



Hype or Ripe?

5 Essential Elements of the 802.11ac Wave 2 Business Case

1. Realizing the Benefits of Advanced Wireless Technologies
2. Making the Most of Capital Budgets
3. Minimizing Operating Expenses – IT Operations
4. Maximizing End User Productivity
5. Benefiting from Related Networking Advances

You know the drill: IT managers everywhere today have the same set of objectives. Reduce costs. Improve implementation schedules. Boost end-user productivity. And align IT operations with overall organizational goals. It's clear that any technology that contributes to accomplishing these goals should be on the front burner.

And throughout their long (almost 20 years now) and remarkable history, Wi-Fi-based wireless LANs (WLANs) have been doing exactly that. WLANs have enabled IT organizations to cut network expense, and mobility has enabled the workforce – *across the entire organization* – to become more productive. And the price/performance improvements that have also arrived with each new generation of Wi-Fi-based products complete the picture. That's why Wi-Fi is now the *primary* or *default* connectivity for users everywhere – in every organization, for essentially all mobile devices and every application.

So the excitement building around Wave 2 of 802.11ac comes as no surprise. Continual advances in wireless and chip technologies, radio design, solution architectures, and access point and client implementations have over the years enabled performance that has blown through that of the major wired-network generations – 10 Mbps, 100 Mbps, and, with 802.11ac, 1 Gbps. In fact, Wave 2 of 802.11ac takes us all the way to *1.733 Gbps* in most common implementations (see Figure 1).

Most importantly, Wave 2 of 802.11ac provides the capacity, and not just the raw throughput, to accommodate essentially any device and traffic mix with greater efficiency, less cost, and higher productivity, than has ever been possible before.

But, of course, this argument has been made for every new generation of Wi-Fi products. So IT managers today, dealing with the reduced budgets and requirements for ever-greater efficiency that still persist from the recession of almost a decade ago, are seeking to understand not just the realities of advances in technology, but even more importantly *the business justifications for making the new investments required to gain the benefits of all that Wave 2 has to offer – and why now is the time to plan for those investments.*

And, so, hence this eBook, which explores the five key justifications required to build a business case for Wave 2. Let's start with the obvious number one, the benefits inherent in the advanced technologies that underpin Wave 2.

Wi-Fi: Dramatic Progress in Performance

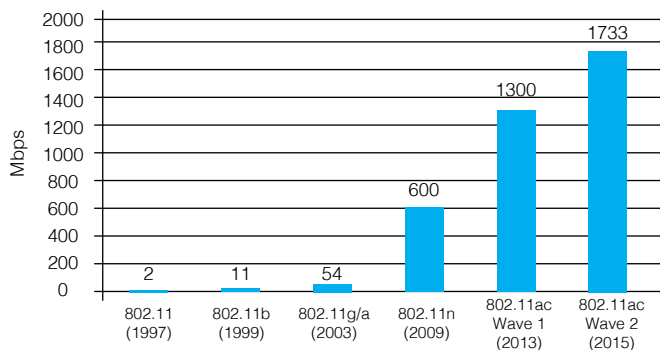


Figure 1



1. Realizing the Benefits of Advanced Wireless Technologies

While everyone marvels at the dramatic improvements in throughput we noted above (keep in mind that the first Wi-Fi products, in the late 1990s, operated at only 1 and 2 Mbps) throughput isn't really the issue anymore, especially as we talk about Wave 2's 1.7 Gbps. Rather, the real issue, is *capacity* – the ability to support large and increasing numbers of users, devices, and applications, many of which involve real-time voice and streaming video. No single user is likely to require 1.7 Gbps, at least not very often.

Even with a 33% improvement in peak throughput over Wave 1, the technologies of Wave 2 are more evolutionary than revolutionary, building on the innovations pioneered in 802.11n and made commonplace with Wave 1 of 802.11ac. These include greater *spectral efficiency* (more bits transmitted successfully per unit of time, bandwidth, and distance), and MIMO (multiple-input/multiple-output), the ability to make use of space, and not just frequency and time, in dramatically improving throughput. An additional innovation, *beamforming*, is also part of the 802.11ac standard. Beamforming is the ability to focus radio transmissions in the direction optimal for communications between a given access point and client at any given moment in time – and, to make real-time adjustments to compensate for motion and other changing radio conditions.

To date, all but a very few 802.11ac products have offered at most three MIMO streams, each with a maximum throughput, under optimal conditions, of 433.3 Mbps. Wave 2 ups this to four streams; hence the 1.733 Gbps we noted above. Interestingly, the 802.11ac standard actually specifies up to eight streams, but products implementing such are unlikely to become common, for reasons of both cost and complexity. Note also that most client devices, on the other hand, support only one or perhaps two streams, leaving, at first glance, the potential of 1.7 Gbps unfulfilled.

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But Wave 2 includes another innovation, known as *Multi-User MIMO (MU-MIMO)*, that is a truly astonishing – and productive – bit of technology. MU-MIMO enables multiple clients to receive a transmission unique to each client during a single transmission from a given access point (see Figure 2). So, instead of having to wait while other clients are served and potential bandwidth is wasted, overall efficiency is boosted, and dramatically, along with end-user productivity. This remarkable win-win is an easy way to enhance capacity, and a key justification to begin investing in Wave 2 now.

Multi-User MIMO

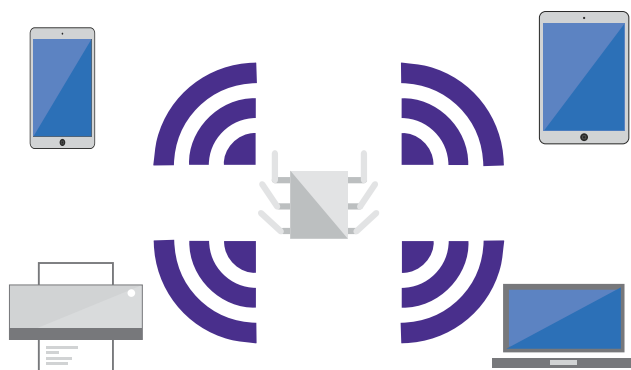


Figure 2



Wave 2 in Public Venues

Wireless traffic growth in many hospitality, sports, and entertainment venues – with their high density of users and devices and the ever-present requirement for instant communications – is motivating demand for the benefits of Wave 2 of 802.11ac. Indeed, we often define both the challenges and the solutions to core wireless LAN capacity demands in terms of density. This term can actually be used in this context to describe both demand (more clients, with ever-greater traffic demands, in a given location within an area covered by Wi-Fi) and also supply (decreasing the distance between access points and providing improved wireless efficiency so as to provide more raw bandwidth to all those users). Demand, after all only grows over time – consider the impact of the Internet of Things (IoT) with many new customer devices that will play a major role in security, location-based services, and other applications over the next few years.

2. Making the Most of Capital Budgets

As we noted above, capital expense (CapEx) budgets have been constrained since the recession of 2008, and this situation has, sadly, become something of a new normal. At the same time, a continuous stream of advances in information technologies have continued to motivate the historical justification for both infrastructure and client refresh cycles, albeit at a somewhat slower and more thoughtful pace than might have been the case in the past. And, of course, careful consideration of both absolute expense and especially return on investment must be part of all capital purchasing decisions.

What's truly remarkable about wireless-LAN equipment purchases, though, is that price/performance improves with each new product cycle (See again, Figure 1).

In general, available throughput increases dramatically, while prices for specific equipment (such as access points) remain the same or even decline. New capital purchases benefit from engineering and manufacturing economies of scale, as well as general advances in the state of the art.

It's thus easy to justify purchasing the latest generation of a given technology regardless of whether the requirement is a new greenfield installation, a partial or staged enhancement to an existing facility, or a wholesale upgrade.

802.11ac Wave 2 products are fully backwards-compatible with Wave 1 (and even to 802.11n), and offer improved performance over their predecessors when operating in backwards-compatible modes, thanks to advances in system architecture, product implementation, firmware, and more. Installations of any form are seamless and non-disruptive.

In fact, this improvement in price/performance with minimal installation expense brings up an interesting question – *is it in fact time to replace existing Wi-Fi implementations with Wave 2?* There's usually no easy answer here, as every organization needs to evaluate purchasing in terms of depreciation cycles, available funds, and compliance with overall IT and organizational strategies. But it is safe to say that any 802.11g (or earlier) implementations are indeed ripe for replacement, as so much has changed in terms of overall WLAN features and value.

802.11n systems will see increasing pressure for replacement as more Wave 2 clients become available, so as to take advantage of MU-MIMO. And, given the price/performance value, any purchases for greenfield installations are very likely to favor Wave 2 regardless – no earlier generation of Wi-Fi offers the technical and financial advantages at work here.



Wave 2 in Education

Education, from primary and secondary through higher ed, has always been a major consumer of wireless-LAN capacity. After all, who consumes more bandwidth than students, especially with the increasing utilization of streaming video and 1:1 computing? And who might want to attend a school without adequate Wi-Fi service? And yet, budgetary constraints often force many education IT managers to underprovision services in an effort to trade off coverage vs. the performance that the user base demands. **Wave 2 is a powerful step forward in addressing this challenge, provisioning more bandwidth – and more intelligently and cost-effectively – than any previous generation of Wi-Fi.** Oh – and a big bonus: higher throughput and improved connection reliability mean that battery life will be maximized, critical in mobile-centric education environments.

3. Minimizing Operating Expense – IT Operations

While the capital-expenditure element of Wave 2 of 802.11ac is clear, the operating-expense (OpEx) side is a bit more complex. Together, CapEx plus OpEx constitute Total Cost of Ownership (TCO), a key metric in determining Return on Investment (ROI) and valuing capital purchases over time (see Figure 3). But whereas seeing the benefits of capital expense is usually very easy, the situation with operating expense can be more challenging.

The reason for this is that operating expense consists of such activities as monitoring, managing, supporting, troubleshooting, and remediating – work that requires the attention of skilled IT professionals. And, unlike CapEx, OpEx tends to increase over time – people get more expensive thanks to inflation and competition for particular skills. This challenge can be met to a great degree, however, by improving IT staff productivity. So the question here is whether Wave 2 is likely to contribute towards this end - after all, we're talking evolution, not revolution, right?

But, as it turns out, Wave 2 implementations promise significant enhancements to IT staff productivity. First of all, improved WLAN performance (throughput, capacity, and support for time-bounded communications like voice and video) will result in fewer calls to support staff complaining of poor responsiveness, and coverage benefits from newer implementations of beamforming. Improved management and analytics (see #5) yield enhanced visibility and faster time-to-solution when problems do arise.

Overall, Wave 2 can lead to significant improvements in IT staff productivity, at least to the point where IT professionals can turn their attention to matters other than those related directly to wireless service, coverage, and reliability.

And, finally, whether Wave 2 is implemented as a new deployment, an upgrade, or a staged enhancement, seamless, flexible, non-disruptive, and low-cost scalability are part of the Wave 2 package, so any staff expense related to deploying Wave 2 is also minimized.

Total Cost of Ownership (TCO)

Capital Expense (CapEx)

Planning
Equipment (wired and wireless)
Installation and other NRE
Management and other software
Upgrades and enhancements

Primarily capital-intensive
Costs decline over time with engineering and manufacturing economies of scales

Operating Expense (OpEx)

Space
Power
Cooling
Network services
Support/Troubleshooting
Outage costs/lost productivity

Primarily labor-intensive
Costs increase over time unless productivity is enhanced

Figure 3



Wave 2 in Manufacturing

Manufacturing environments are among the most challenging settings for Wi-Fi services. Reliability is the most important element for wireless on shop floors and distribution centers, as the equipment and materiel flows here, along with the potential for harsh environmental conditions and even radio-frequency interference (especially at the 2.4 GHz frequencies that 802.11ac does not use), can restrict the ability of IT staff to deal with service issues without adversely affecting production. **The additional coverage and capacity of Wave 2 are thus perfect for manufacturing environments, enhancing capacity, mobility, and performance at any range in one of the most challenging environments possible.**

4. Maximizing End User Productivity

The true test of any networking strategy is best evaluated in terms of improvements to the productivity of the end-users served by the network. After all, with the network serving as the circulatory system of the organization, all network implementations are best judged on how well they serve the user base.

And, as we noted above, that user base is growing, and not just in terms of the number of users. Rather, thanks at least partially to the widespread adoption of bring your own device (BYOD) policies, ever-greater demand for service is accruing from users with multiple simultaneously-active devices. It's not at all unusual today to see users active with two devices (a handset and a tablet, for example), and perhaps even three or four.

Time is indeed money – or, we should say, productivity.

None of those devices, or any of those users, can tolerate a network that is slow, unavailable in certain locations, unreliable, or incapable of meeting growing needs, including support for streaming media and real-time telephony and similar communications. Time is indeed money – or, we should say, *productivity*.

And new applications like those related to the Internet of Things (IoT) promise to create significant additional demand for capacity, coverage, and time-bounded services. While many IoT applications will involve relatively light traffic loads, the sheer volume of these devices and the fact that many will indeed bring significant service demands (video surveillance, for example, and other real-time requirements) means that the Wi-Fi network serving all of these devices will really need to be on its toes – a situation made for Wave 2.

For end-users, it's about not just quality of service (QoS), but rather quality of experience (QoE). The more reliable, and more available the wireless LAN is, the more productive end-users will be. This is why more MIMO streams and multi-user MIMO are so important in scaling up wireless services in essentially every organization.

The bottom line: a small investment in new technology can have big payoffs in terms of minimizing operating expense via maximizing productivity, and thus in minimizing TCO and maximizing ROI.



Wave 2 in the Enterprise

Almost every enterprise today – and most government organizations as well – depends upon Wi-Fi as the primary and default communications for essentially all of their users.

With the density of these users and their devices always increasing, it's important to put in place solutions that meet this demand with minimal effort and cost.

Wave 2 is the culmination of years of science, engineering, and manufacturing effort building upon real-world experience in diverse, high-demand environments. And it provides a foundation to build on that will carry essentially all high-demand environments for many years to come.

5. Benefitting from Related Networking Advances

Finally, products based on Wave 2 of 802.11ac embody the latest in features and technologies designed to optimize the entire network value chain, from mobile and other clients to access points, controllers, switches, routers, management systems, and more. Just as Wave 2 is the technology base for wireless LANs going forward (don't expect significant new features to be added to older products), making the most of the remainder of an investment in network infrastructure will increasingly depend upon a complementary relationship with the latest capabilities embodied in products based on Wave 2.

Just consider these advances, many of which will be deployed along with Wave 2:

- **Switching** – Wave 2 will require PoE+ (802.3at power over Ethernet) to realize its full potential. And the greater-than 1 Gbps throughput will spur demand for more switch ports, and eventually to 2.5/5/10 Gbps switch ports as well.
- **Management** – This vital function includes context-driven monitoring, alerts and alarms, reporting, auditing and more. It's best to look for single-console access to both the wired and wireless networks (there's no point in having to debug conflicting or overlapping services), and solutions that are based on policy definition, implementation, and enforcement. Network management tools also provide reporting on device growth to justify further investments.
- **Analytics** – Analytics is often defined as a set of capabilities designed to explore large amounts of data when you don't know what you're looking for. Contemporary networking has become very much of a big-data challenge, with enormous amounts of traffic often obscuring an understanding of patterns of usage that could otherwise lead to improvements in performance, reliability, policy, security, and more.
- **Advanced security** – Security is, of course, always an essential element in any network. Increasingly, though, real securing is less a function of Wi-Fi's WPA2 (which remains important, of course), and more dependent upon other network-wide facilities that are based on identity, access, policy, context, content filtering, and more.
- **Cloud** – A key trend in the deployment of both wired and wireless networks is to implement management and related capabilities in the Cloud. The key advantages of Cloud-based management are (very) easy turnkey implementation, simple scalability, intrinsic fault-tolerance, and enhanced security. The cost benefits of a Cloud-based approach are also significant – CapEx is converted into very economical OpEx, in concert with a lean IT strategy.
- **SDN** – And, finally, software-defined networking is going to play a much larger role in both wired and wireless networking over the next few years as well. SDN enhances network security, integrity, policy definition and implementation, and management and analytics far more comprehensively than is otherwise common today.

Given the continuous stream of advances in Wi-Fi technologies and systems that is always at work, will another technology shortly appear to limit the long-term value of Wave 2? While the IEEE 802 Standards Committee is indeed hard at work on new advances, we don't expect to see these for another three years, and five years will likely pass before any of these become mainstream. So the payback period for Wave 2 is quite long, with the business-case benefits accruing from Day 1 of any deployment.



Wave 2 in Healthcare

No IT environment is more demanding than healthcare, which literally defines reliability in mission-critical information systems. Optimal outcomes – in healthcare services, organizational budgets, IT efficiency and effectiveness, and beyond – depend upon wireless LANs providing the best possible coverage, capacity, and reliability for communications and patient telemetry monitoring, as well as low-latency access to often (very) large amounts of data, produced by MRI and CT imaging. **Wave 2 offers the very best possible combination of capabilities here, enabling healthcare IT – and the medical professionals and patients who depend upon the network – to benefit from the most reliable, cost-effective, efficient, and pervasive wireless services possible, in settings where compromise is never an option.**

Conclusions

So hype or ripe? Your business case will be unique, but one thing is clear: Wave 2 is here and offers real benefits for your IT organizations. New features like 1.7 Gbps aggregate throughput and multi-user MIMO simply aren't available in any other generation of Wi-Fi products. Advances in price/performance and seamless integration with existing installations easily deflate any concerns regarding capital expense. Productivity improvements for both IT staff and end-users lower operating costs, minimizing TCO and maximizing ROI. And additional network capabilities in switching, management, analytics, security, and even SDN work synergistically with Wave 2, optimizing the business case even further. 802.11ac Wave 2 – the time is now.

Get Inspired

"We had a rock solid experience with Extreme's Wave 2 APs. I got a performance bump both on premise and while roaming."

- Jonathan Linton, Sr. Wireless Architect
Henry Ford Health System

"I love Extreme's Wave 2 wireless products. I've already specified Wave 2 APs in my upcoming funding proposal."

- Jeff Crawford, Manager of Networking and Security, East Grand Rapids Public Schools

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