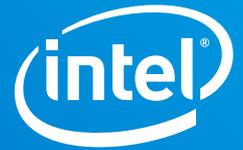


SOLUTION BRIEF

Communications Service Providers
In-Building Cellular Coverage



JMA Wireless' XRAN Reinvents In-Building Mobile Connectivity

Demand for mobile connectivity is growing for today's in-building business operations and high-density venues, but traditional small cells and distributed antenna systems fall short in offering a streamlined solution. Integrated with JMA Wireless' award-winning TEKO™ DAS platform, XRAN™ software delivers a complete, scalable, and elastic cell system that delivers edge connectivity economically.



Introduction

It's becoming increasingly harder for cellular network signals to penetrate buildings and meet demand where, by some estimates, over 80 percent of all mobile voice and data usage occurs.¹ In the US in 2012, there were 5.6 million commercial buildings covering 87 billion square feet of floor space (900 billion square feet globally). This is expected to grow 32 percent to 109 billion square feet by 2040.² Wireless signals attenuate dramatically as they pass through concrete or steel walls, and the trend toward increased use of low-emissivity (low-e) glass or film on windows dramatically reduces the signal strength of outdoor cellular signals. Global mobile device data usage is expected to increase from 11 exabytes per month in 2017 to 41 exabytes per month in 2021.³ Despite the trends increasing the gap between supply and demand, far less than 10 percent of commercial workspaces in the US (5 percent globally) have dedicated mobile wireless systems.⁴

Today's solutions for in-building cellular systems, such as small cells and distributed antenna systems (DAS), have worked to close the gap, as they are installed inside the building, much like Wi-Fi access points, and enable mobile communications service. These systems are composed of both antenna systems and radio access network (RAN) equipment on the edge that process and transmit signals to and from the mobile device, forwarding the voice and data payloads out to the core network of mobile network operators (MNO). As evidenced by the low market penetration levels for in-building systems while demand rapidly grows, these solutions have not met the needs for enterprise and commercial building owners and operators.

Intel® Network Builders ecosystem partner JMA Wireless™ has launched XRAN™, a 100 percent software platform that provides the cellular RF source, key element of the overall system. Running on Intel processor-based servers and delivered as a software solution, XRAN is a new and innovative solution for indoor cellular coverage and capacity. It brings cloud economics to the RAN function, enabling high capacity support for multiple operators and differentiated services for public venues and enterprise buildings.

The Challenge

While the in-building market is projected to grow fast, it is at an inflection point as to how mobile connectivity infrastructure is deployed and operated. Historically, mobile network operators built out and funded the wireless infrastructure. However, enterprises increasingly are expected to fund the installation of in-building systems, which means a new expense and technology. Along with these systems comes the need for additional specialized personnel to manage and maintain the in-building mobile network, which historically is fundamentally different from coexisting IT systems.

At the same time, many in-building systems are deploying small cell or other quick-fix solutions, which typically provide only single-MNO service and inherently create noise issues (reduced capacity) with overlapping signals resulting from poor RF design. Achieving a multi-operator solution with these systems is costly and complex. DAS deployments do address multi-operator needs and are cost effective per square foot, but enterprises are often challenged in getting access to, and commitment for, specialized RF source equipment from the MNOs. The RF source equipment is complicated, expensive, and requires highly trained technicians to commission it.

In-building systems historically deploy as a cascade of fixed-function infrastructure components, each providing unique capabilities for processing the various stages of mobile connectivity and data transmission. Historically, there has not been a fully integrated system that has addressed all in-building needs. Many different forms of small cells have come and gone, and DAS vendors often get creative by providing

alternative means to get RF source equipment such as stacking up multiple small cells or femto cells to feed the DAS from multiple operators. The coming of 5G networks—which are expected to be operational in 2019⁵—is potentially problematic for these legacy systems as they are hardware dependent and thus fixed in time as to spectrum, technology, and capacity supported.

To date, there has not been a fully virtualized system for the critical baseband/RF source function that can be leveraged for in-building wireless systems. A virtualized approach can reduce costs, future proof the infrastructure, eliminate the need for specialized deployment and operational knowledge, and replace specialized hardware with commercial off-the-shelf servers powered by Intel processors.

The Solution

The JMA Wireless solution to this challenge is XTRAN, a completely virtualized baseband function that can run on servers powered by Intel® processors that combines with the company's TEKOTM RF distribution technology to precisely address the key needs of the in-building market.

As shown in Figure 1, traditional RF sources that comprise the RAN, in the form of an eNodeB (eNB), are proprietary, closed and fixed architectures with a hardware dependency for layer 1 to 3 signal processing. While there are numerous solutions entering the market that partially virtualize the RAN by using specialized hardware accelerators and proprietary hardware and firmware to “split” the RAN solutions as an incremental step in resolving in-building challenges, XTRAN breaks away from any hardware or firmware dependencies to provide a fully virtualized RAN platform.

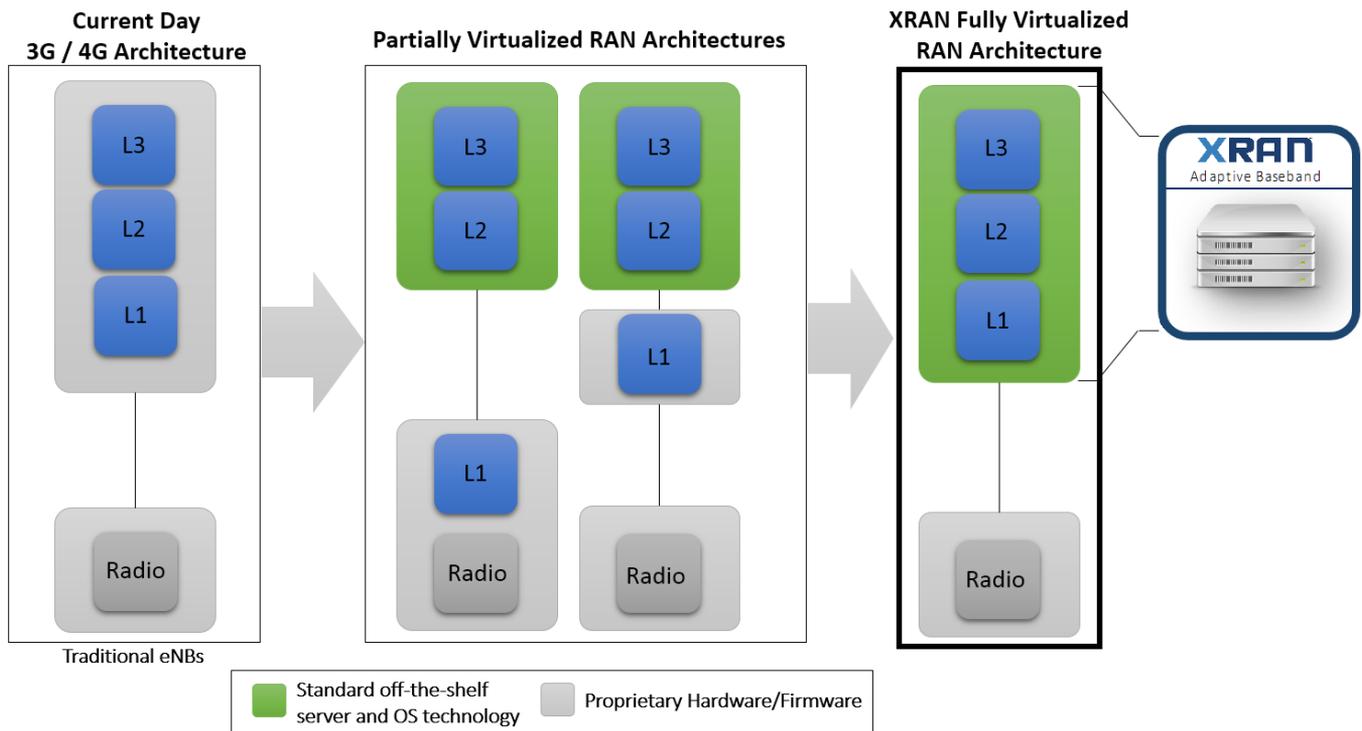


Figure 1. Three approaches to delivering the RF Source components in the RAN.⁶

Solution Brief | JMA Wireless' X-RAN Reinvents In-Building Mobile Connectivity

X-RAN was created to deliver on the needs of both the carrier and the enterprise by offering:

- Support for multiple MNO network access, including public safety bands
- Options for both licensed and unlicensed spectrum
- Enterprise-class architecture with carrier-class performance and security features
- 5G readiness for broadband user mobile device demand
- IoT readiness for massive numbers of narrowband connections
- Application readiness for new services and business process integration
- Flexibility, adaptability, and modular design, delivering an economical solution whether deployed with existing infrastructure or in a greenfield location
- Ability to be deployed in the cloud, on premises, or as a hybrid solution

The X-RAN Adaptive Baseband processes the RF signals and delivers them to the transmitting radios, and then to and from the mobile devices. Baseband processors today are typically built on hardware-based digital signal processors and are not portable to standard Intel processors, until now. Newer approaches achieve only portions of the baseband function, namely network interfaces and high level controls, whereas X-RAN has cracked the problem of a full software solution that can process the full protocol stack, layers 1

through 3. This means that X-RAN Adaptive Baseband can scale up or down by simply deploying more Intel processing capabilities, making it suitable for very large venues, enterprises, multitenant facilities, industrial campuses, and metro and outdoor areas.

The X-RAN Adaptive Baseband software is compatible with all major wireless standards, including 3GPP* LTE, LTE category M (CAT-M), narrowband-IoT, and public safety bands and is capable of processing 3.5 GHz Citizens Broadband Radio Service (CBRS) in software. X-RAN utilizes 3GPP-defined network interfaces to be compatible with core mobile networks worldwide, and its software characteristics mean it can more easily be changed and enhanced for new spectrums, protocols, capabilities, and performance.

The Operations Platform provides an IT-centric management interface and configuration capability for X-RAN services and operations. The OP is based on enterprise DevOps concepts, helping optimize the operations and tie into existing IT network management skillsets. For management, the OP provides a complete system view of X-RAN from either cloud or on-premises deployments, while offering tiered permission levels for security-enabled access. The OP brings value to the network by managing software licenses, thus giving enterprises the ability to match their software instances with their wireless demand. The software also features standard integration with other networking systems in use, providing vital management, fault, and alarm information required by core network applications and systems.

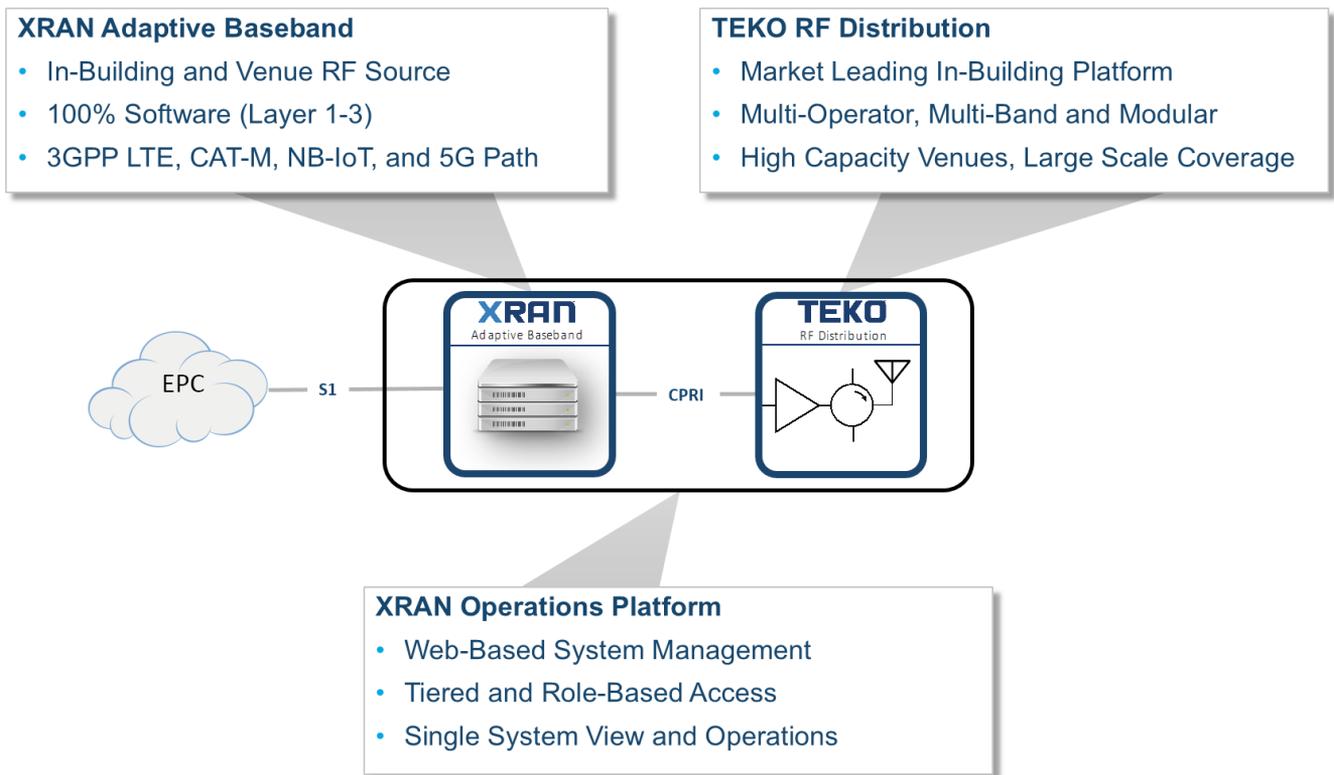


Figure 2. Diagram shows how the two main functions of the X-RAN work together with the TEKO DAS.

XTRAN is optimized to work with JMA Wireless' TEKO DAS platform, a market leader in DAS solutions, and components as a single managed system. It has a common web-based management, configuration, and operations interface with role-based access and tiered administration. The TEKO DAS platform is modular, with a small footprint for multi-operator, multi-bands, and high performance in-building RF distribution. Like XTRAN, it is adaptable for any enterprise or commercial property deployment topology. Using Software Defined Radio Units (SDRU), TEKO DAS allows for future additions of bands and signals from XTRAN without any traditional hardware dependencies.

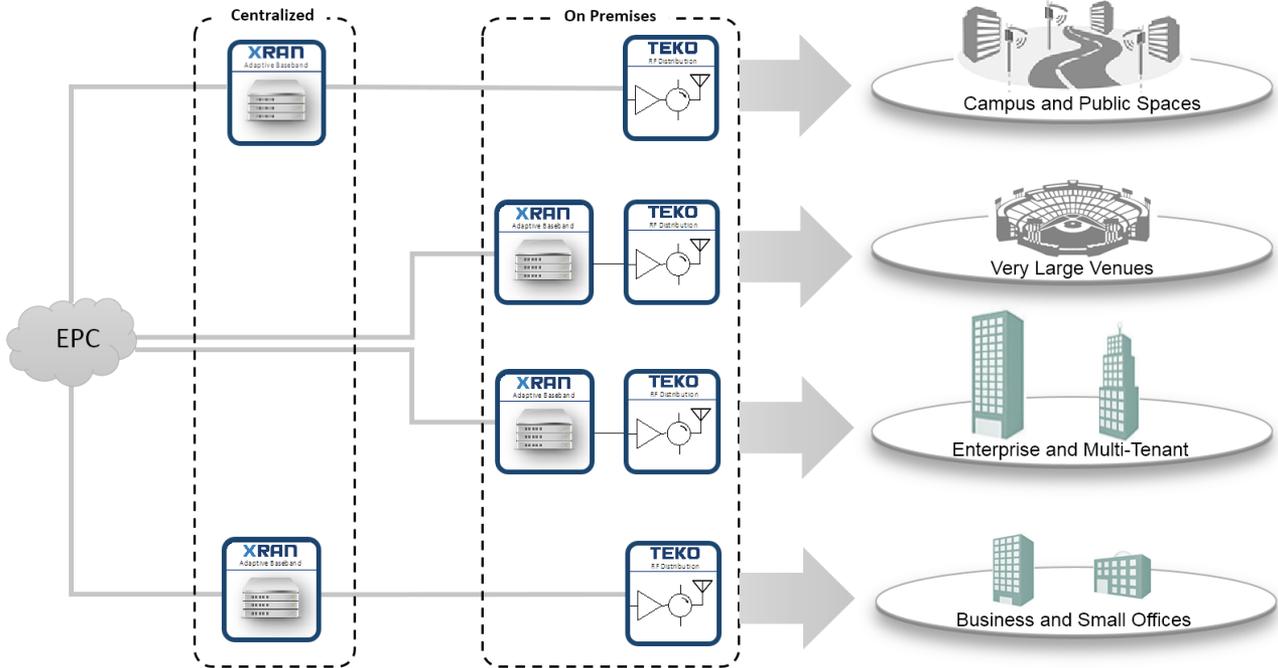


Figure 3. XTRAN and TEKO DAS working together to provide wireless services to venues of different sizes.

All of the XTRAN software components are optimized to run on servers powered by Intel® Xeon® processors E5 v4 with eight cores for a mid-sized deployment and 18 cores for a large deployment. The software is designed with parallelized code and data structures and utilizes the performance-enhancing Intel® Advanced Vector Extensions 2 (Intel® AVX2) to take advantage of processor scalability features.

With the full abstraction of the baseband software from the underlying processing hardware, XTRAN has the flexibility to deploy in a way that matches existing enterprise network architectures and topologies. By utilizing the common IT network infrastructure already available in data centers, the software can be hosted in the cloud, deployed on a customer premises server, or deployed in a hybrid mode where functionality is split between the cloud and the premises.

This flexibility allows for a wide range of business models; for example, specialized third-party operators (3POs) that are MNO neutral can host the network infrastructure, earning revenue from rental or service fees.

Alternatively, the XTRAN architecture opens up new business models where the enterprise can pay for the entire infrastructure and then subscribe to mobile operator wireless-as-a-service programs.

Conclusion

With the decline in enterprise landline usage, the exponential growth of mobile device only environments, and the proliferation of IoT devices and 5G solutions, powerful in-building wireless coverage and capacity are critical and will be an essential way that carriers and enterprises deliver today's LTE and tomorrow's 5G services. The JMA Wireless XTRAN portfolio virtualizes this infrastructure in order to take advantage of the improved economics offered by Intel® architecture-based hardware, while also delivering better integration with IT systems. This will close the gap between access and demand while supporting new business models for in-building wireless connectivity.

About JMA Wireless

JMA Wireless is a global innovator in mobile wireless connectivity solutions that assure infrastructure reliability, streamline service operations, and maximize wireless performance. Employing powerful, patented innovations their solutions portfolio can lower the cost of operations while ensuring lifetime quality levels in equipment and excellent performance for coverage and high-speed mobile data. JMA Wireless solutions cover macro infrastructure, outdoor and indoor distributed antenna systems and small cell solutions. JMA Wireless corporate headquarters are located in Liverpool, NY, with manufacturing, R&D, and sales operations in over 20 locations worldwide. More information is at <http://www.jmawireless.com/index.php>.

About Intel® Network Builders

Intel Network Builders is an ecosystem of infrastructure, software, and technology vendors coming together with communications service providers and end users to accelerate the adoption of solutions based on network functions virtualization (NFV) and software defined networking (SDN) in telecommunications and data center networks. The program offers technical support, matchmaking, and co-marketing opportunities to help facilitate joint collaboration through to the trial and deployment of NFV and SDN solutions. Learn more at <http://networkbuilders.intel.com>.



¹ ABI Research, "In-Building Mobile Data Traffic Forecast, 2016," <https://www.abiresearch.com/press/abi-research-anticipates-building-mobile-data-traf/> and <https://www.prnewswire.com/news-releases/abi-research-anticipates-in-building-mobile-data-traffic-to-grow-by-more-than-600-by-2020-300202224.html>

² U.S. Energy Information Administration (2015) "2012 Commercial Buildings Energy Consumption Survey," <http://css.umich.edu/factsheets/commercial-buildings-factsheet> and ABI Research, "In-Building Mobile Data Traffic Forecast, 2016," <https://www.abiresearch.com/press/abi-research-anticipates-building-mobile-data-traf/>

³ Business Insider, February 9, 2017, "Mobile data will skyrocket 700% by 2021," <http://www.businessinsider.com/mobile-data-will-skyrocket-700-by-2021-2017-2>

⁴ ABI Research, "In-Building Mobile Data Traffic Forecast, 2016," <https://www.abiresearch.com/press/abi-research-anticipates-building-mobile-data-traf/> and "NCR In-Building Wireless Infographic, 2017," <https://www.ncr.com/company/blogs/telecom-technology/in-building-wireless-ncr-infographic>

⁵ CNET, February 25, 2017, "5G Phones Are Coming Earlier Than You Thought," <https://www.cnet.com/news/5g-network-wireless-phones-qualcomm-2019-are-coming-earlier-than-you-thought/>

⁶ Figures provided courtesy of JMA Wireless.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com.

Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

JMA Wireless, X-RAN, and TEKO are trademarks of JMA Wireless.

© Intel Corporation. Intel, the Intel logo, and Xeon are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries.

* Other names and brands may be claimed as the property of others.