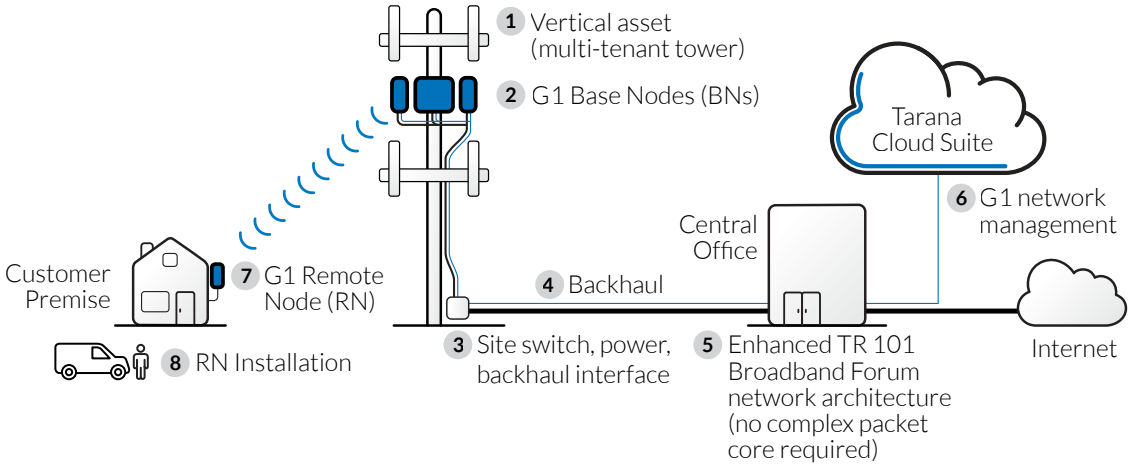
Next-Generation Fixed Wireless Network Economics — A Brief Introduction

Context

Next-generation fixed wireless (ngFWA) networks are a significant departure from prior approaches to delivering broadband over the air. As Tarana's quickly-growing base of now over 200 ISP customers will readily attest, our ngFWA combination of simple deployment, unprecedented real-world radio performance in challenging conditions (whether in licensed or unlicensed spectrum), and the resulting dramatic improvements in network economics, are opening up a broad set of new opportunities — both to close digital divides and to increase healthy competition in established broadband markets. Our performance and economic metrics are now well-proven through commercial operation of the technology at scale in both of these applications.

This succinct introduction to ngFWA deployment and operational cost structures aims to help you gain a baseline understanding of the key economic metrics of networks built on our unique G1 ngFWA platform. Since service circumstances can vary widely along the key dimensions of coverage morphology, service definitions, spectrum availability, and installation challenges, detailed assessment of network economics can become complex. To keep this introduction relatively simple, accessible, and aligned with our most high-volume application, we illustrate basic G1 economics in the context of a typical US suburban setting, and for a single tower among a deployment of many.

The Essential Elements of G1 ngFWA Networks



Delivering fiber-class broadband service to an area with ngFWA requires 11 essential ingredients, as noted in the element numbering in the diagram above, and in the table overleaf:

(1) A "vertical asset" — typically an existing multi-tenant cell tower, but other structures such as water towers or tall-building rooftops can be used as well. Because G1 base nodes (BNs) require less vertical real estate — and represent lower wind loads — compared to conventional cellular antennas, the monthly lease cost for BNs is typically 50 to 70% lower than for common cellular installations (i.e. ~$250 per BN), and and these BNs can be added to even relatively "crowded" existing towers without disruption of current tenants.

(2) A set of sometimes 3 and most often 4 BNs per tower to attain full 360° coverage, with installed costs of ~$25k each, including equipment, accessories, and skilled labor. Each BN can support up to 256 subscribers, but given current and forecast capacity demands, 150-200 subscribers is a more common planning metric among our G1 operators, to maintain headroom that can reduce contention at full load over time.

(3) Common elements of cell-site power supply, traffic aggregation, and connection to a backhaul source, which in combination with modest site engineering and typical permitting costs add another ~$30k to the 1x capital cost at the tower.

(4) Backhaul from tower to central office. For towers expected to be well loaded, 10 Gbps Ethernet service is in order, for ~$2k per site per month. Fiber or point-to-point microwave are both options.

(5) Routing equipment at the CO, following the commonly-used Enhanced TR 101 Broadband Forum architecture (rather than the much more complex mobile packet core approach of 4G/5G). Amortized across a network of G1-equipped towers, capital costs at the CO are ~$2k / tower, and recurring CO costs are ~$1k/month per tower.

(6) Network management, which includes OSS/BSS and (in the case of 3 GHz operation) spectrum access system (SAS) fees at the CO and SMS fees to Tarana for use of our Cloud Suite for G1 element and network management — totaling on average ~$5 per subscriber per month.

(7) The G1 remote node (RN) and (8) its professional installation on the home, totaling ~$750 ea.

There are a couple other costs that don't fit well into a physical-network picture (so you won't see these labeled on page 1), but they're nonetheless a material consideration in the end-to-end service operation cost structure. These include:

(9) Subscriber acquisition (i.e. marketing) costs — typically ~$300 per new sub, (10) subscriber churn rate, and finally...

(11) Customer support plus (12) other "overhead" functions required to manage the business, which together add costs on the order of ~$15 per sub per month.

These essential ingredients and their costs are summarized in the table below.

Gn	Network & Service Cost Elements	Unit Cost		per . . .	1x Costs Qty	$k	Recurring $/mo
1	Vertical asset — space rental for BNs	$	250	BN tower-month	4		1,000
2	G1 BNs, installed	$k	20	tower	4	80	
3	Common tower-base gear (power supply, traffic aggregation, backhaul connectivity, H rack, enclosure)	$k	30	tower	1	30	
4	Backhaul service (10 Gbps Ethernet)	$k	2	tower-month	1		2,000
5	Central office equipment (routing & network control elements)	$k	2	site (apportioned)	1	2	1,000
6	G1 network management (Tarana Cloud Suite + 24/7 support) + SAS fee [a]	$	5	RN-month	1		5
7+8	G1 RN, installed	$	750	HH served	1	0.750	
ISP Operational Elements (periodic recurring $ figures depend on volume of activity driver in year)							
9	Subscriber acquisition cost	$	300	sub (separate from RN & installation)			
10	Subscriber churn rate [b]	%	1.0	per month			
11	Customer support	$	5	sub-month			
12	ISP management overhead	$	10	sub-month			

Summary	**$k 1x**	**$/mo**
Total cost per tower	112	4,000
Total cost per subscriber (1x = acq + RN + install & recurring = support + TCS + mgt. overhead)	1.1	20
ARPU (weighted average of speed-tiered plans)		75

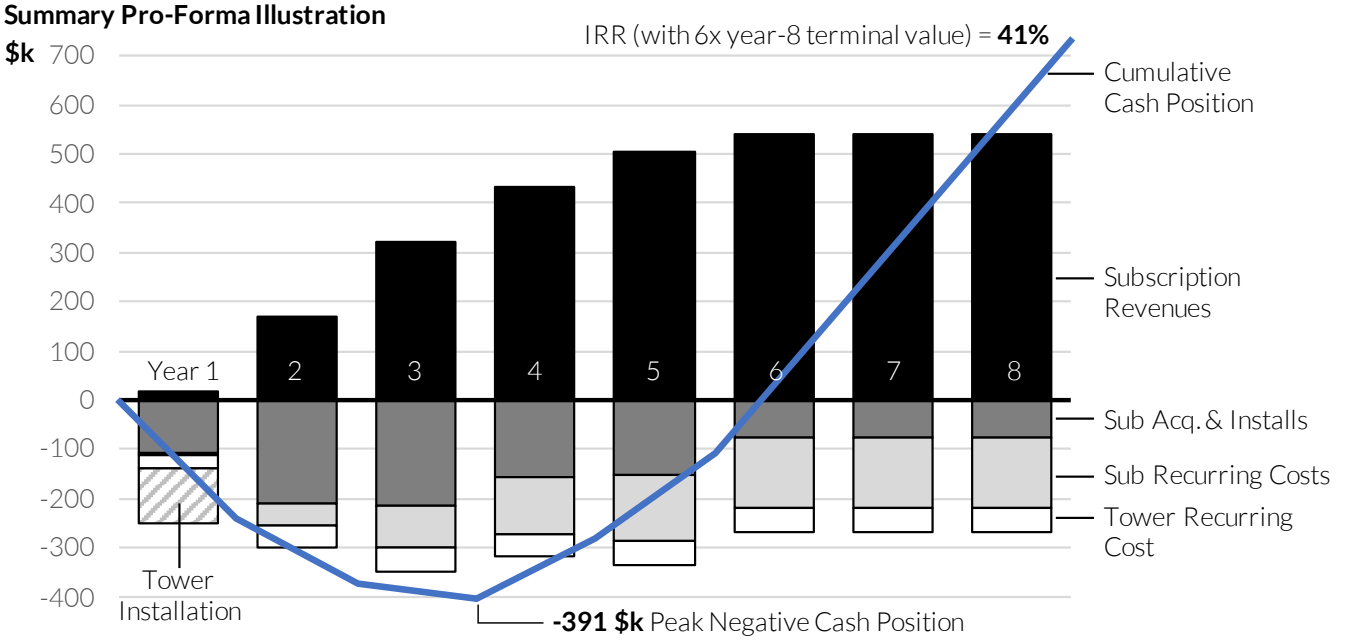
Notes: [a] Assumes 50:50 3 & 5 GHz network mix [b] Based on current G1 network operators' experiences

An important additional dimension to note in modeling with these inputs is the factor of applied time. A tower can be outfitted with BNs in 2 or 3 days of on-site work, given proper site engineering and permitting, the latter of which usually involves more elapsed than applied-resource time, given permit interactions with local governments. The installation of the RN at the home is typically a couple of person-hours — with a good portion of that time spent running an Ethernet cable from the outdoor unit into the home. The G1 network cost model summary illustration that follows here incorporates that elapsed vs. applied resource time factor and calculates the initiative's economics as a function of such accordingly.

Single-Tower Economics Pro Forma

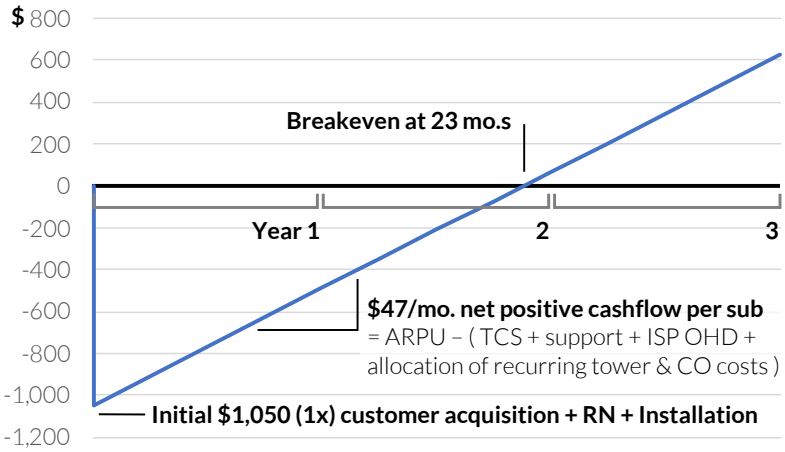
Applying the cost structure we've outlined above to the most common suburban use case yields the following typical deployment and operational metrics for a well-loaded G1 network tower (with 100 subs by the end of year 1, growing steadily to a max of 600 subs by the end of year 5):

Summary Pro-Forma Illustration



It's also instructive to look at the cash flows associated with a single subscriber over time (at right). Given the costs of subscriber acquisition, the RN, and installation (totaling $1,050) — along with net positive cashflow per subscriber of $47/month — an individual subscriber reaches cash-flow breakeven in 23 months.

Single Subscriber Install Cash Position over Time



Next Steps

Fueled by these compelling network economics, we now have ISPs across a wide range of sizes, origins, and strategic intent engaged in the development and execution of network deployments, expansions, and upgrades based on our G1 platform — across the full spectrum from digital divide projects, upgrades in the competitiveness of existing networks, to overbuild initiatives aimed at bringing fresh competition to the many effective-monopoly broadband markets across the US. The modeling tools from which we've assembled this high-level illustration are quite detailed and the performance and cost benchmarks used are informed directly by our real-world experience with current customers and the technology's well-proven operation at scale. Our team would be happy to engage with you and apply this expertise to see where ngFWA could take your business — just let us know where you'd like to start!

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