Tarana Has Created the Next Generation of Fixed Wireless Access
as an Essential Complement to Fiber in Closing the Digital Divide

TARANA

Fiber is preferred for closing the digital divide, but in many cases its implementation is too slow and costly to show timely returns on either public or private investment.

Prior wireless options have not solved the problem in mainstream markets.

Tarana has introduced a new wireless alternative that is a long-term substitute, delivering fiber-class performance at a small fraction of the deployment time and cost of fiber.

The Problem We're Addressing

Fast broadband connectivity is no longer a matter of just entertainment and convenience, it's an absolute necessity for multiple aspects of our lives — work, education, healthcare, and social survival.

Those who have no affordable high-speed broadband options are being left further and further behind. And there are still hundreds of millions of households in that unfortunate position today, in both developed and developing economies. ITU data and reliable, unprioritized speed test statistics indicate ~50% of the world's 2.3 billion households still have no fixed broadband, and 80% of those who do have speeds less than 25 Mbps.

Given the scope, scale, and urgency of this problem, broadband service providers need a better network toolbox that gives them the ability to deploy new or upgrade existing infrastructure to achieve both high capacity and long reach, on much shorter timelines, with viable network costs across a wide range of neighborhood conditions.

Optical fiber networks are certainly the preferred tool for high-household-density markets, delivering an attractive combination of high capacity and low latency. However, last-mile fiber deployment involves long timelines and high deployment complexity + costs per subscriber in the medium- and low-density markets that include most households. Given that, pursuit of

faster progress on the divide leads to consideration of the relative ease of wireless network deployment.

Unfortunately, wireless options have not shown the ability to scale broadly in fixed access. Mobile networks (4G/5G) require expensive licensed spectrum better used for higher-margin mobile services, limiting availability for fixed, and when actually used for fixed service have typically highly varied quality and poor operator economics. Legacy fixed wireless access (FWA) networks based on re-purposed indoor wireless technology (Wi-Fi) struggle with interference from within their own and other networks and their inability to work around physical obstructions like other houses and trees that are common in residential neighborhoods. Finally, while new satellite broadband networks now being deployed are uniquely suited to reaching very remote areas and oceans, they will have nowhere near enough capacity to serve mainstream residential markets at scale, given their necessarily wide distribution around a globe that is 71% covered by water and very limited bandwidth per satellite.

To be sure, all of these wireless technologies have been contributing to closing the broadband gap, but mostly at the margins of the problem. The central question remains: how can service providers deliver 100s of Mbps cost-effectively to broad populations, and much sooner rather than later?

ngFWA Defined:

› Fiber-class (100 Mbps to 1 Gbps) per-household speeds and low latency at long range, with support for symmetric (100 Mbps down / 100 upstream) service where desired

› High capacity per neighborhood for economically scalable deployment

› Solid connections despite obstacles in the way (like other houses, trees, and vehicles moving on the streets) and interference from other wireless networks

› Consistent service quality throughout the neighborhood, to support clean subscription plan marketing, sales, and fulfillment

› High-quality service delivery in unlicensed spectrum to avoid the high cost of licensed spectrum

› Simple installation at the home, and ideally customer self-installation

Enter Next-Generation FWA

As noted, existing FWA approaches are based on technologies that fulfill their original purpose well (4G/5G for mobility and Wi-Fi for indoor networks), but that are not as successful at scalable fixed access in mainstream residential markets. To deliver fast, affordable residential access more broadly, the industry needs a next generation of FWA (ngFWA) to augment last-mile fiber by meeting a clear set of new requirements (summarized at left).

Solutions that achieve these characteristics would enable current operators and new entrants to expand their reach into unserved areas more quickly through lower network costs and easier deployment, along with enabling healthy competition in underserved markets.

Introducing the First ngFWA System: Tarana's G1

Tarana has created the industry's first instance of ngFWA, the Gigabit 1 (G1) platform. G1 is the product of over $300M invested over a decade of ground-up R&D focused exclusively on FWA. By marrying the continued march of silicon integration with new, innovative signal processing techniques, G1 creates a completely new possibility for broadband.

G1 offers all the fast-deployment advantages of FWA but now with the performance, capacity, and interference-rejection required to deliver reliable fixed broadband connections for homes and businesses at large scale, in challenging non line-of-sight conditions, and even in unlicensed spectrum, as (at last) a fully-formed wireless alternative to last-mile fiber for the long term.

Technology Fundamentals of G1

Designed from scratch specifically to meet the goal of delivering fiber-class throughput and low latency with the ease and much shorter deployment timelines of long-range, cellular wireless network models, the G1 platform capitalizes on three fundamental

G1 At a Glance
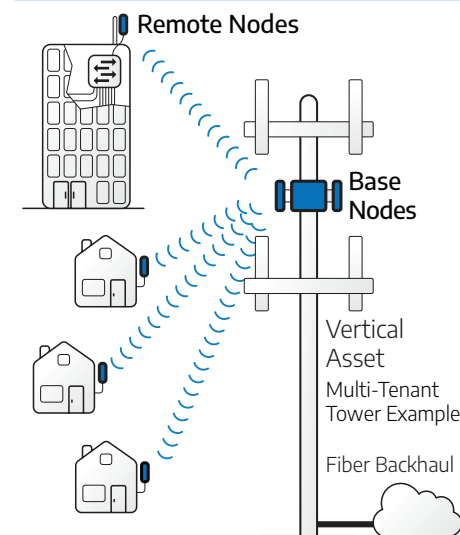
Tarana's G1 platform meets all of ngFWA's requirements, delivering fiber-class service with the speed and ease of wireless deployment, in unlicensed spectrum.

advances in the state of the art for outdoor wireless networks:

› a unique distributed real-time computing architecture that enables unprecedented precision over the control of radio waves throughout the system, fully compensating for obstructions and motion in the environment, creating the foundation for its equally unprecedented link- and network-level performance,

› a true industry first in interference cancellation that clears a clean path to enable high performance in busy unlicensed spectrum, and

› a family of custom digital and analog signal processing chips that make installation of the processing power required to execute all these complex algorithms at every home affordable.

All of this technology allows G1 to do things impossible with previous wireless systems. In layman's terms, G1 can "hear" distant signals even in very noisy environments. It's nearly magical — a bit like being able to converse with a person far across a crowded room by filtering out all others at will.
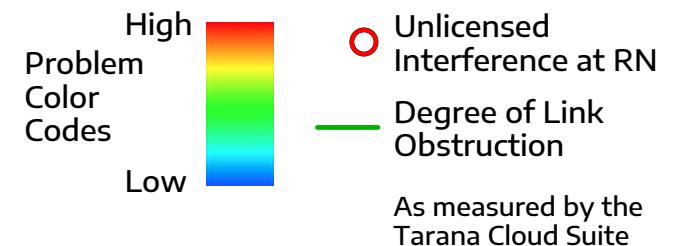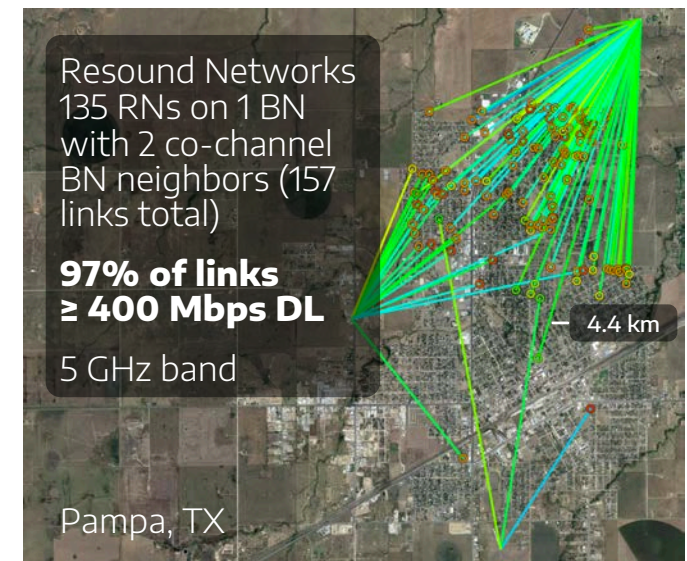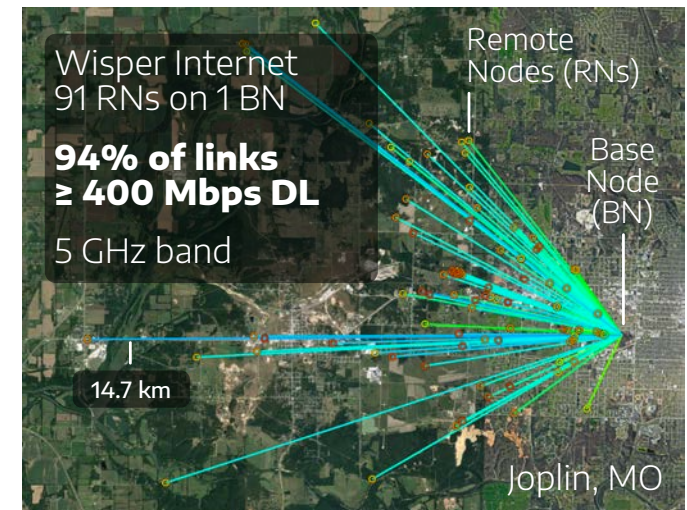
G1 in the Real World

The potential of ngFWA is being realized now in real-world networks. As examples, we show at right G1 sites operated by two leading US WISPs — Wisper Internet in Missouri and Resound Networks in Texas — both delivering commercial service in two very different geographies. The key points to take away are, first, both sites have ~100 subscribers receiving high-performance internet service with mostly obstructed links off of one base radio. In fact, the signal strength is high enough to offer >90% of the customers 400Mbps DL service with a 4.5:1 high-performance uplink. There has never been a wireless system that could come close to this kind of aggregate wide-area performance.

Second, these installations are both in the 5 GHz unlicensed band, which means the operators did not need to acquire costly spectrum to offer this outstanding service.

Third, there is unlicensed interference being actively cancelled by the G1 ngFWA platform, as denoted by the colored donut at the end of each link. This cancellation is what makes it possible to use free spectrum yet still offer a reliable service.

The fourth takeaway from G1's real-world performance is now emerging as our operators' deployments advance to multi-cell installations in the same market. This raises the potential for service degradation from inter-cell interference, which is a pervasive problem in mobile networks. It has been mitigated in prior-generation FWA installations by using multiple frequency bands in alternating patterns, which is spectrally inefficient and creates significant deployment complexity. To avoid these issues, G1 was designed to operate all radio elements in a single spectrum band ("k=1" deployment, in the industry's parlance), enabled by precise and autonomous inter-cell interference cancellation by both base and remote notes.

> G1's unprecedented performance in real-world conditions has now been thoroughly validated — on live commercial networks.

Wisper Internet
91 RNs on 1 BN

94% of links ≥ 400 Mbps DL

5 GHz band

Remote Nodes (RNs)

Base Node (BN)

14.7 km

Joplin, MO

Resound Networks
135 RNs on 1 BN with 2 co-channel BN neighbors (157 links total)

97% of links ≥ 400 Mbps DL

5 GHz band

Pampa, TX

4.4 km

High
Problem Color Codes
Low

◯ Unlicensed Interference at RN

— Degree of Link Obstruction

As measured by the Tarana Cloud Suite

G1's cooperative, autonomous inter-cell interference cancellation enables deployment of all network elements in a single frequency band, significantly increasing spectral efficiency and eliminating the debilitating deployment complexity common to all prior FWA solutions

100 RNs on 2 co-channel BNs in AZ

96% of links with ≥ 400 Mbps DL

5 GHz unlicensed-band operation

Service providers in rapidly growing numbers have been embracing G1, with over 190 customers in 8 countries piloting and deploying ngFWA G1 networks in its first year of production.
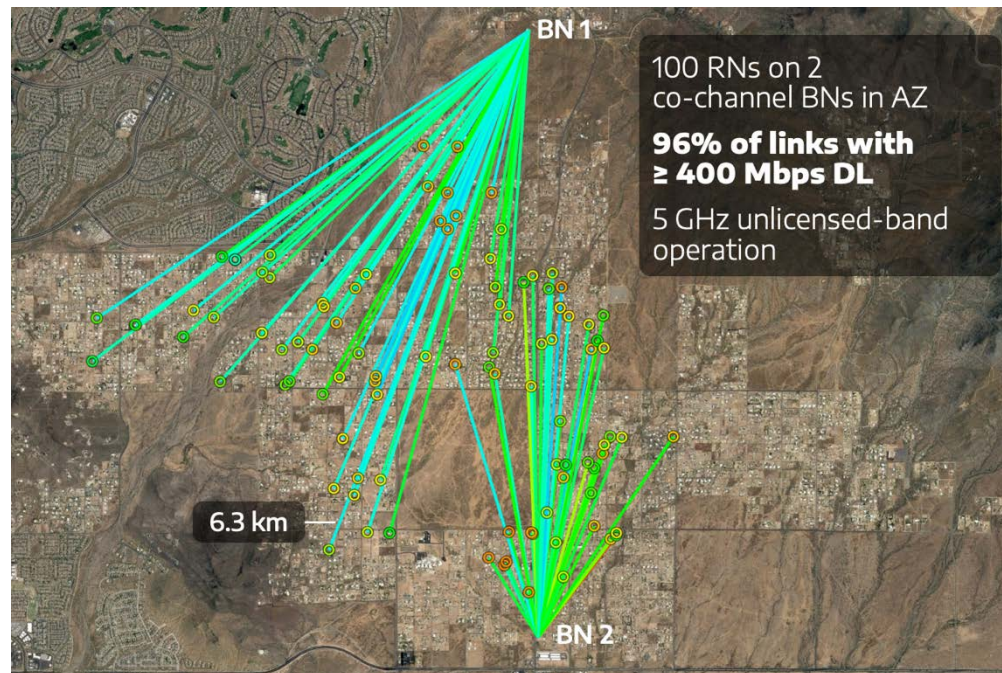
Multi-cell tests during G1's development demonstrated that its inter-cell interference cancellation was able to contain the capacity loss from k=1 deployment to less than 5% even in dense, conflicting conditions. The examples above show G1's inter-cell interference cancellation proven out in commercial deployment.

G1's unprecedented performance tends to surprise and impress operators when they first work with the platform, and word is spreading quickly. Service providers in rapidly growing numbers have been embracing G1, with over 190 customers in 8 countries piloting and deploying ngFWA G1 networks in its first year alone. These customers span the globe, including operators that scale from hundreds to millions of current subscribers, and featuring both incumbents as well as new entrants from outside the telecom segment.

Looking Forward

G1 is just the beginning of a new era for fixed wireless broadband. Now that the foundational techniques that power G1 are proven, extending to broadly offer 1 Gbps and 3 Gbps services in both licensed and unlicensed spectrum is well within reach and already under development by Tarana.

Next Steps

The world needs more and better broadband, but getting it to the home has long been challenging. Tarana's rapidly growing list of operators deploying G1 showcases ngFWA and foretells a future of high-performance broadband on timelines and at scales that were, until now, simply impossible.

"Tarana is the only tech that will allow us to democratize internet connectivity in Africa, and to do it now, not in 5 or 10 years. This will change people's lives. I see no reason why we can't get to doing millions of customers per annum."

— Amit Maharaj, Group Technology Executive
MTN / Supersonic

"Tarana's performance is just mind-blowing. It lets me flip the script on my business. Now we can seriously compete in urban and suburban markets where the incumbent ISPs are neglecting their clients. Rural is still our focus, but it's great to be able to offer urban and suburban markets another choice for their internet service."

— Nathan Stooke, CEO
Wisper Internet

"We were astounded by G1's performance. We realized immediately that Tarana's technology is a broadband game-changer for Maine and Redzone. We can deliver fiber speeds at 80% lower cost and 1/10th of the installation time, without the escalating uncertainties of today's fiber-to-the-home builds."

— Jim McKenna, CEO
Redzone Wireless

"G1 works as advertised. This will break fiber economic models. Say goodbye to monopoly-era penetration rates for fiber."

— Matt Larsen, Owner
Vistabeam Wireless Internet

"After just one day of running our pilot on G1, customers are saying, 'You're not going to turn this off for years, right!?!' It's a very sticky product."

— Neil McRae, Chief Network Architect
British Telecom

"G1 smoked everything else we've tried. Impressive feats — 300 Mbps plus through trees and 1 Gbps in near line of sight at 5 miles — unbelievable. It's cutting our tower counts by 40% and our installation times by 50%, while giving us 6x more capacity per tower and 3x the speeds of our prior FWA gear. We can now bring competition to larger markets we would never have even considered before."

— Tyson Curtis, CEO
Resound Networks

"Tarana will 100% change how we attack markets."

— Ryan Grewell, Managing Director
SmartWay Communications

About Tarana

Tarana Wireless, Inc. is the industry's performance leader and new category creator in ngFWA, powered by well-proven breakthroughs in precise, multidimensional optimization of radio signals. Our G1 access platform overcomes previously insurmountable network economics challenges for service providers in both mainstream broadband and underserved markets, using free unlicensed spectrum. Unit sales of G1 in its first year are sufficient to cover 15M households, with millions more in the pipeline. We're headquartered in Milpitas, California, with additional research and development in Pune, India. Visit www.taranawireless.com for more on G1.

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