

Intel and Red Hat Validate Containerized Industrial Private 5G

Intel® FlexRAN™ reference software running on Red Hat® OpenShift® delivers a pre-validated foundation for industrial private 5G deployments.



Industry 4.0 promises a more connected, automated, safe and reliable manufacturing floor with the ability to instantly analyze process deviations or machine conditions and resolve issues or alert staff before there is a problem.

To be successful, Industry 4.0 initiatives need connectivity. Earlier industrial digitalization efforts used high-speed Ethernet which offered the low latency and high throughput needed for machine connectivity and diagnostics.

However, the on-site cabling needed for industrial solutions can be expensive and time consuming to install and reconfigure, making it challenging and costly to reorganize manufacturing equipment to adjust for changes in demand or new product launches. Cabling may not facilitate the growing need for mobile connectivity for robotic devices and network connected devices on forklift vehicles.



Enter private 5G networking which provides very low latency, high data throughput, extended coverage, increased reliability, privacy and security. Private 5G is poised to provide many of these benefits to Industry 4.0 initiatives. Private 5G is taking off thanks to increasing availability of devices, a better understanding of use cases, and dedicated spectrum.

Private 5G systems benefit from virtualized and containerized radio access networks (RAN) and 5G core (5GC) implementations and open standards for the interfaces that connect all of the network functions together. This allows enterprises to customize their deployments and for vendors to make systems more cost effective. This also allows for third-party software and other innovations to be used to customize networks.

But this openness and virtualization can lead to complexity that can make deploying and managing these systems more challenging.

To address these challenges, Red Hat, an Intel® Network Builders ecosystem partner, has joined with Intel to integrate and validate a containerized and cloud native private 5G reference solution comprised of Intel® FlexRAN reference software and Red Hat OpenShift. This solution is optimized for Intel® Xeon® Scalable processors and provides a private 5G foundation that can be trusted for performance and can be expanded or customized using third-party innovations from both companies' partner ecosystems, which are among the largest in the industry.

Intel FlexRAN Reference Software for Private Wireless

Intel FlexRAN reference software is a fully cloud and edge-native containerized 5G software stack for industrial applications that leverages the performance and advanced capabilities of Intel® architecture processors, Ethernet controllers and fully integrated vRAN acceleration.

With a software-defined, cloud-native architecture, the software can help the industry accelerate 5G product development aimed at the unique requirements of industrial networks that include:

- Ultra-reliable and low latency communications (uRLLC) for robotic and other delay sensitive applications.
- Time sensitive networking for improved quality of service.
- Support for industrial protocols for specialized management systems.
- Converged access of 5G, Wi-Fi and Ethernet to leverage existing network systems.
- Data privacy and security.

The software platform includes the 5G core control and user plane functions, operations and management subsystem, and support for industry standard radio units (RUs). The two main components are:

5G Core Functions: a complete control plane function based on 5G standards and including network functions such as AMF, SMF, AUSF, PCF, UDM, UDR, UDSF, NSSF, NRF, NEF, UPF.

5G RAN Functions: provides the gNodeB (gNB) features, baseband processing functions (centralized unit (CU) and distributed unit (DU), and user plane function (UPF) that interfaces with the RAN to exchange data. The gNB creates a packet data unit (PDU) session to move packets from the user equipment (UE) through the control plane functions and out to the data network.

The software is engineered to support a variety of spectrum frequencies that countries are dedicating to unlicensed use in private 5G applications. The platform supports band n48 (3.55-3.7 GHz) which is suitable for Citizen’s Broadband Radio Service (CBRS) bands in the U.S., band n78 (3.7-3.8 GHz), which has been dedicated to private 5G use by a growing number of countries worldwide, and band n40 (2.3-2.5 GHz), which has been dedicated for private networks in Spain. Other private spectrum bands are planned as part of future releases.

The platform, running on an Intel® Xeon® Scalable processor-based server, can currently support four 100MHz RUs or up to twelve 20-40 MHz RUs in a single server.

Figure 1 shows how Red Hat and Intel combine capabilities to deliver an edge native experience for OEM and ecosystem partners to build and deploy private 5G wireless systems.

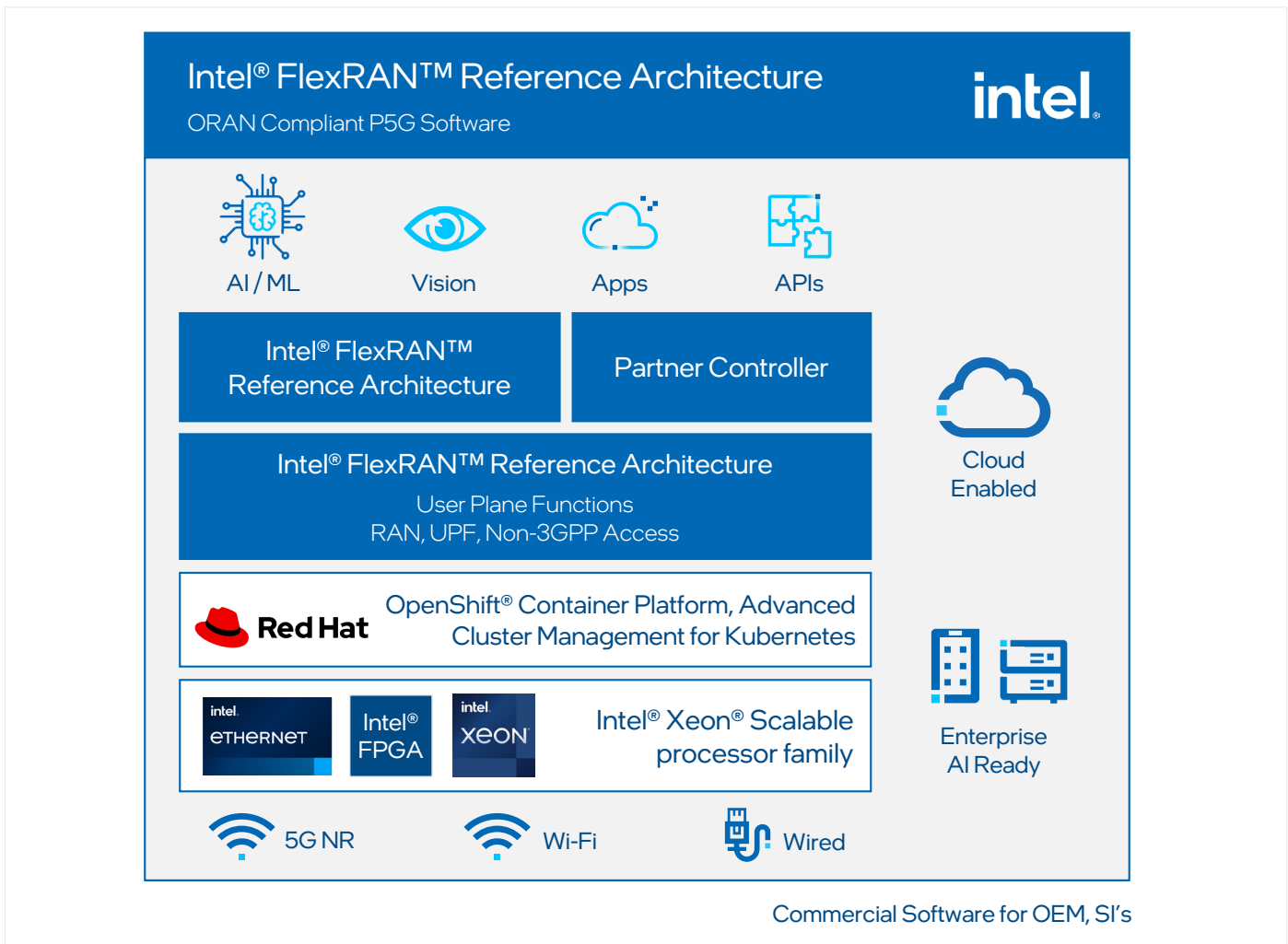


Figure 1. Block diagram of private 5G network built using Red Hat OpenShift and Intel software.

The foundation of the 5G RAN is Intel FlexRAN reference software, a layer 1 reference implementation for PHY and MAC layer processing. Intel FlexRAN reference software efficiently processes wireless access workloads. It is comprised of several modular, virtualized control functions with well-defined interfaces that allow flexible and programmable control of the layer 1 wireless infrastructure.

TSN enables packet and clock synchronization to reduce latencies and enhance the ability of quality of service (QoS) standards to enable a more deterministic network. Support for TSN is critical as uRLLC services are launched in support of robotic and other factory applications.

Intel reference software is optimized for servers using Intel architecture processors and can be deployed in the cloud or using on-premises compute resources for either a single factory or a multi-factory deployment.

The software also features a suite of APIs as part of the operations and management subsystem (OMS) that is connected to the user and control planes and helps with management of the entire 5G system. This includes container network function (CNF) topology and providing the CNF configurations create, read, update, delete (CRUD) capabilities. Fault management, configuration back-up and restore functions are also provided by the OMS. With a REST API, system integrators can use OMS data in a variety of management systems.

Validated with Red Hat Solutions

Intel FlexRAN reference software is a fully containerized solution that has been validated on Red Hat OpenShift Container Platform, the industry's leading hybrid cloud application platform powered by Kubernetes.

OpenShift brings together tested and trusted services to reduce the friction of developing, modernizing, deploying, running, and managing applications. OpenShift delivers a consistent experience across public cloud, on-premises, hybrid cloud, or edge architecture.

OpenShift offers consistent security, built-in monitoring, centralized policy management, and compatibility with Kubernetes container workloads. OpenShift is engineered to be fast, with self-service provisioning, and integration with a range of tools.

For cloud native cluster and application monitoring, Red Hat includes Prometheus, an open source metrics and alerting software, and that interfaces to open source Grafana that can visualize the data.

Ensuring security and compliance are major requirements for efficiently deploying and operating a private 5G network. Red Hat Advanced Cluster Management for Kubernetes offers end-to-end management, visibility, and control of Red Hat OpenShift and other Kubernetes-based clusters. Service providers can take control of the full application lifecycle, and desired-state security and compliance across multiple datacenters and public cloud environments. Deploy, run, and move applications automatically across public and private domains based on policy control.

Red Hat Advanced Cluster Security for Kubernetes equips service providers to build, deploy, and run cloud-native applications anywhere more securely. The solution lowers operational costs, provides built-in controls for enforcement, and supports built-in security across the entire software development lifecycle.

Conclusion

Private 5G networks provide the low latency communications services that are essential for Industry 4.0 initiatives. But the flexibility and carrier-grade technology can make it too complex for enterprises or system integrators to deploy.

Intel and Red Hat have joined forces to combat this complexity by providing a validated network foundation that can provide high data rate services out of the box and be customized when integrated with third-party software. The joint solution is comprised of Red Hat OpenShift and Intel FlexRAN reference software. Thanks to this validation, the combined solution delivers a reference implementation for network deployment and operation and full feature support.



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