# Wi-Fi enabled in-building 3G/4G base station

*RAN innovator enhances in-building 3G/4G base stations with Wi-Fi, to give mobile operators cost-effective converged access solution for reliable Mobile Internet in high density public venues and enterprises.*


## CASE STUDY

A leading innovator of scalable small-cell Radio Access Network (RAN) systems recognized an opportunity to broaden its market appeal and increase its competitive advantage, by integrating Wi-Fi access into the same platform. Their solution enables mobile operators to give large venue owners and enterprise customers, reliable 3G and LTE/4G coverage within premises of any size.

### *Radio Access Networks*

Large public venues such as stadiums, arenas and convention centers, even shopping malls are notorious for lousy cellular coverage because there are simply too many mobile users competing for access. Internet demand from smartphones and tablets, which account for nearly 50% of all mobile phones, only makes the problem worse. With the Mobile Internet in the palm of their hands, this problem has now spread to Enterprises, as employees' desk phones sit idle - displaced by a friendly, more flexible, and personalized Internet-ready device – the smartphone.

This incredible shift is a huge problem for Enterprises and venue operators alike. While for mobile operators, it is an opportunity to sell a lucrative managed service that alleviates the problem.

The solution consists of a network of small 3G/4G radio cells (Radio Nodes) distributed through the premises over a switched Ethernet infrastructure. Distributed radios multiply 3G/4G access capacity by a quantum leap. While the switched infrastructure tunnels all calls back to the operator's Mobile Core via a Radio Node Controller and the customer's high-speed internet trunk.

### *Multi-mode wireless access*

If you have a network of Access Points (AP) for cellular, why not use it for Wi-Fi access as well, and increase capacity even more? That's what Distributed Antenna Systems (DAS) are designed to do, but they are expensive and proprietary. The company recognized the opportunity. By combining 3G/4G and 802.11 in the same AP they could deliver converged wireless access, and remove the need for a separate Wi-Fi overlay. This significantly increased their addressable market.

*Working with embedUR we tapped into Wi-Fi expertise that takes years to accumulate. In just 6 months, they helped us gain a huge competitive lead.*

*A.T., VP Product Management*

## OBJECTIVE:

Seize first mover competitive advantage with mobile operators, by integrating Wi-Fi access with 3G/4G in-building Radio Access Network, to create cost-effective converged wireless access solution.

## SOLUTION:

***Radio Node***

- Ported wireless SDK to CPU
- Brought-up 11n module

***Radio Node Controller***

- Ported WLAN Controller SDK
- Optimized control-plane

## RESULTS:

- Concept to market in 6 months
- First to deliver converged access
- Maintained competitive lead
- Focus kept on core solution
- Field trials in over 20 networks

### *embedUR engaged to add Wi-Fi*

The company first approached embedUR for our expertise in WLAN Access Point and Controller software development. They soon realized our deep experience porting Wi-Fi drivers and software across different multi-core processors would be a critical success factor as well.

First we would need to port, bring-up and productize the complete Wi-Fi radio and processor subsystem software on the AP. Second, we would need to enhance the Radio Node Controller with Wireless LAN controller software and new control-plane and security protocols, without requiring processor upgrades to the platform. It was clear that performance optimization would be important.

### *11n radios with wireless SDK*

To add Wi-Fi to the Radio Nodes, 11n radio modules from a customer-selected chipset vendor were used. Our job was to port boot loader, OS and access point software stack, from the vendor's wireless SDK to the new hardware. Although this involved the client in designing and building new Radio Node hardware, it was relatively easy and fast, as all chipsets came from the same vendor. In addition to software porting, we also added diagnostics and various client-specified customizations. We then carried out extensive interoperability testing, performance benchmarking and Wi-Fi pre-certification testing.

### *Controller port across chipsets*

For the Radio Node Controller, we ported controller software from the same chipset vendor's SDK to carry out all the Wi-Fi control functions. But this time, we needed to port the software to run with an Ethernet switch platform from a completely different chipset vendor. This switch was already an integral part of the Radio Node Controller architecture, and the client did not want to redesign the platform, as it would increase time-to-market by many months.

Our job was to port the WLAN Controller software and diagnostics, and to design and execute a comprehensive test plan to fully validate functionality. Porting the controller software across different chipsets i.e. working with one chipset vendors SDK to migrate APIs to support a different chipset vendor's platform, required designing a shim or OS abstraction layer which would map over 100 different API calls to the switch chipsets. This required expertise and prior knowledge of APIs on both switching platforms.

### *Concept to competitive advantage in 6 months*

This project was completed in just over 6 months requiring 2 man years of embedded engineering expertise. During this period, the client's engineers were able to stay focused on their core solution - enhancing scalability, adding features and improving management, while embedUR brought up the new Wi-Fi enabled Radio Node with all the embedded infrastructure needed to support the new features and got it interworking with the Radio Node Controller. This enabled them to increase their competitive lead, and penetrate high profile mobile operators.

The new converged wireless access Radio Nodes are now in extensive field trials in public venues and enterprises across the US. Being one of the first small-cell providers to offer both cellular and Wi-Fi, the company is uniquely positioned to address almost all competitive opportunities before them. They might not have gained this competitive advantage, if they had taken on the Wi-Fi project themselves, instead of engaging embedUR to help them accelerate time to market.