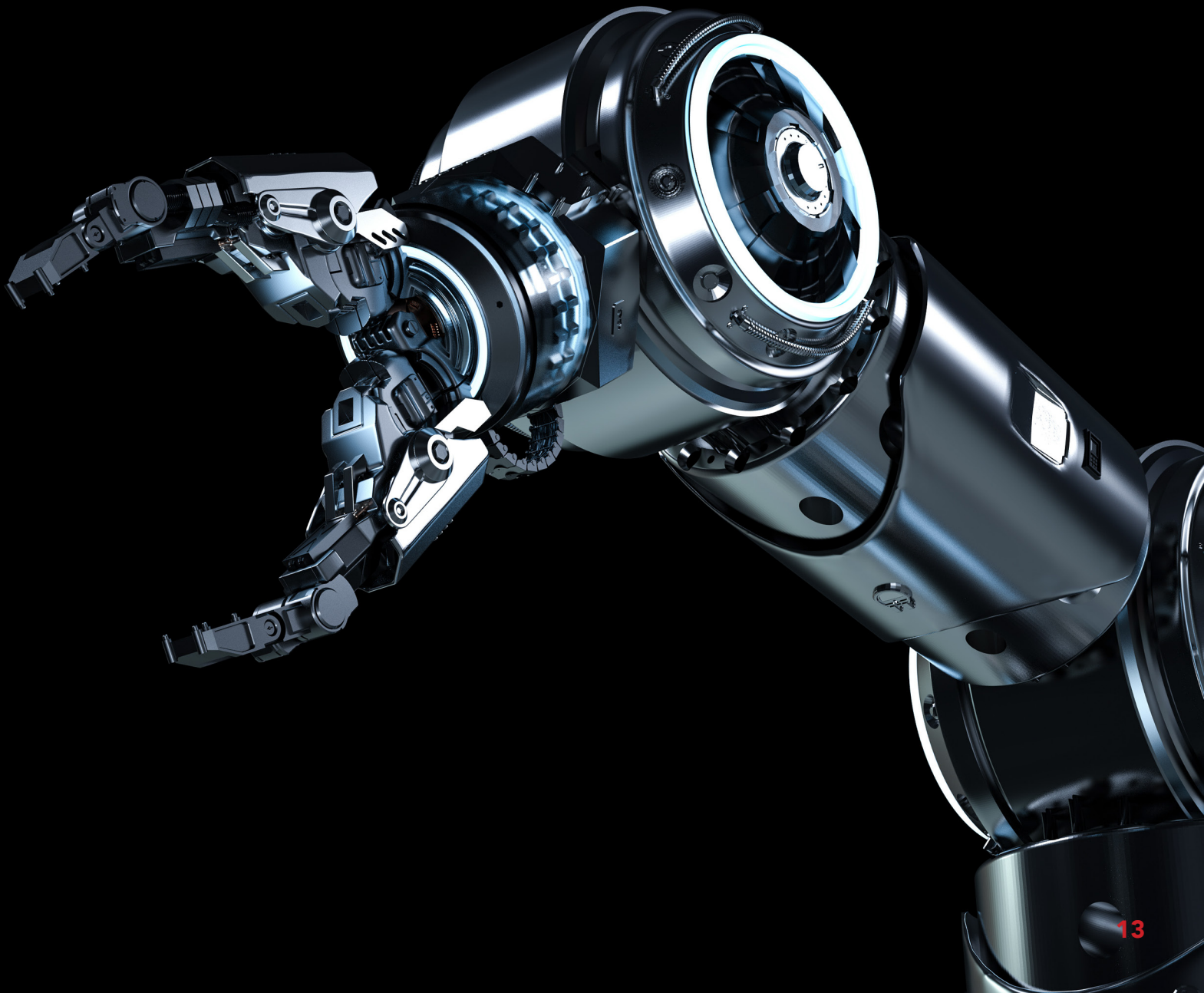
Who will these industries turn to for 5G services? Most likely, they will want to work with established CSPs. Industrial companies, "smart city" governments, automakers, and others will likely prefer to outsource the management of 5G's higher bandwidth and massive endpoint count. In other words, it's a big revenue growth opportunity for CSPs.

At the same time, these new avenues of growth come with customers who will present unfamiliar requirements. Setting up a massive industrial IoT environment, for instance, promises to be different from the regular business of running a CSP. Each opportunity is uncharted territory that comes with unique challenges.

We can help. Wind River has been a leader in embedded systems for over 35 years, supporting enterprise customers in the automotive, medical, aerospace and defense, industrial, and telecommunications sectors. We understand the unique requirements that arise for safety, security, and reliability in these settings.

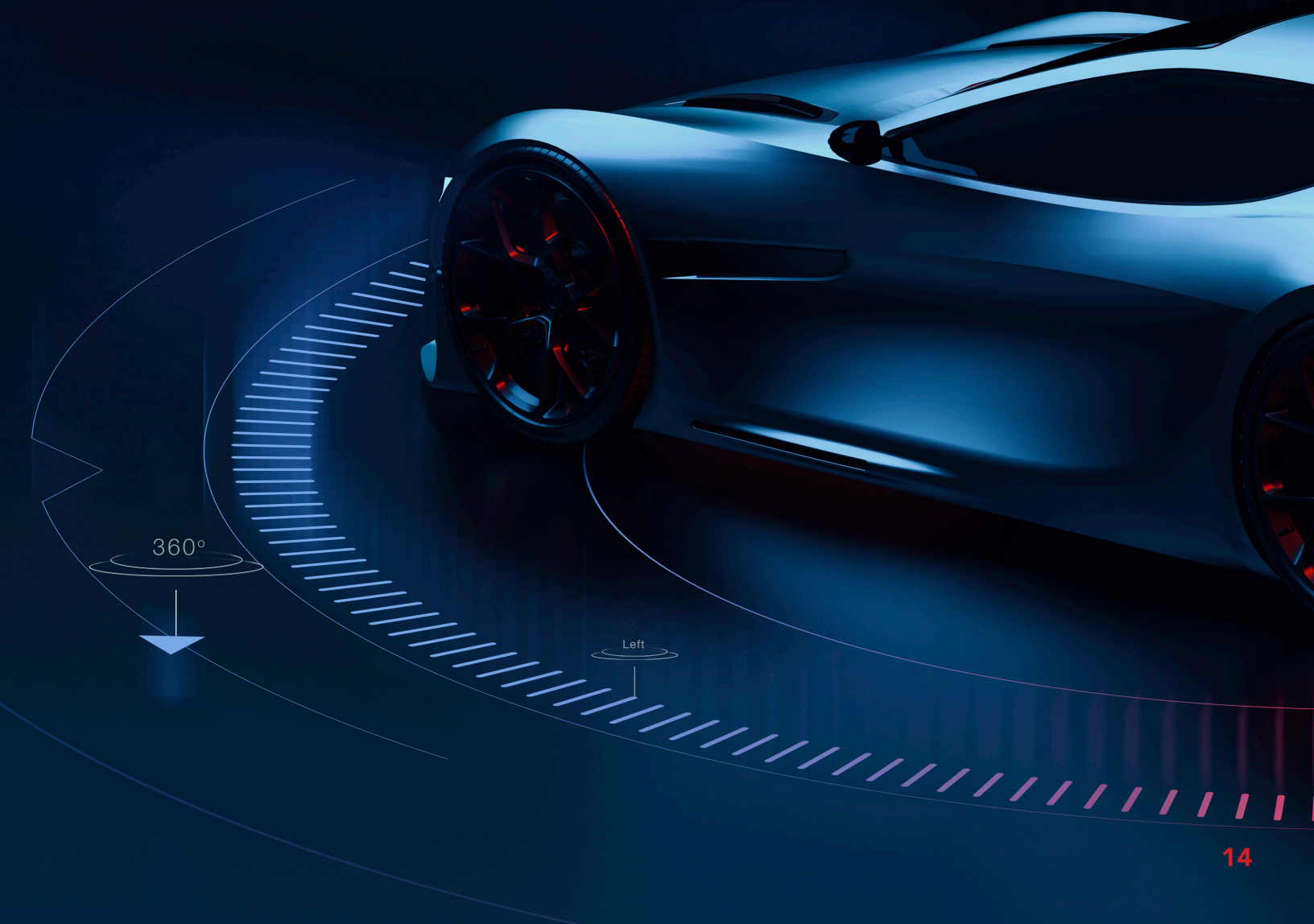
INDUSTRIAL AND ROBOTICS

Industrial companies want 5G to serve as the basis for an intelligent and secure edge platform, one that enables autonomous operations and distributed decision-making. One difficulty with this comes from vision-based systems, i.e., robots that can “see.” They need low latency. Otherwise, the robot may not be able to react in time to visual inputs. Wind River has been active in this space for many years. We can help create a unified platform that meets the low latency and security requirements needed to support industrial robotic operations.



AUTOMOTIVE

Original Equipment Makers (OEMs) like Detroit's "Big Three" and others want to make autonomous vehicles a commercially viable reality. One goal is to produce a "Level 4" (L4) autonomous car that carries people around as if they were cargo. The car does everything, perhaps not even having controls for a person to use. L4 vehicles need, what appears to be, an unsustainably costly amount of onboard compute power in order to function safely. This problem can be solved with a small-footprint edge computing solution that provides on-vehicle compute while offloading compute to an edge cloud.



AEROSPACE AND DEFENSE

This sector is largely interested in 5G for its relevance to Urban Air Mobility as well as the potential to maintain global technology leadership and ensure defense communications are optimized and secure. As a long-standing partner to the A&D industry, Wind River is already helping our customers capitalize on the opportunities and overcome the obstacles. Wind River can modernize aerospace and defense networks to take advantage of 5G's new spectrum, with the required low latency and security.





#4 NEW SECURITY ISSUES

5G, like any new, accelerative technology, will produce its share of new security risks. Given the distributed and sometimes remote nature of 5G far edge nodes, some unique capabilities need to be considered to mitigate that risk, such as:

- TPM (Trusted Platform Module) to secure edge site hardware via cryptographic keys
- QAT (Quick Assist Technology) with Key Protection
- Secure UEFI boot
- Zero Touch updates to keep infrastructure current and secure

Distributed Cloud topology requires new tools and processes to ensure security.

WIND RIVER'S BUILT-IN SECURITY

Wind River takes a double-edged approach to secure 5G networks. First, we use secure design principles in the products we build from the start and constantly provide ongoing security monitoring and patches for all of our products.

We also provide extensive professional services to keep our clients secure. Wind River advises on security practices for 5G networks and cloud operations. Our Professional Services and Advisory teams can monitor 5G networks at all levels—from hardware to application software, operating systems, and switches—and issue patches when necessary.

I CONCLUSION

5G offers promise but also challenges for CSPs. The networks must be dense and complex and can potentially impose high operating and maintenance costs on carriers. Many, if not most, applications on 5G will require extremely low or deterministic latency. And of course, security is a factor to contend with as well.

Wind River offers a portfolio of solutions that help mitigate the challenges the 5G presents.

- **Wind River Cloud Platform** provides the key functionality required for 5G networks while cutting OpEx and CapEx costs.
- **Wind River Simics** can test an infinite number of 5G network scenarios, including deployment patterns and outage simulations.
- **Wind River Linux** has the highly reliable, ultra-low deterministic latency required to support edge applications.
- **All Wind River solutions have built-in security**, including ongoing monitoring and regular patches for all solutions.

Wind River has the software components and development tools you need to advance your infrastructure to meet the needs of 5G. Success requires a robust and scalable infrastructure that can provide the performance, reliability, and security you need.



I ABOUT WIND RIVER



For nearly 40 years, Wind River has helped the world's leading technology companies power generation after generation of the safest, most secure devices in the world. And in a new era of autonomy and connectivity, we continue to lead the way. As a result, we are uniquely positioned to help CSPs accelerate their paths to pervasive, profitable 5G. The company is already a dominant player in existing 5G RAN deployments. We have been active in the telecommunications and telecom equipment industries for decades.

Our software runs the "can't fail" computing systems of the most important modern infrastructure, including mission-critical aircraft, rail, automobiles, medical devices, manufacturing plants, and communications networks. Our technology is in more than 2 billion devices throughout the world and backed by our industry-leading professional services, award-winning customer support, and robust partner ecosystem.

TO LEARN MORE, VISIT WWW.WINDRIVER.COM.