# Distributed Radios Need Centralized Intelligence

John Spindler, Director of Product Management for In-building Wireless Products at TE Connectivity

The rise of 4G services is dictating a new radio network architecture for mobile operators. Rather than relying on macro cell sites operators deploy small cells that bring capacity closer to the end customer. One way to bring capacity closer to the end user is to deploy a network of distributed radios, essentially small base stations that are placed on utility poles or buildings. Another way to distribute signals and capacity is to link centrally housed base stations with distributed antenna systems (DAS), which distribute base station signals from any location throughout buildings or neighborhoods, cities or campuses. In this article, we'll look at the pros and cons of each approach.

Distributed radio architecture envisions placing picocells, femtocells, and microcells at specific locations close to the user population. The advantage of this approach is that the mobile operator can place capacity exactly where it is needed. Since there are many of these radios there are fewer users competing for each radio's capacity, and everyone gets good quality of service. In addition, distributed radios are relatively low cost to acquire and deploy.

However, distributed radios must be individually backhauled and maintained. Rather than having to maintain one macro cell in a given area, the mobile operator may have to maintain dozens or even hundreds of distributed radios, raising operating costs. And providing adequate backhaul facilities for each radio can be difficult.

Distributed radios support just one or two frequency bands, so an operator wanting to support several frequency bands must deploy multiple radios in each location. And in order to upgrade service to newer technologies, additional radios must also be deployed. Each network change adds equipment and infrastructure.

Another issue with distributed radios is that all radios in a system must be bought from the same supplier, so the mobile operator is tied to the vendor's technology development cycle.

Finally, distributed radios can have interference issues when many radios are used in close proximity to one another. It's necessary to carefully adjust and control each radio's power level to minimize interference with other radios nearby. Each distributed radio also needs its own spectrum, so this approach is not spectrally efficient.

While distributed radios may seem a promising solution to small cell architecture needs, they cause as many challenges as they address and they lead to a RAN architecture that is cluttered, making the network more difficult and costly to maintain, backhaul, and upgrade.

Another way to create a small cell network is to separate coverage from capacity. While the distributed radio concept links coverage and capacity in the same device, it is possible to centralize radio resources and distribute their signals with DAS (Figure 1) to create a flexible and scalable small cell network.

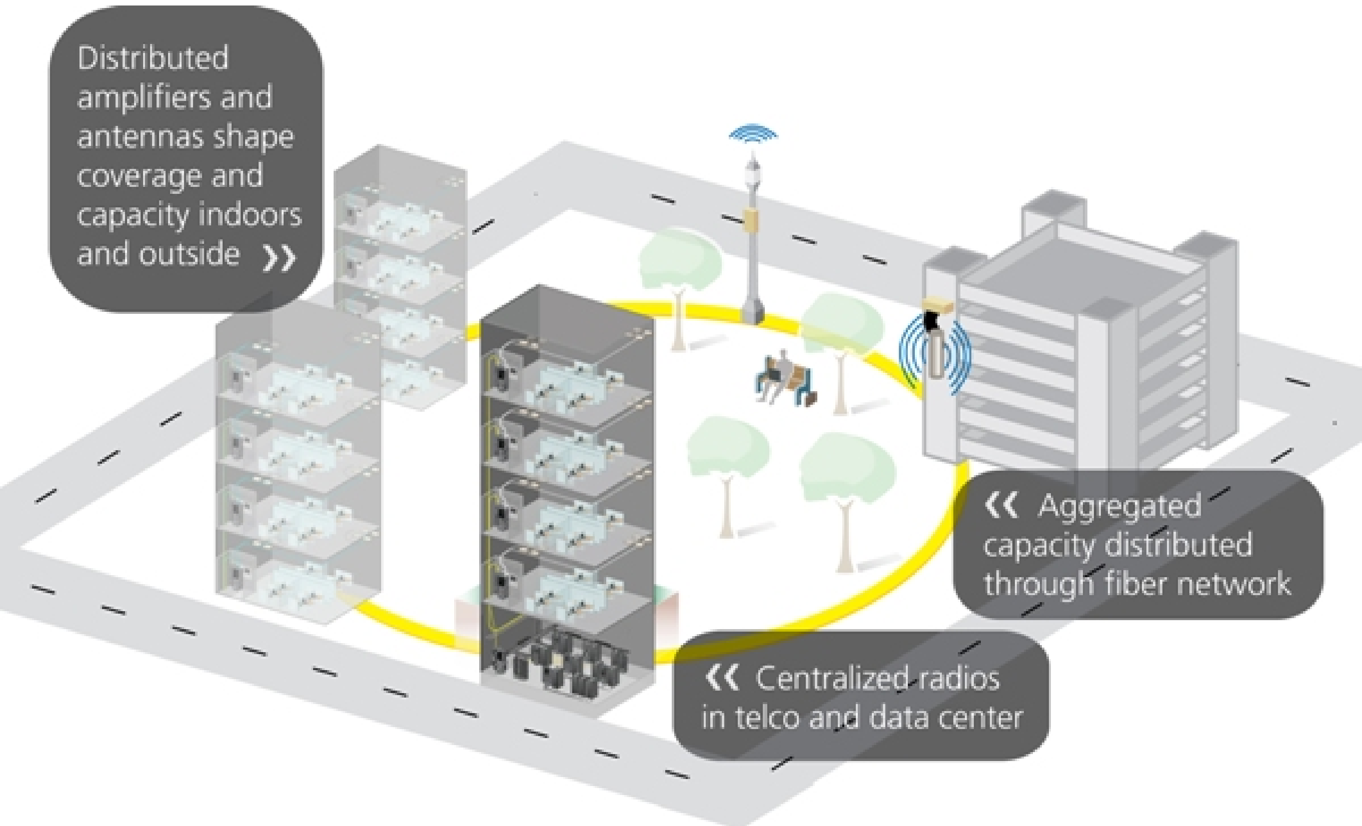


Figure 1: Centralized radio resources with DAS-based signal distribution.

This approach has several advantages over distributed radios. Since the radio resources are centralized in a base station hotel, they are much easier to backhaul and maintain than a far-flung network of distributed radios. The DAS is used to distribute the signals from the BTS hotel, and the DAS is simple and inexpensive to maintain.

When it is necessary to add more capacity or new frequency bands in the system, the operator can simply add a new base station or channel card to the centralized hotel. The DAS will automatically distribute the new frequency or capacity.

The DAS-radio combination also makes better use of capacity resources. Rather than tying small, distributed radios to specific locations, the DAS can extend into multiple locations so the radios’ capacity is not stranded in any particular location. For example, imagine a network of distributed radios serving a neighborhood, commuter station, and downtown area. As people leave for work in the morning, the capacity in the neighborhood goes unused until they return from work at night. Similarly, the capacity at the commuter station is idle or underused at all times other than peak commute hours. If these areas were covered by a centralized BTS hotel and all-digital DAS networks, on the other hand, the capacity would be used in the areas where it is needed throughout the day.

In addition, DAS can be expanded to cover new areas whenever necessary. Rather than having to deploy more distributed radios, a mobile operator can add more DAS nodes to cover a new area from the existing base station hotel.

When comparing DAS networks in a multi-operator environment, the benefits of DAS grow at the same rate as the number of operators. Distributed radios require distinct radio solutions for each Wireless Service Provider. DAS systems are multi-operator. So the number of antenna sites, service, backhaul/fronthaul are shared over the multiple operators so the benefits of the system are multiplied by each operator added into the system.

The downside to using DAS is cost. Radios are still required for the signal source and fiber or coax are required for infrastructure. In many cases, however, outdoor DAS can share existing fiber originally deployed by wireline operators or MSOs, which saves the cost of fiber deployment. In any case, the extra capital expenses required for DAS will be more than made up by lower operational expenses and a system that is far easier to expand, upgrade, and maintain. And while more simple to build than a macro site, many municipalities are still learning about DAS and are defining standard operating procedures, as they have for macro cell site construction.

When looking at two alternatives for deploying small cells, we can see that distributed radios alone bring cost and complexity into the network while limiting operator flexibility to expand and upgrade, while a combination of centralized BTS hotels and DAS delivers flexibility with much lower operating costs.

**About the Author**

John Spindler was named Director of Product Management for TE Connectivity’s (TE) wireless business in December 2010 when TE acquired ADC. Previously he served as Vice President of Product Management for ADC’s Wireless Business Unit, as a result of the company’s acquisition of LGC Wireless in December 2007 where he served as Vice President of Marketing. In his current role, Spindler is responsible for developing and managing an innovative wireless product portfolio for the company’s Wireless Business.

During his more than 20 years of industry experience, Spindler has held a variety of product management positions with companies such as Nortel Networks, GTE and InteCom. In these positions, he had responsibility for the areas of networking, network management, computer telephony integration and wireless technologies.

Spindler received a Bachelors of Arts Degree from the University of California, Los Angeles (UCLA) and an MBA from the University of Southern California, Los Angeles.

**Posted April 25, 2012**