XCellAir: A shared solution to manage Wi-Fi and LTE unlicensed traffic

A conversation with Narayan Menon, CTO and EVP of Engineering, XCellAir

By Monica Paolini
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XCellAir: LTE unlicensed and Wi-Fi

XCellAir, a spinoff from InterDigital announced in February 2015, provides a shared solution with which operators can manage large-scale LTE and Wi-Fi networks within a HetNet framework.

To address the surge in data traffic, mobile operators have to move beyond the limited small-cell deployments that dominate in their networks today, to large-scale densification deployments that will involve multiple access technologies (Wi-Fi and LTE), multiple bands (licensed and unlicensed), and multiple vendors. A denser and more complex network infrastructure will increase operators' need for scalability, reliability and resiliency. At the core of the XCellAir solution is SON functionality to address the requirements of operators managing – or preparing to manage – these multi-access, multivendor networks.

XCellAir aims to go beyond coexistence of network elements, and to maximize resource utilization and revenue generation. XCellAir's is a shared platform that takes into account real-time RAN performance data, policy, and application and traffic information.

The unified management system includes

- Radio resource management (RRM)
- SON
- Capacity optimization
- Analytics

Deploying and managing a network with multiple access technologies makes it possible for an operator to benefit from the specific strengths of each technology – e.g., using higher frequencies for indoor coverage and lower, licensed frequencies for outdoor hot spots and wide area coverage. In turn, the improved network utilization can reduce per-bit costs and improve coverage.

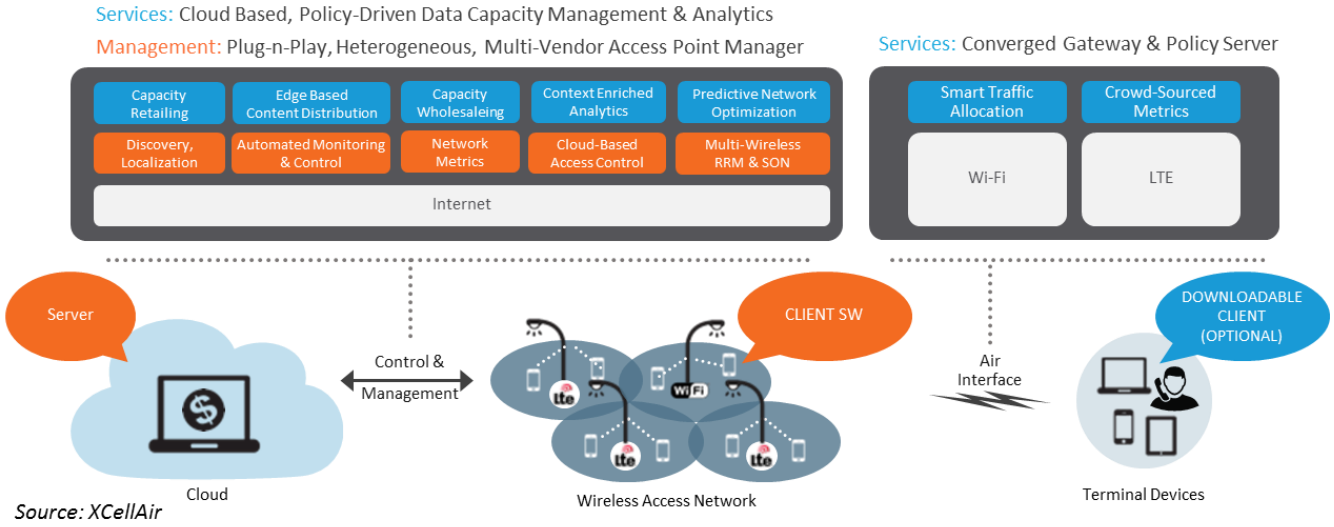
In line with the trend toward virtualization, XCellAir takes a cloud-based approach designed to provide the flexibility and scalability that operators require as they build out and expand dense, large-scale HetNets. The cloud-based architecture supports SaaS business models geared toward a shift from a capex-intensive business model to a cost model more tightly linked to the pace of network growth.

The integrated LTE and Wi-Fi network management solution leverages development work previously done at InterDigital and contributions from two ecosystem partners:

- GoNet, for the management of in outdoor and indoor deployments, with high-performance Wi-Fi access points with MIMO and beamforming
- AirHop, for SON functionality supporting LTE-A features in LTE-TDD and LTE-FDD networks

In this context, LTE unlicensed is treated as another air channel. Mobile operators can use traffic steering and load balancing to decide how to allocate traffic across technologies, depending on network loading, user preferences, subscription plans, location, time of day, and RAN conditions.

XCellAir's solution integrating LTE and Wi-Fi management



Source: XCellAir

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Monica Paolini: Welcome to our conversation with Narayan Menon. He is the CTO and EVP of Engineering at XCellAir, and one of the company's founders. Today's conversation is part of our report on LTE unlicensed.

Narayan, thanks a lot for taking the time to talk to us today.

Narayan Menon: It's my pleasure to talk to you about these topics.

Monica: XCellAir is a new company that just came out of stealth mode. Can you tell us what is it you do at XCellAir?

Narayan: At XCellAir, we are developing network management and optimization solutions for HetNets, and particularly for LTE small cells and Wi-Fi networks. The company was formally launched a few weeks ago. It's a spin-out of InterDigital and folks who were at InterDigital in its early years, like I and the rest of the team were. The technology was initially incubated and developed starting in late 2013 in InterDigital. A few weeks back, the team and the technology were transitioned over to XCellAir, which was launched just before the Mobile World Congress in Barcelona. Our solution includes both management and optimization of mobile traffic. We cover things like provisioning, configuration management, fault management, and optimization techniques like SON, applied to both Wi-Fi and cellular.

We also deal with optimization aspects – like traffic management, capacity management, and traffic steering – that apply to both Wi-Fi and cellular. It's a cloud-based, scalable, multivendor, multi-technology solution.

Monica: This is a brand new solution, but you have a lot of experience and substantial work already done. You start off in a very good position. It's really a very hot topic right now because all operators are working with both Wi-Fi and cellular. Obviously they face a big challenge in how to combine the two.

To date, mobile operators have used a basic offload type of environment in which, whenever there is Wi-Fi, you use it. There is not much coordinating and integrating of the two sources of traffic.

With LTE unlicensed, there will be an additional layer of complexity, integration, and opportunity at the same time. How will LTE unlicensed fit in with both Wi-Fi, on one end, and licensed LTE on the other end?

Narayan: LTE unlicensed, the way we see it, is going to be a nice complement to LTE the way it is today. It will help augment the capacity and bandwidth available to LTE systems by being able to take channels in the unlicensed band and aggregate them with channels in the licensed band. It serves as a bandwidth boost for the LTE solutions.

Most of the scenarios you're talking about involve both the macro cells and small cells, and aim to give this bandwidth boost. They also segregate traffic intelligently between licensed or unlicensed spectrum, based on quality-of-service requirements.

Wi-Fi is a very key aspect to consider, because when LTE operates in these bands, in the 5 GHz band, it will need to coexist with Wi-Fi, as well as with other LTE systems that are operating in the same band, following the channel access etiquette. This etiquette and the rules that apply within the band become very important. It is crucial that one network doesn't trample on the others. The LTE system should not trample on or interfere with the Wi-Fi solutions.

The coexistence of the two systems, Wi-Fi and LTE unlicensed, will become very, very critical. That's the way they would relate to each other. One would not necessarily displace the other. Wi-Fi will have its own place and continue to have its place in the sun. What this enables is for the LTE solutions to expand and reach out on the unlicensed spectrum and gain more bandwidth.

Monica: There are going to be locations where there is only Wi-Fi or only LTE unlicensed. That's relatively easy to manage. The challenge for the operator is to operate in locations with a

combination of Wi-Fi, LTE unlicensed, and LTE. How can you help an operator steer different types of traffic to the different interfaces?

Narayan: A very interesting, very relevant question. There are multiple ways to do traffic steering, or traffic segregation as we call it.

It could be done based upon policy – policy as it relates to the user's SLA, as it relates to the user's quality-of-service requirements, as it relates to the type of application. The policy could end up placing some applications on one system and other applications on the other system.

For example, the operator might prefer to keep applications that require a high level of quality of service and reliability on the licensed band – whereas best-effort traffic, for example, might be placed on the unlicensed band. Or it could be the other way around, depending on the scenario.

The operator could also leverage this to provide wholesaling capabilities to in-house customers and third parties. The bandwidth that is wholesaled to the third party might come out of the unlicensed band, or it could be the other way around. The operator may prefer to place that on the licensed band. LTE-U gives the operator the flexibility to choose.

Network conditions are another angle. As conditions change, the system has to be adroit enough, nimble enough, to be able to move things around. If a particular application is on the unlicensed band and things start to get flaky because there's too much contention there, the system might move that piece of traffic back to the licensed band.

Those kinds of mechanisms – based on awareness of the network conditions, based on awareness of latency, throughput, packet loss rates, etc. – have to come into play to make this work really well.

Monica: This level of complexity is difficult to manage. But if you manage it correctly, it brings a lot of value to the operator because it can use the resources more efficiently. You're combining the real-time network information from the RAN with policy.

Narayan: A third element that comes into play is user preferences. On top of all of these requirements, the user might have certain preferences – for example, not to use the unlicensed band at all, or in certain scenarios or locations.

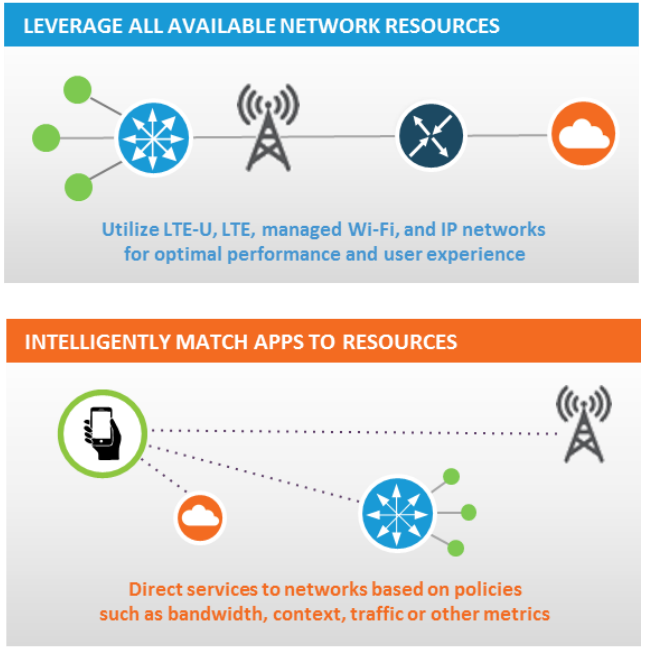
Monica: Voice is a special case. How can an operator manage voice where you have three different interfaces?

Narayan: Voice will be treated as one of the applications. It's obviously a key application. Especially as we move more and more to VoIP and away from the circuit switch world, network quality, link quality and quality of service become more and more important. In the case of voice, the default preference is to keep that on the licensed side. If you're using VoIP, there's no reason why you couldn't be on either side.

This would be subject to the actual network conditions. If the voice call is on the unlicensed band and the conditions start to get bad, the operator needs to be able to hand the voice call back over to the licensed band. That capability becomes very important. In a sense, VoIP, video and other applications could be associated to a per-user policy.

There would be a per-user, per-application policy that really depends on what the user has signed up for and paid for. Based on that policy, the application might be placed in one place or the other. Then if network conditions change, the application can be moved back and forth. If the user has some preferences applied on top of that, those preferences would need to be respected as well.

XCellAir's optimization of network resources



Source: XCellAir

Monica: The same flexibility can be used when an operator has to manage IoT applications, for which you have different types of devices and different requirements.

Narayan: Absolutely. IoT is such a diverse world. There are tons and tons of applications in the IoT space. Some of them, such as health care applications, will require higher reliability.

You may want to keep those on the band you consider to be more secure, more safe – perhaps on the licensed side. Some applications within the IoT space that may be best effort or may be possible to do after hours have more flexibility in terms of placing them on the unlicensed side.

Monica: Mobile operators today use unlicensed spectrum through Wi-Fi offload, but they don't really manage it. With LTE unlicensed, they face a new challenge because they have to manage traffic both in licensed and unlicensed bands, using the same air interface.

Narayan: The management of mobile traffic with respect to LTE-U has to happen at two levels. At one level, there have to be mechanisms in place to make sure that the LTE system, when it operates on the unlicensed band, is following the rules and etiquette that apply on that channel and on that spectrum, to ensure that it doesn't cause any kind of damage to Wi-Fi services.

LTE-U should not impact Wi-Fi any more than another Wi-Fi system on the same branch of the system. That's where listen before talk and similar mechanisms come into play. And on top of that is the traffic steering, traffic management capability we talked about: being able to place traffic intelligently on one or the other band, based on these factors that we outlined previously.

There's a challenge in terms of how effectively that gets done, but it's also a huge opportunity for operators.

It is two levels. One is fundamentally making sure that the mobile traffic is not impacting or impeding other types of traffic in the unlicensed band. The second aspect is once you've conquered that, you try to make best use of that bandwidth with the right things in the right place.

Monica: Let's go back a little bit. Wi-Fi is widely available. Every handset has Wi-Fi. Why does an operator need LTE unlicensed? What is he going to gain from it that Wi-Fi cannot deliver?

Narayan: That's a great question as well. Wi-Fi is there today. As you mentioned earlier, it exists in a somewhat disparate fashion. Today, when you go home, the iPhone switches to Wi-Fi no matter what. There's no real control. Like you said, Monica, there's no real management, there's no control of that. There's no ability to put certain types of traffic on Wi-Fi, some types of traffic on cellular. Those elements are missing now.

Cellular standards have tried to foster more integration of Wi-Fi networks into the cellular core. They haven't yet come into play on a large scale in the cellular network.

LTE-U provides another, and in some ways more interesting, more tightly coupled way to combine transmission in the two types of bands, without forcing the integration of Wi-Fi with LTE.

You're not trying to integrate your Wi-Fi solution with LTE. LTE-U is another way of tapping into, or leveraging, the unlicensed band without necessarily trying to couple Wi-Fi with cellular or integrate Wi-Fi with cellular in a very tight fashion. That's the opportunity here – to be able to use LTE-U to provide bandwidth aggregation and bandwidth segregation.

It could be used either to segregate traffic, like we discussed before, or to aggregate bandwidth, or to provide more bandwidth to an application when it needs it. When a single application needs more bandwidth, you reach out on the unlicensed band, grab a couple of channels, aggregate them, and you get this boost.

This ties in nicely with the LTE architecture. Some of these mechanisms, such as listen before talk and radio resource management schemes, will get built into the LTE architecture. It becomes a much more holistic solution that happens to be on the unlicensed band.

Monica: For an operator, LTE unlicensed is a way to leverage unlicensed spectrum in a more efficient way, and that's good.

But what about Wi-Fi? Is LTE unlicensed going to be nice enough to the existing Wi-Fi infrastructure there? Should we worry about it? There are a lot of worries that it's going to create a lot of disruption in Wi-Fi networks. Do you think that challenge is being addressed right now?

Narayan: That challenge is being addressed quite adequately, in my opinion. There was a study item that 3GPP started a while back to study LTE-U and the impact on Wi-Fi, to come up with requirements and recommendations for what needs to be done to ensure that the LTE systems don't disrupt the Wi-Fi systems in place. The end of that study item resulted in a technical report which outlines several recommendations.

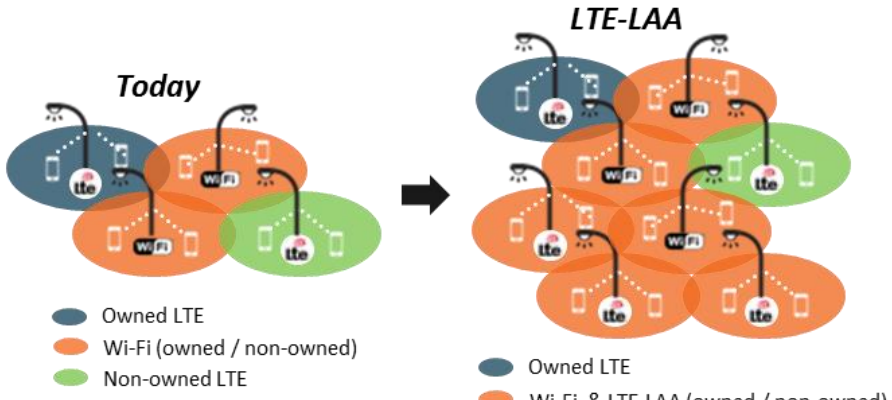
One of those recommendations, one of the key ones, is listen before talk (LBT). That's essentially making the LTE system do a channel check to see if there's any activity on the channel, via energy sensing or energy detection on the channel, before trying to access and use that channel. It's essentially making LTE behave almost like Wi-Fi. That's what Wi-Fi does with the collision detection in that band.

There are other things as well. They recommended the use of dynamic frequency selection (DFS) to prevent interference with radar and other systems that operate on the 5 GHz band in some countries.

One other recommendation is to use discontinuous transmission to ensure that you don't hog the channel and increase the probability of collision due to an existing Wi-Fi system trying to access the channel. In 3GPP, we've discussed things like radio resource management schemes that will come into play.

For Wi-Fi and LTE systems to coexist, we believe that some of the SON schemes will have to evolve to incorporate awareness of other systems. Today's SON solutions are LTE-specific. Or in some cases, there's limited SON functionality in some

XCellAir's solution to manage LAA-LTE interference



BS ID	Type	Owned	Channel	SS
SSID: XCellAir	W-Fi	N	3	-60dbm
Operator A	LTE-U	Y	7	-80dbm
Operator A	LTE-U	Y	7	-80dbm
SSID: Guest	Wi-Fi	N	6	-102dbm
SSID: Free-Wi-Fi	Wi-Fi	N	7	-60dbm
Operator A	LTE-U	Y	7	-80dbm
Operator B	LTE-U	N	8	-72dbm
SSID: Carrier Wi-Fi A	Wi-Fi	Y	5	-80dbm
SSID: Carrier Wi-Fi B	Wi-Fi	N	3	-102dbm
Operator C	LTE-U	N	11	-80dbm
SSID: Carrier Wi-Fi A	Wi-Fi	Y	10	-60dbm

Source: XCellAir

Wi-Fi systems. One technology is not cognizant of the other.

We believe SON has to evolve significantly to create this multi cross-technology awareness. That's an area we can have at XCellAir. Our solutions address the whole network management with multi-technology access designed into our solution from the beginning. Extending our SON's schemes to provide this kind of multi-technology coordination in the unlicensed band would not be difficult at all for us to do.

Monica: What's special about what you do at XCellAir, in terms of how you help operators deal with this challenge?

Narayan: A big part of our solution is network management and optimization. We provide the ability to configure, provision and fault-manage small cells and Wi-Fi access points. Also, we

combine that with optimization and SON capabilities, such as optimal channel allocation and interference mitigation schemes.

The nice thing is that these are all tied into one solution. Traditionally, network management and SON tended to be uncoordinated. We combine these into one end-to-end solution. To that, we are adding other capabilities, like traffic management, traffic steering, and bandwidth management, into one holistic solution.

We help the operator accelerate the rollout of small-cell networks. Today, one of the impediments for small-cell network adoption is the lack of plug-and-play automated procedures to bring up small cells quickly. If you want to bring these up in large numbers, you need much-more-automated procedures than what the macro-cell network procedures support today.

With our solution, we help operators to manage millions of units in a hands-free, zero-touch fashion. We enable the operator to get the small cells up and running fast, and to be able to manage them easily and scale the network easily. Then, we enable the operator to extract value out of the network by adding other aspects, such as capacity band and the bandwidth optimization.

One aspect is acceleration of deployment. Other ones are ease of management, and value extraction from the access technology the operator deploys.

There are three key attributes that make our solution unique.

One is that it is access technology independent. From the outset, we have designed it to be unified across LTE and Wi-Fi – and LTE-U can be easily added to that. We have developed the system with reusable components that enable us to go from Wi-Fi to LTE very quickly.

This enables us to support the two systems with a unified visual interface, a common set of algorithmic tools, a common set of database components, etc. This is unique, because a lot of systems start with one technology and then try to move to the other. They're breaking concrete to do that.

The second key aspect is our multivendor approach. One of the issues that operators will have with large-scale small-cell deployments is that they will inherently end up going multivendor. Today, each vendor solution comes with its own native management capability, its own EMS. What we provide here is a multivendor solution that easily works across multiple vendors' access points.

The way we do it is that the vendor specificities are isolated or confined to a small part of our system. Large parts of our system that deal, for instance, with the algorithms, the databases and the virtualized tools do not get impacted when we move from one technology to the other. This enables us to adapt to each vendor's specifications very quickly and flexibly.

The third piece is the scalability. Our solution is virtualized today in the cloud. It makes the network bandwidth solution very scalable for the operator. As opposed to buying big controller boxes upfront, the operator can scale the solution very granularly as the network grows and as it adds more access points. Resources on the cloud side – such as processing, memory and storage – can be scaled very gradually, very granularly. Operators are able to scale as they grow. They pay for those resources as they scale. That gives them a lot of flexibility.

Monica: In closing, can you tell us what we should expect next from XCellAir? This is all new ground. What's coming next?

Narayan: On one hand, we are working very promisingly towards taking our technology to market. We are dialoguing with operators, we are dialoguing with vendors to integrate our solution with different vendors' access points. In our near-term roadmap, our goal is to get the ecosystem dialogs going, get the IoTs, get to the lab trials, pretrials in the next few months, and get this to market very quickly.

In the longer term, we will focus on the capacity and bandwidth management capabilities and on analytics. We collect, store and analyze a lot of information from the access points within our system – attributes, metrics that relate to network performance, subscriber data that we get from the access points. All of that data can be analyzed and made available to the carrier or service provider, via either well-defined APIs or analytics capabilities that we will provide in the future.

Of course, support of LTE-U is on our roadmap, as well as supporting community Wi-Fi networks and enabling coordinated management of community Wi-Fi networks.

Glossary

3GPP	Third Generation Partnership Project
API	Application programming interface
BS	Base station
DFS	Dynamic frequency selection
EMS	Element management system
HetNet	Heterogeneous network
IoT	Interoperability testing
LBT	Listen before talk
LAA	License Assisted Access
LTE	Long Term Evolution
LTE-FDD	LTE frequency-division duplex
LTE-TDD	LTE time-division duplex
LTE-U	LTE unlicensed
MIMO	Multiple input, multiple output
RAN	Radio access network
RRM	Radio resource management
SaaS	Software as a service
SLA	Service-level agreement
SON	Self-organizing network
SSID	Service Set Identifier
SW	Software
VoIP	Voice over Internet Protocol

About XCellAir

XCellAir enables wireless service providers to efficiently manage, optimize and monetize their wireless access networks. Heterogenous Networks (HetNets) consisting of Wi-Fi and/or cellular small cells can deliver massive increases in capacity, extended coverage and a lower cost-per-bit for wireless service providers, but – to date – their potential remains largely unrealized. This untapped potential is why XCellAir exists. XCellAir provides the industry's first cloud-based, multi-vendor, multi-technology mobile network management and optimization solution.

About Narayan Menon

At XCellAir, Narayan develops and evangelizes the technology strategy and roadmap, and leads product development. Prior to XCellAir, Narayan drove research and development for InterDigital, leading elite teams to innovate and implement next-generation wireless solutions – including the inception and early development of the XCellAir product. Narayan has over 25 years of experience in the wireless field, holding leadership roles at Siemens Mobile Networks, Omnipoint Technologies and Hughes Network Systems in the development of TDMA, GSM/GPRS and 3G systems. Narayan holds Engineering degrees from the Indian Institute of Technology, New Delhi and an Executive MBA from Hofstra University.

This conversation is included in the Senza Fili report
"LTE unlicensed and Wi-Fi: Moving beyond coexistence,"
prepared in collaboration with RCR Wireless News and available for download
from www.rcrwireless.com and www.senzafiliconsulting.com

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About Senza Fili

Senza Fili provides advisory support on wireless data technologies and services. At Senza Fili we have in-depth expertise in financial modeling, market forecasts and research, white paper preparation, business plan support, RFP preparation and management, due diligence, and training. Our client base is international and spans the entire value chain: clients include wireline, fixed wireless and mobile operators, enterprises and other vertical players, vendors, system integrators, investors, regulators, and industry associations.

We provide a bridge between technologies and services, helping our clients assess established and emerging technologies, leverage these technologies to support new or existing services, and build solid, profitable business models. Independent advice, a strong quantitative orientation, and an international perspective are the hallmarks of our work. For additional information, visit www.senzafiliconsulting.com or contact us at info@senzafiliconsulting.com or +1 425 657 4991.

About the interviewer

Monica Paolini, PhD, is the founder and president of Senza Fili. She is an expert in wireless technologies and has helped clients worldwide to understand technology and customer requirements, evaluate business plan opportunities, market their services and products, and estimate the market size and revenue opportunity of new and established wireless technologies. She has frequently been invited to give presentations at conferences and has written several reports and articles on wireless broadband technologies. She has a PhD in cognitive science from the University of California, San Diego (US), an MBA from the University of Oxford (UK), and a BA/MA in philosophy from the University of Bologna (Italy). She can be contacted at monica.paolini@senzafiliconsulting.com