



# Baicells\* Modularizes Small Cells for Next-Gen Indoor Networks

To meet indoor cellular network demand, the Baicells M-RAN virtual small cell provides deployment flexibility and helps to minimize power and backhaul costs. Enterprises can deploy Baicells M-RAN to support today's 4G/LTE networks and move to future 5G networks with a software update.



## The Challenge: Supporting Increased Indoor Mobile Device Usage

Between home, work, and hot spots, consumers are increasingly consuming mobile data indoors, with some analysts expecting that trend to grow significantly when 5G wireless services are available. Serving these users will require an expansion of indoor 4G and 5G cellular base station infrastructure to deliver indoor coverage, capacity, and low-latency services.



One popular infrastructure option for indoor cellular services is the small cell. Small cells feature the same technology components as the macro cells that serve outdoor coverage needs but are scaled for a smaller signal radius. Key components of a small cell include:

- Baseband Unit (BBU): Utilizes digital signal processing to convert modulated signals to digital signals.
- Remote Radio Unit (RRU): Receives and processes incoming radio signals, converting them into modulated signals. Performs the process in reverse to transmit outgoing signals.
- Control processing: Processing signaling traffic between small cell and connected mobile devices.

The BBU and control processing constitute the radio access network (RAN). The other elements that are required for a complete wireless system include antennas that capture and transmit RF signals between the small cell and the mobile device, and a backhaul network that transfers the data between the small cell and the core network for switching out to the internet.

Without virtualization, each small cell is a self-contained unit placed in close proximity to the antenna. Enterprises were called on to do sophisticated signal mapping and planning to place the small cells throughout a building or campus and then ensure that power and backhaul network connections were available. Even though the utilization percentage of the small cell fluctuated throughout the day, the enterprise had little ability to scale that resource up or down.

While this impacted the purchase price of the network, it also impacted the power and electricity operating expenses. When an enterprise builds out an in-building network infrastructure, it has to absorb the costs of the electricity to power the infrastructure as well as the internet connectivity costs for backhaul.

In a 5G network with non-virtualized small cells, these costs will increase. Supporting the increased number of 5G small cells needed for coverage due to signal attenuation will add to both capital expense and electricity costs. 5G network standards are projected to have higher data throughput as compared to 4G/LTE networks, which will drive a significant increase in network backhaul capacity and cost.

By virtualizing the small cell, the enterprise can size the network appropriately for hourly utilization by pooling of resources and allowing statistical dimensioning across multiple virtual cells within a server. When utilization is low—at night, for example—the small cell can be scaled down for power energy savings.

Virtualizing the RAN elements of the small cell provides better scaling and cost minimization without impacting coverage. Baicells,\* an Intel® Network Builders ecosystem member, has developed its Baicells Modular RAN (M-RAN) to provide a cost-effective 4G/LTE solution that can move to 5G when the enterprise is ready.

## Baicells M-RAN Virtualizes Key Components of the RAN

To deliver next-generation indoor wireless connectivity, the Baicells M-RAN solution offers a solution that decouples software-based RAN functions from fixed-function hardware, which improves scalability and reduces costs. Key benefits that Baicells M-RAN brings to the enterprise include:

- Carrier-grade 4G/LTE BBU running on an Intel® Xeon® processor-based server
- System architecture that allows for software upgrade to 5G BBU
- Scalable capacity with hardware expansion
- Interoperability with BBUs and RRUs from other vendors
- Fully compatible RRU solution

The Baicells M-RAN solution comprises virtualized BBUs (hosts) connected to RRUs via 10 GbE switches. M-RAN is a fully virtualized solution running on servers in the enterprise or provided by the carrier in a multi-access edge computing (MEC) environment. The BBU software creates an LTE cell that can support a maximum of 640 active users simultaneously with maximum of 2 Gbps download speed.<sup>1</sup>

The RRUs are connected to antennas mounted throughout the organization in order to provide the cellular coverage. The RRUs support 1.8 GHz frequency and use a 2\*2 MIMO antenna. They consume less than 40 watts of power.<sup>1</sup>

The RRUs connect into 10 GbE switches, which makes their data flow available to all of the pool of resources and services on the network. These servers are virtualized with the virtual host running on the server in order to process the data coming onto the network. Baicells RRUs have a 10 GbE interface that supports power over Ethernet (PoE) to simplify the powering of the devices. The RRUs also support the Common Public Radio Interface (CPRI/eCPRI) for connecting to distant antenna fronthaul networks, providing more flexibility in utilizing antenna infrastructure.

The Baicells M-RAN can split or combine cells when needed to support fluctuations in network traffic volume or to support

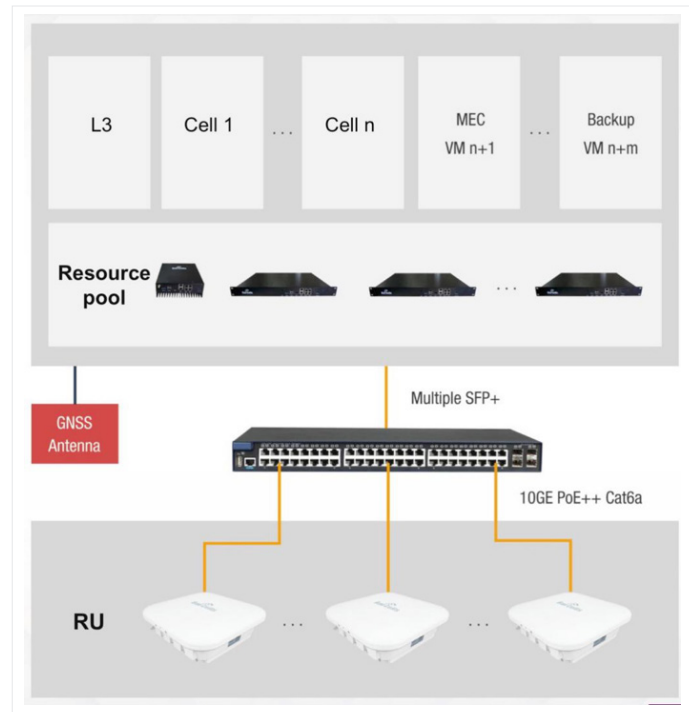


Figure 1. Baicells M-RAN product architecture.

access to multiple MNO networks. Up to 20 RRUs can participate in a cell for a capacity of 400 users per cell, and a server can accommodate up to three cells.<sup>1</sup> When 5G network standards are finalized and implemented in the M-RAN, this splitting functionality will aid in the transition to the new network through support for both 4G/LTE network cells and 5G NR cells from the same servers.

Additional server resources can be added to the M-RAN resource pool to provide low-latency network access to commonly used services or resources by running them in their own VM on an adjacent server or within the MEC. Some of these services or resources include the following:

- video servers
- webhost
- enterprise private local cloud services
- NFV infrastructure services

The BBU software supports global positioning system (GPS) and IEEE 1588 or SyncE for signal timing needed for voice calls. It also supports fault recovery features, including N+1 redundancy and live migration to a backup server. Idle servers can be remotely shut down for power savings based either on data volume thresholds or time of day to accommodate rush hours, for example.

## Intel® Technology Powers M-RAN

For the LTE BBU, Baicells specifies servers that use Intel Xeon D-1567 or Intel Xeon D-1548 processors. These SoCs (system on chips) are part of the Intel Xeon processor D-1500 product family, which is based on the company's industry-leading 14 nm silicon technology and delivers a performance per watt ratio that is ideal for mid-to-large-size business services gateway applications.

SoCs in the Intel Xeon processor D-1500 product family feature either eight cores (Intel Xeon D-1540 processor) or 16 cores (Intel Xeon D-1560 processor), each of which has a maximum of 128 GB of addressable memory and a thermal design point (TDP) range of between ~20 watts to 45 watts. The Intel Xeon D-1500 processors include an integrated platform controller hub (PCH), integrated I/O, four integrated 10 Gigabit Intel® Ethernet data ports, and four integrated 25 Gigabit Intel Ethernet data ports.

For the 5G BBU, Baicells specifies servers that use the Intel Xeon D-2100 processors. The Intel Xeon processor D-2100 product family delivers data center processor architecture in a form factor optimized for flexible, scalable, and high-density solutions for network, storage, and cloud edge computing. The Intel Xeon processor D-2100 product family is based on the architecture of Intel Xeon Scalable processors. This includes integration of network, security, and acceleration capabilities. This shared architecture provides software consistency and scale for applications and services that are deployed both in the data center and the network edge. Intel Xeon D-2100 processors are available with between 4 and 18 cores and with up to 512 GB of addressable memory. The SoC has an integrated platform controller hub (PCH), integrated high-speed I/O, up to four integrated 10 Gigabit Intel® Ethernet ports, and a thermal design point (TDP) of 60 watts to 110 watts.

The small cell solution also leverages Intel® Transcende™ T3000 LTE/dual-mode small cell SoC. The Intel Transcende T3000 SoC is a complete small cell base station on a chip, supporting concurrent multistandard operation with carrier-grade software performance for high speed packet access (HSPA) and LTE networks. The Intel Transcende T3000 SoCs handle the complete signal flow from the radio interface to IP packets for network connectivity. The Intel Transcende T3000 SoC family supports 20 MHz channels and MIMO (2x2) antenna support and interoperability with either TD-LTE or LTE FDD.

## Conclusion

Dramatically increasing volumes of indoor cellular data is driving a need for more indoor cellular infrastructure. Baicells M-RAN is a virtualized RAN system that provides 4G/LTE services today with a path to 5G in the future. The virtualized system can help manage the cost of this infrastructure through its scalability and power management capabilities.

## About Baicells

Baicells is a customer-oriented high-tech company providing innovative and affordable LTE solutions that can be used by mobile operators, fixed/wireless operators and ISPs, MNO/MVNO, governments, and enterprise private networks. With the vision of “connecting more with less driving the ultimate LTE experience,” Baicells has introduced some real breakthrough technologies to LTE, including OpenRAN architecture, SDN-based architectures, as well as LTE on unlicensed spectrum (5.8GHz/CBRS, etc.). With Baicells’ end-to-end turnkey solutions, it becomes much easier for operators and ISPs to provide wireless broadband within everyone’s reach. More information is at [www.baicells.com](http://www.baicells.com).

## 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>.



<sup>1</sup> Testing conducted by Baicells. Configurations: 1x Intel® Xeon® processor D-1548 with 16 cores, 32 GB of DDR4 RAM, integrated Ethernet controller supporting four 25 Gbps connections and four 10 Gbps connections.

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