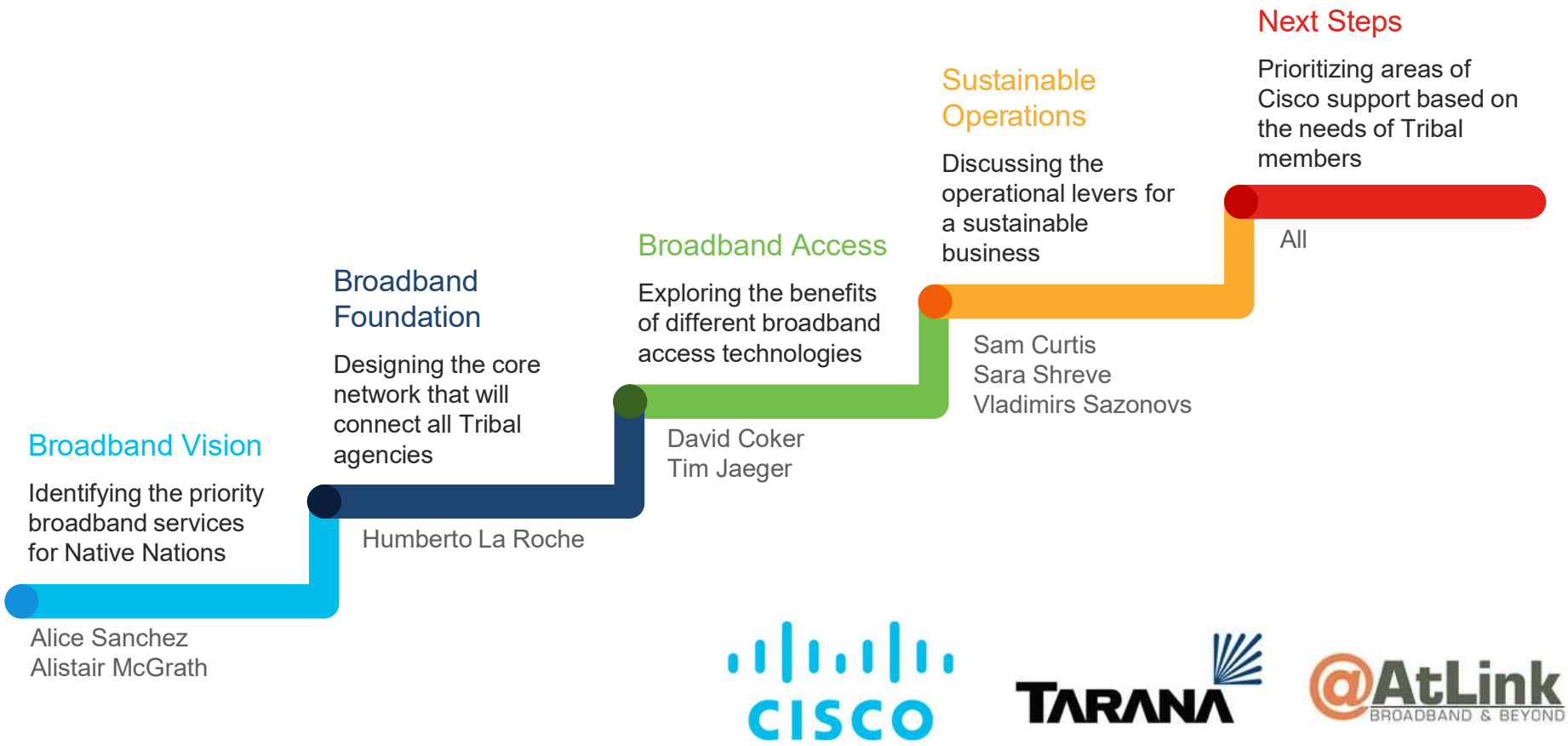
The bridge to possible

Pathways to sustainable broadband

Cisco, Tarana Wireless & Atlink Services
National Tribal Telecommunications Summit, Chandler, AZ
August 30, 2023

Our next 2 hours



Workshop Principles

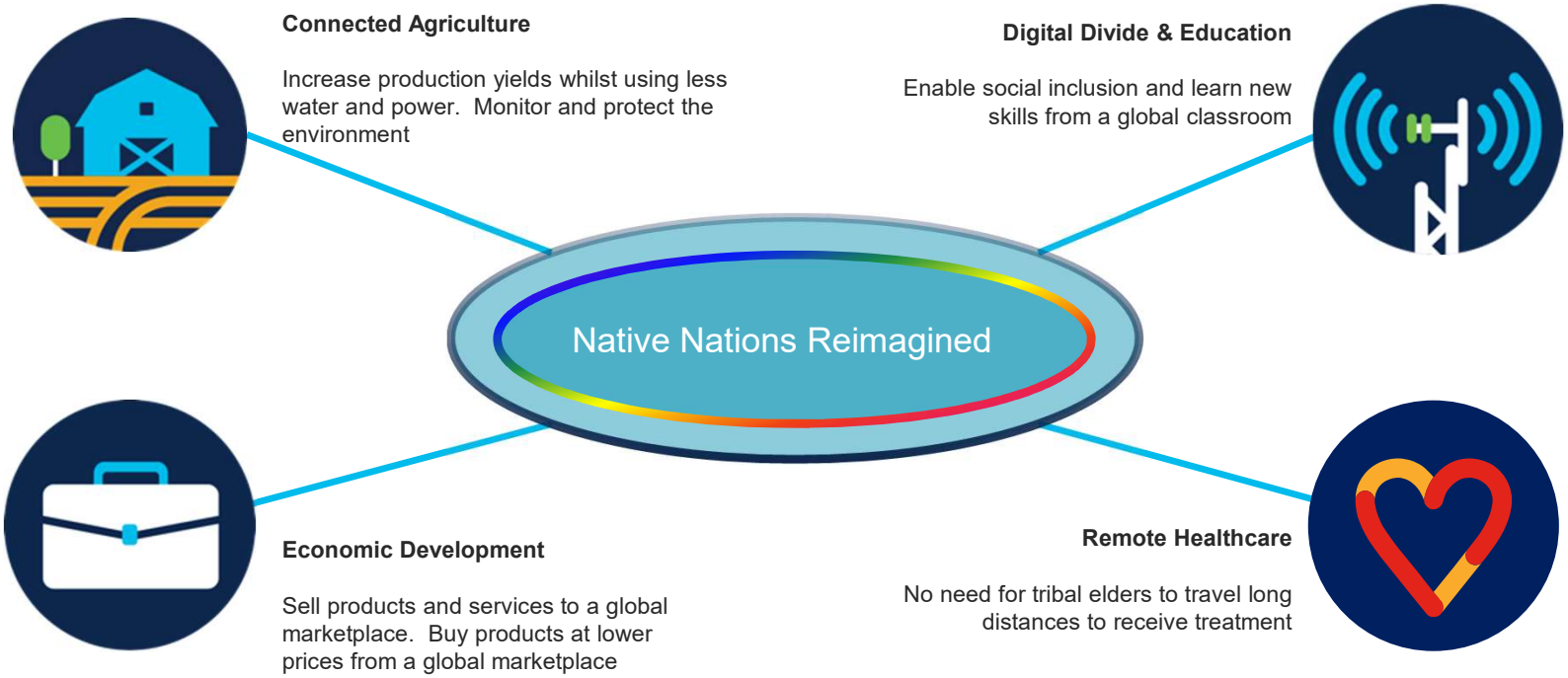
Let’s have fun and:

1. **Be interactive**
   We’re here to listen and learn too
2. **Ask questions**
   Lots of experience from three leading broadband companies
3. **Share your experiences**
   We’re flexible to adjust and committed to follow-up

Path 1

Building the vision

Broadband is changing lives



Powering Native Nations

A planning model for Tribal communities

Building the Vision (Months 1-3)

- Appoint leader and team
- Tour other Native Nations
- Engage the community
- Market analysis
- Regulatory review
- Workshops on services
- Secure sponsorship and political buy-in
- Hire advisors
- Signed MOU

Starting the Plan (Months 2-5)

- Audit infrastructure
- Identify required infrastructure
- Evaluate operating models
- Implementation studies
- Explore partners
- Consult the community
- Grants and financing plan
- High level business plan

Completing the Plan (Months 4-6)

- Evaluate and select partners
- Complete business plan
- Secure financing
- Sign-off on plan
- Detailed implementation plan
- Consult the community
- Contractual framework

Starting Operations (month 6 ongoing)

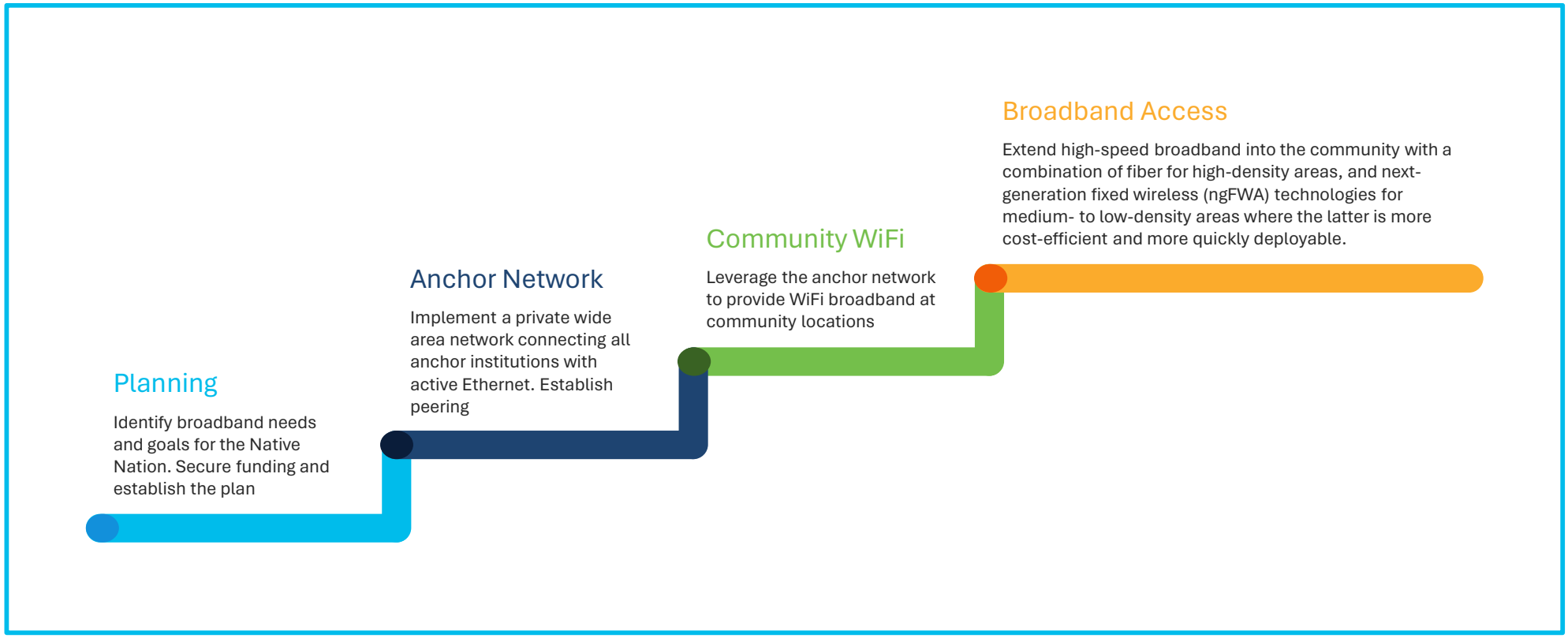
- Hire leadership
- Build organization
- Contractual awards
- Detailed network planning
- Site acquisition
- Network implementation
- Network operations
- Interconnect
- Pilot services

Manage for Sustainability (ongoing from launch)

- Establish governance
- Performance reviews
- Achievement of goals and metrics
- Review contract performance
- Expand portfolio and coverage
- Workforce development
- Community outreach

Link to detailed planning model

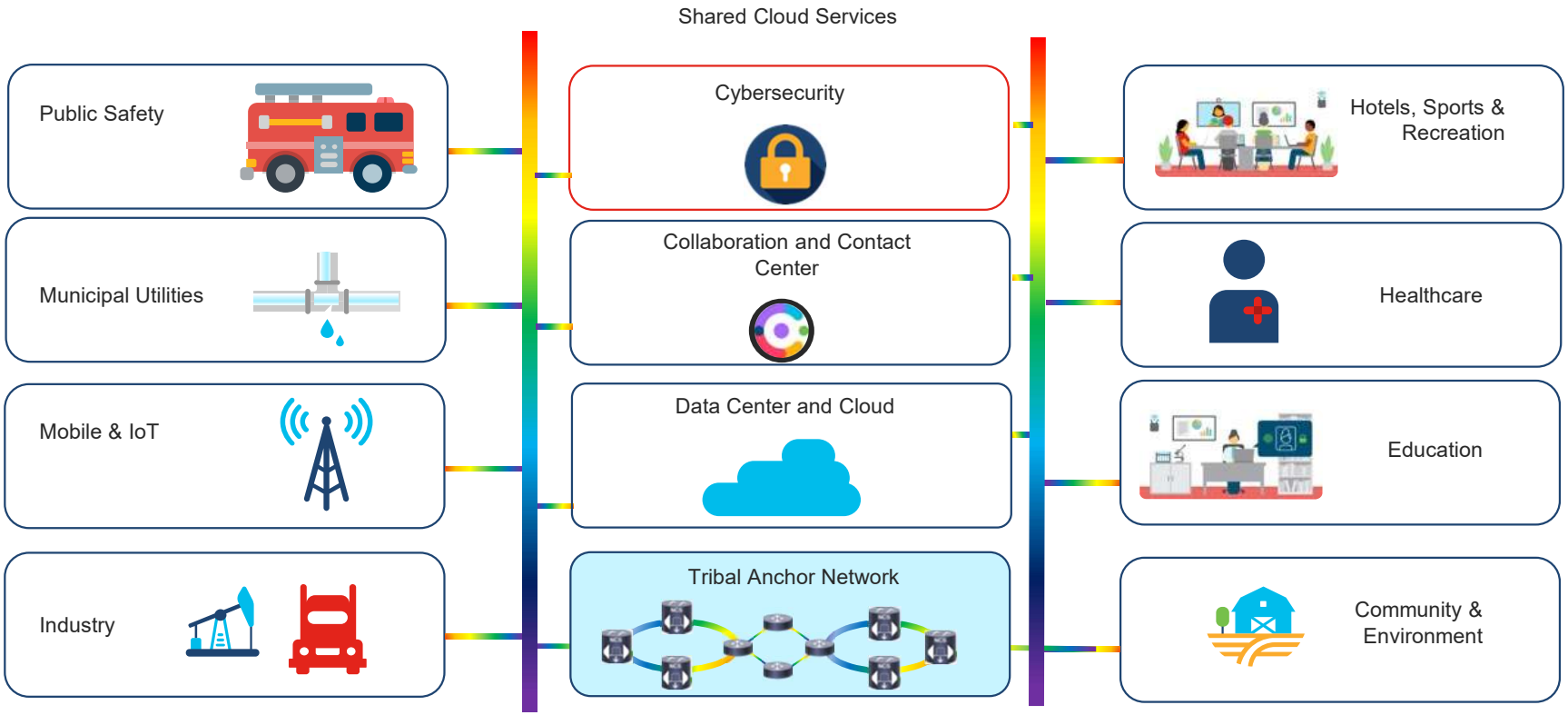
Predictable patterns



Predictable patterns in action

	Coeur d'Alene Tribe Idaho	Nez Perce Tribe Idaho	St. Regis Mohawk Tribe New York
Funding	American Recovery & Reinvestment Act	BTOP and ARRA, expanding with CARES	American Recovery & Reinvestment Act
Anchor Network	Government offices (5Gbps) and schools (10Gbps)	Tribal law enforcement buildings	Government offices
Last Mile Access	FTTH and fixed wireless (licensed and unlicensed)	FTTH and fixed wireless (licensed and unlicensed)	FTTH and fixed wireless (licensed and unlicensed)
Size	1700 households	2300 households	1500 households (+ fixed wireless off nation)

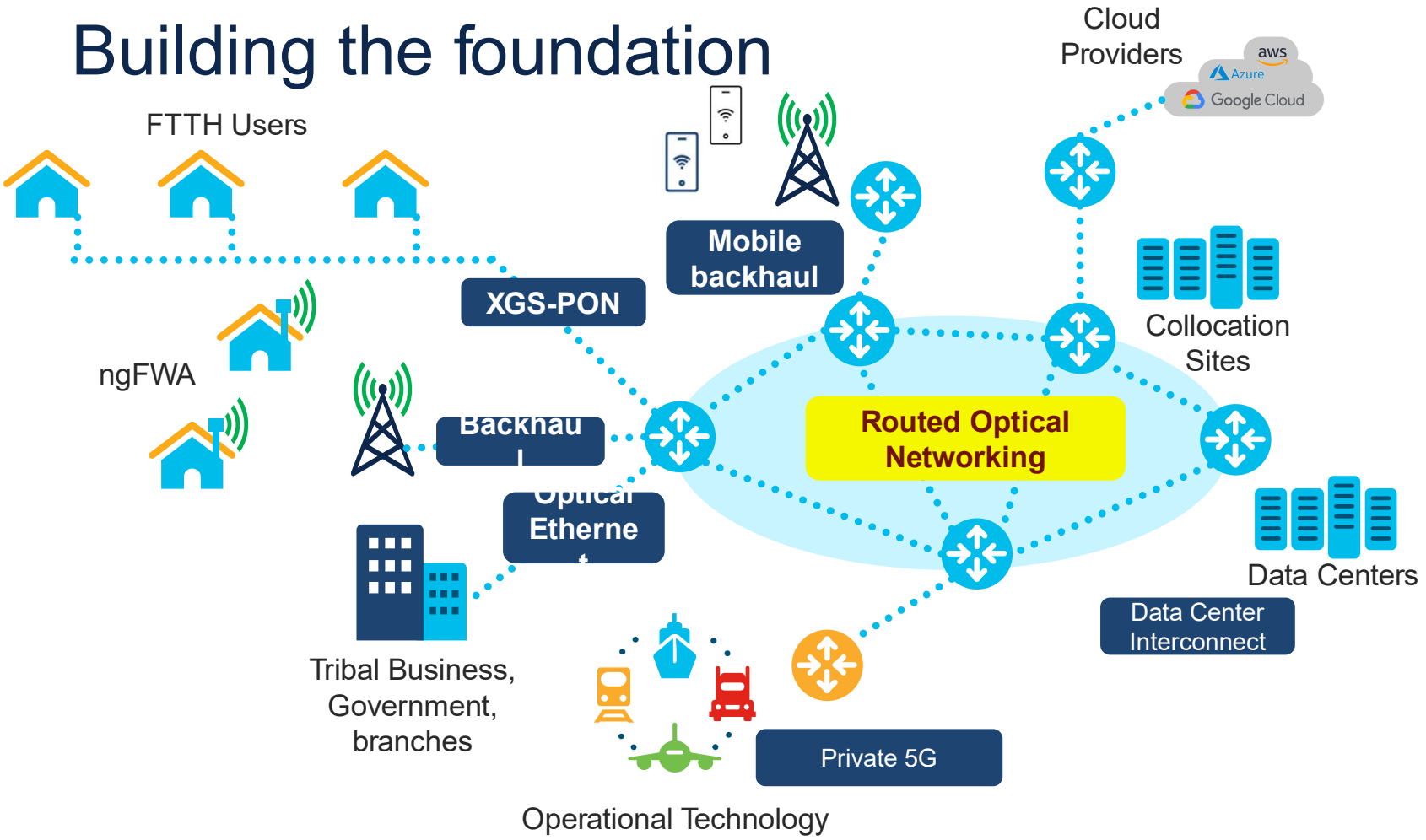
One Tribal anchor core with many services



Path 2

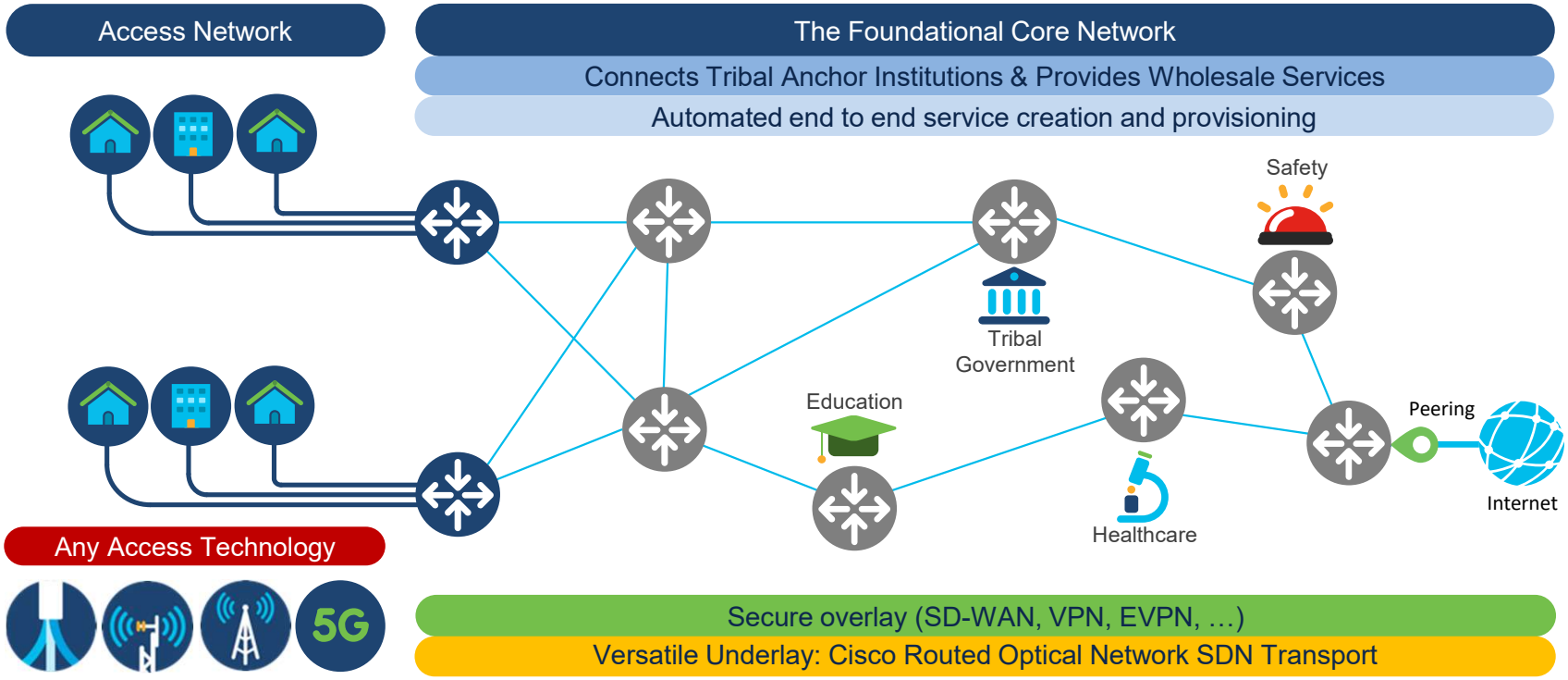
Building the foundation

Building the foundation



- Scale
- Performance
- Resiliency
- Security
- Visibility
- Reach

Tribal Broadband Foundation
Transport Infrastructure



Cisco’s portfolio for the foundation

Crosswork Automation SW

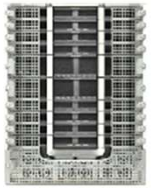
Optics

Routers

ASR 900

NCS 500

Cable Access



cBR8

Routers

ASR 9000

Optical

NCS 1000

Routers

NCS 5500

Optical

NCS 2000

Routers

8000
Silicon One

5G Mobility

Ultra
SW

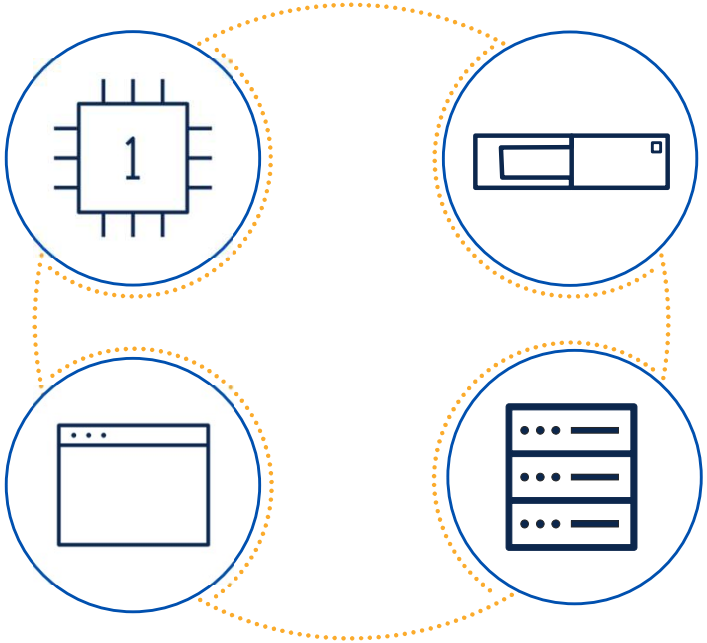
Access/Aggregation

Edge

Core

Innovations in the foundation

Silicon
3.2Tbps to
25.6Tbps



Optics
100GE ZR
400G ZR/OpenZR

Software
Modern and
Cloud Enhanced

Transport Systems
100G & 400G
800G & 1.2T

Architectures / Solutions

Innovations transforming the economics of broadband

Mass Scale
IP Routers
(Up to 260Tbps,
>12.8Tbps NPU)

+

400GE ZR/ZR+
/BZR+ QSFP-DD
Pluggable DCOs

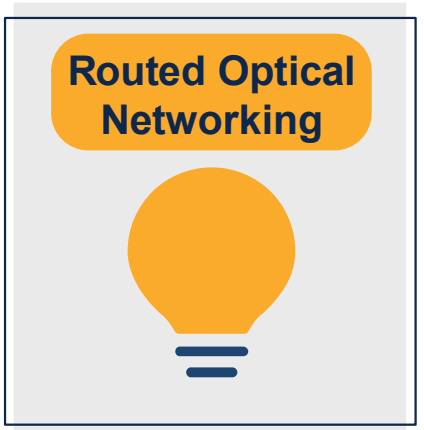
+

Open, Simpler
DWDM
Line Systems

+

Modernized
Software
& Provisioning

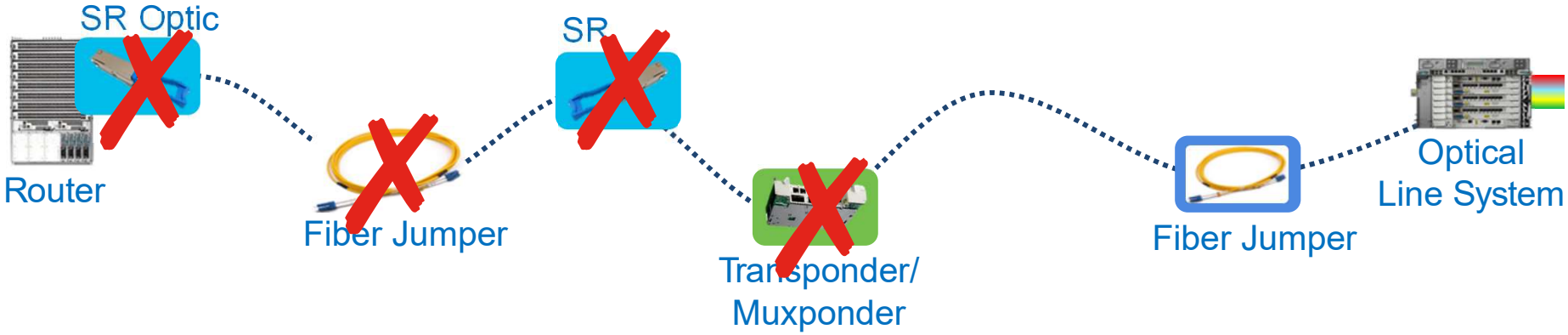
=



New Network Paradigm

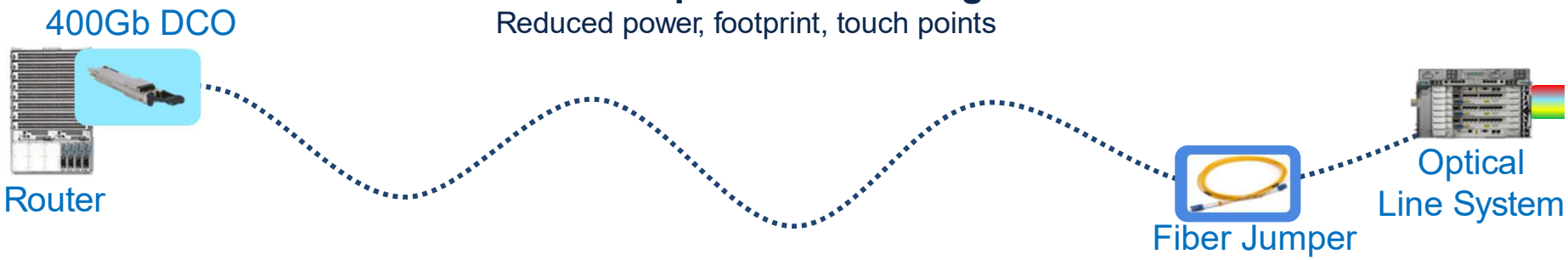
Removing hardware complexity and cost with optics

Traditional



Routed Optical Networking

Reduced power, footprint, touch points



Building a sustainable foundation

Present Mode of Operation

- -78% in Power
- -76% in Rack Unit
- -76% in Physical Weight

Additional Reductions not accounted above:

- Packaging material
- Shipment costs
- Installation time

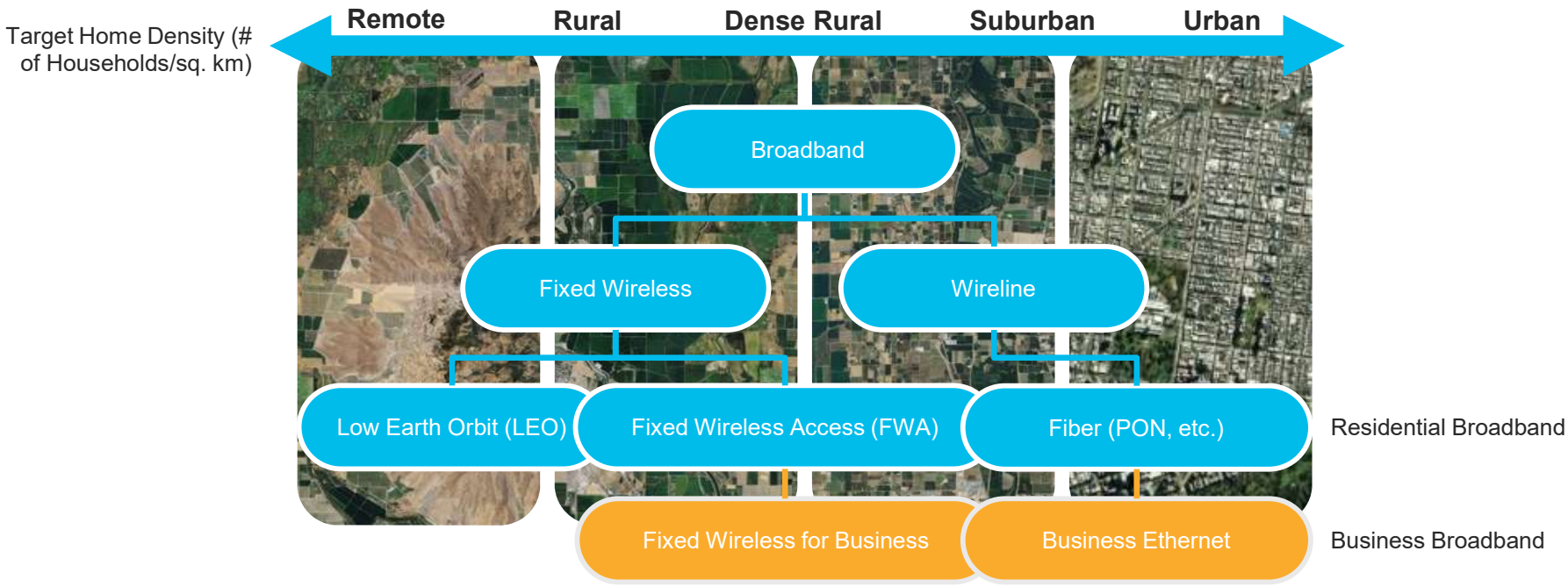
Routed Optical Networking

Path 3

Building broadband access

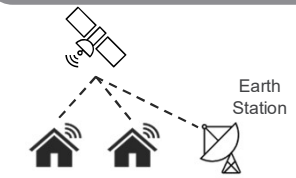
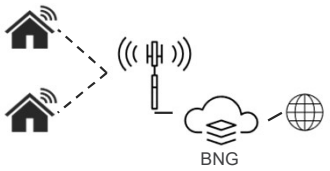
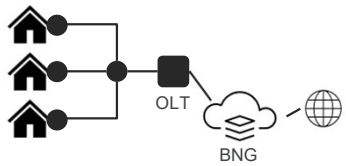
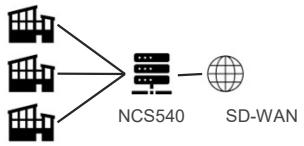
Last Mile Broadband Technologies

Two technology sets, Wired and Wireless, each with a unique set of trade-offs



Broadband Technology Trade-offs

Each technology is designed for a unique set of requirements…

Mobility	Fixed Wireless		Wireline	
2.5GHz LTE/5G	Low Earth Orbit (LEO)	ngFWA	Fiber (PON)	Business Ethernet
				
Good option for mobility and IOT applications	**Good option for hard-to-reach remote areas**	**Good option for rural, dense rural and suburban areas**	**Good option where timing and economics make sense**	**Good option where bandwidth is paramount and economically viable**
• Designed for mobile and IOT use cases • Not ideal for fixed wireless access application • Possible wholesale opportunity	• Satellite constellation provides global coverage • Number of subscribers per sector can impact scalability / performance	• Designed for FWA, leveraging free spectrum with good propagation • Some upfront site acquisition	• Durable asset. Supplies up to 10Gbps symmetrical bandwidth • Economics and time-to-market present challenges	• Dedicated SLA for each business or government services locations • Highest bandwidth but most expensive option to deploy • SD-WAN provides secure connectivity

NCS540

Two Technology Sets, Just One Access Platform…

NCS5XX series is your one stop shop for all converged access use cases

Compact Form Factor

Environmentally Hardened

Predictable Performance

High Throughput / Density / Scale
Need for devices supporting 160-800Gbps, with dense interfaces 25/50/100G/400G

Low Latency
xx

Secure Deployment
Enhanced security for both hardware and software
i.e., Secure ZTP, Runtime defense

XGS-PON
Fully functional OLT delivering up to 10Gbps symmetrical broadband

NCS540 Medium Density Routers (At a Glance)

N540-24Z8Q2C-SYS
N540(X)-ACC-SYS

N540X-16Z4G8Q2C-D/A

N540-28Z4C-SYS-D/A

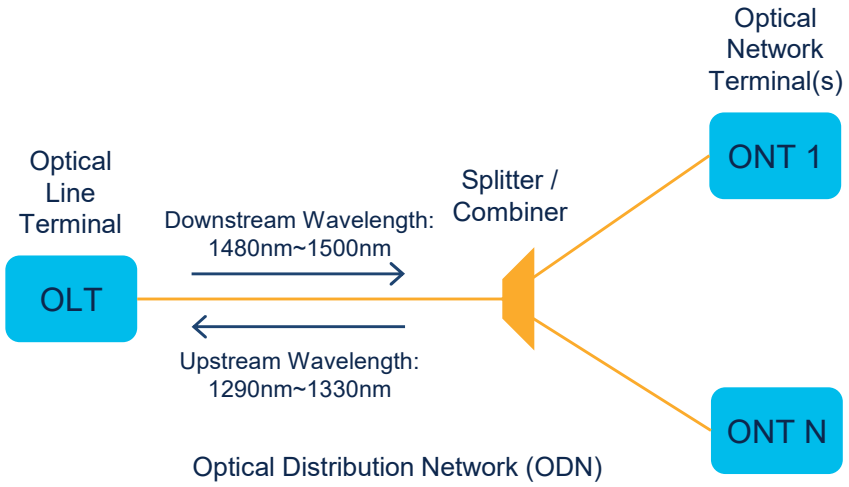
N540X-12Z16G-SYS-D/A

N540-12Z20G-SYS-D/A

Interfaces	Throughput	Timing	Power
2x 100/40GE 8x 25/10/1GE 24x 10/1GE	300G Max Interfaces: 640G	GNSS Class B	Modular: 1+1 AC/DC
2x 100/40GE 8x 25/10/1GE 16x 10/1GE 4x 1GE Cu	300G Max Interfaces: 564G	GNSS Class C	Fixed: 1 AC 1+1 DC
4x 100/40GE 28x 10/1GE	300G Max Interfaces: 680G	Class B	Fixed: 1 AC 1+1 DC
12x 10/1GE 12x 1GE 4x 1GE Cu	160G Max Interfaces: 136G	GNSS Class C	Fixed: 1 AC 1+1 DC
12x 10/1GE 20x 1GE	160G Max Interfaces: 140G	Class B	Fixed: 1 AC 1+1 DC

XGS-PON system overview: Working principles

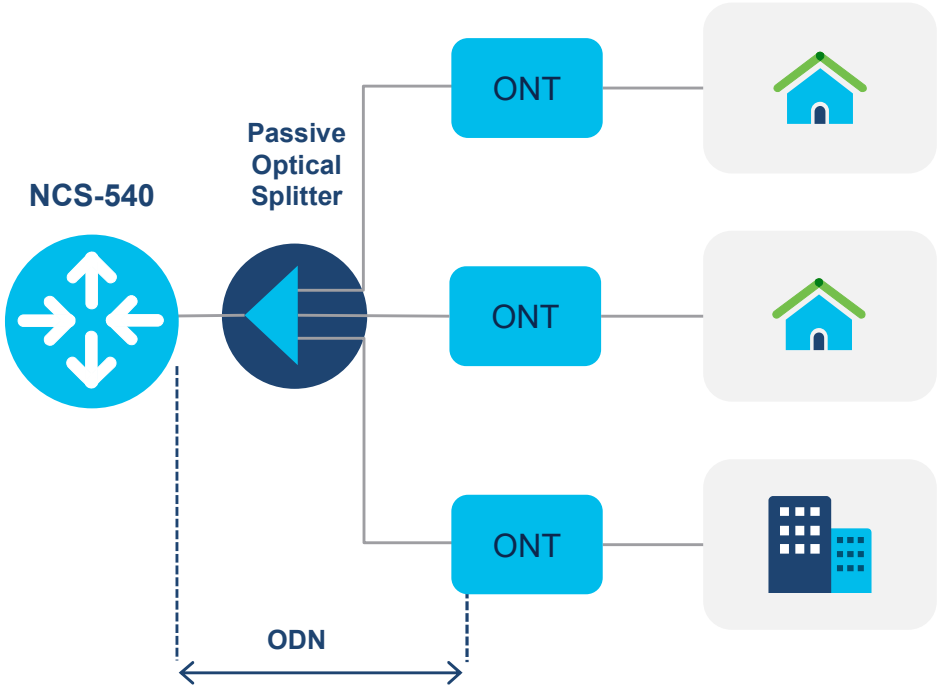
- Passive Optical Network or PON, where **G-PON is 1Gbps PON**, and **XGS-PON** is **10**(X)**Gbps**(G)**Symmetrical**(S) PON.
- The OLT is connected to the optical splitter through a **single optical fiber**, and the optical **splitter / combiner** is then connected to ONTs
- The GPON adopts WDM to transmit data of different upstream/downstream wavelengths over the same ODN
- Data is **broadcast** in the downstream direction and transmitted in the **TDMA** mode (based on timeslots) in the upstream direction
- Supports point-to-multipoint (**P2MP**) multicast transmission



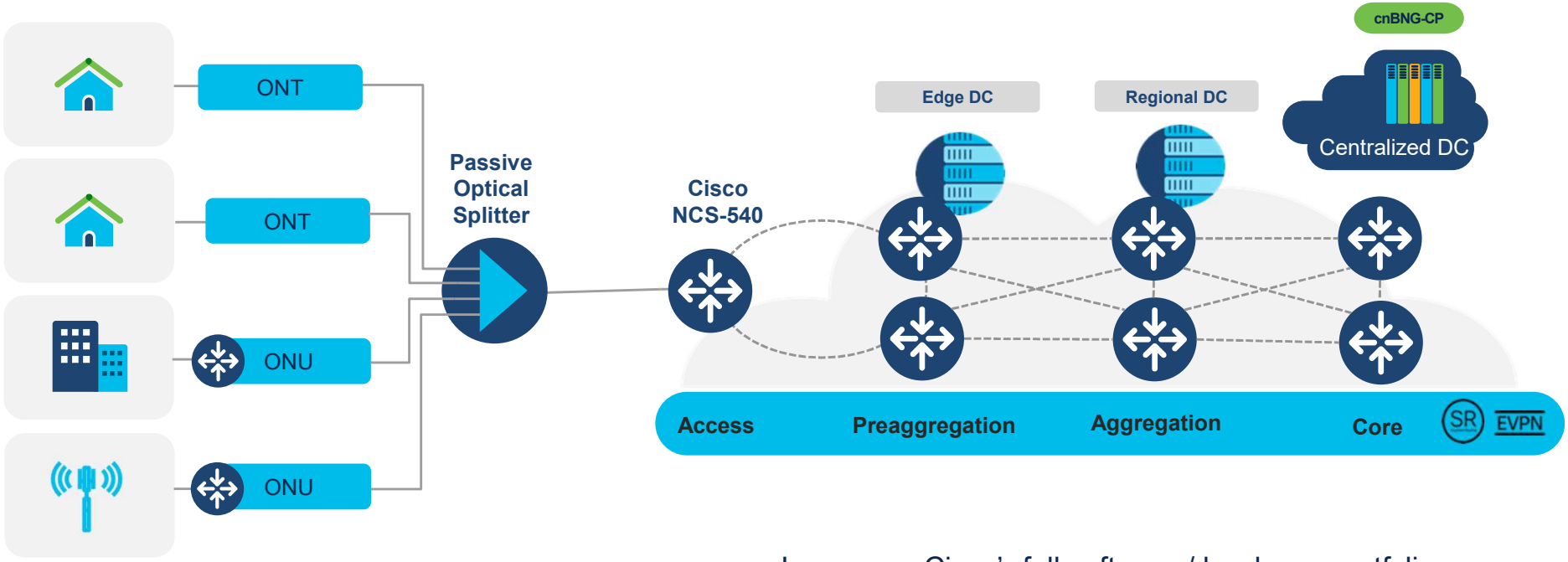
- Maximum logical reach: 60 km
- Maximum physical reach: 20 km
- Maximum differential fiber distance: 20 km
- Split ratio: up to 1:128 (64 is recommendation)
- Rate: 1.24 Gbit/s up, 2.48 Gbit/s down

XGS-PON Feature in NCS-540

- XGS-PON can deliver 10 Gbps symmetric in shared modality to homes and businesses
- ONTs are located on the user side, providing ports for connecting to user terminals
- The Optical Distribution Network **(ODN)** is composed of passive optical components, such as optical fibers, and passive optical splitters
- The ODN provides optical channels between the OLT and ONTs. It interconnects the OLT and ONTs and is highly reliable



Broadband Architecture
Wireline XGS-PON with NSC-540 XGS PON Feature



Leverages Cisco's full software / hardware portfolio
(Converged SDN Transport)

TARANA

BROADBAND REINVENTED

Tarana NTTA

August 30

Tarana at a Glance

Founded in 2009
Headquartered in
Milpitas, CA
400 Employees

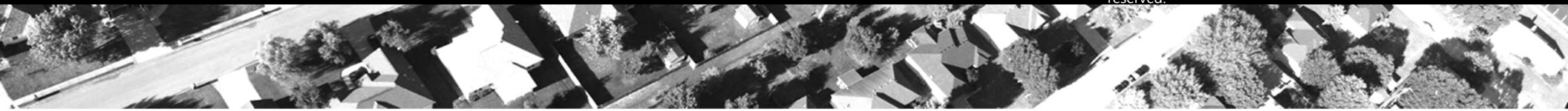
Addressing $50B
wireless broadband
access market

280+
Production Networks

~20M locations
passed with
deployed equipment

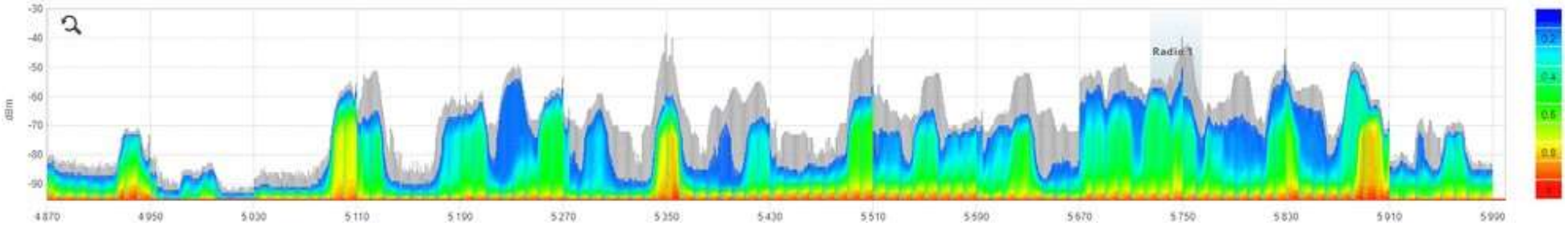
$120M Q422 Annualized
Revenue run-rate

28 Patents issued
and pending



Common Challenges for FWA (Fixed Wireless Access)

- Single carrier channels in congested spectrum
- Low spectral efficiency
- Lack of support for nLoS and NLoS
  - Foliage, multipath, motion, narrow CPE/client antenna
- Limited to interference mitigation, NOT cancelation
  - Common techniques: changing RF parameters, simple beamforming, directional antennas, MicroPoP deployment
  - These methods typically result in lower performance, require more APs and tower sites/space, and increase capex/opex



ngFWA: Built From the Ground Up for Fixed Broadband

- ✓ **Works in nLoS and NLoS**
- ✓ **True interference cancelation**
- ✓ **High throughput and spectral efficiency**
- ✓ **Uniform service delivery**
- ✓ **Spectrum reuse**
- ✓ **k=1 channel reuse**
- ✓ **Can be rapidly deployed**

G1 Features — Critical to Success in Broadband Markets

Integrated
Base Node
(BN)

- Dual Carrier up to 2x40 MHz
- Distributed Massive MIMO — on both ends
- Multi-TFLOPs computation
- Carrier ethernet switch
- GPS receiver
- 6 spatial planes (MU-MIMO)
- 256 users per sector / 1024 users per site
- Max 2.4 Gbps /sector & 9.6 Gbps / site
- Digital beamforming with IC in Tx and Rx
- Single frequency reuse

Integrated
Remote Node
(RN)

- Dual Carrier 2x40 MHz
- 8x8 MIMO
- 800 Mbps (2x2 MIMO)
- Digital beamforming with IC in Tx and Rx
- Auto antenna alignment (5000/sec)
- Good Neighbor
- ABIC – Adaptive Burst interference Canceller

Meeting the Challenges of the Tribal Market

Broadband Delivery

- Tarana's delivers on the Broadband requirements to comply with all major federal funding programs.

Unprecedented Technical performance

- Tarana's technology deploys several break-through technologies to deliver unprecedented wireless broadband performance. Dramatically better bandwidth, with less infrastructure costs.

Designed for Practical Management and Monitoring of your wireless network

- Tarana's Cloud Suite (TCS) provides a single pane of glass to manage all aspects of your network.

Technology Designed for the Future

- Tarana's technology delivers unprecedented performance in the unlicensed spectrum today, but is expandable and extensible, with upgrades improving performance in the future.

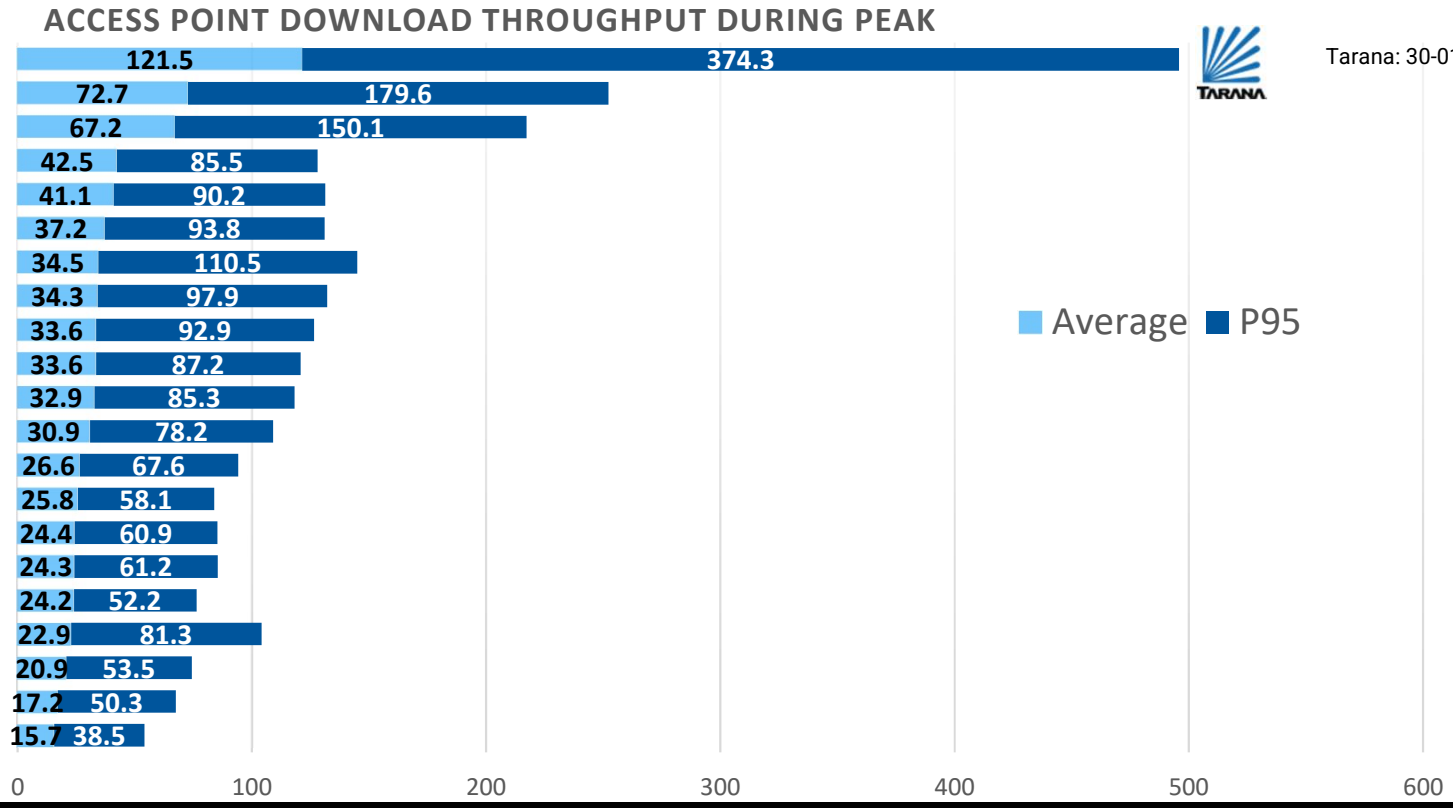
Deploy today- Don't wait for Fiber

- Wireless Broadband projects can go from concept to reality in a matter of weeks- not months or years. The cost and time involved with Fiber-based broadband introduces unnecessary challenges.

Meeting the Challenges of the Tribal Market

〉Unmatched Wireless Bandwidth Performance

Independently Verified Results: ***2022 Preseem Fixed Wireless Report***



Tarana: 30-0134-001

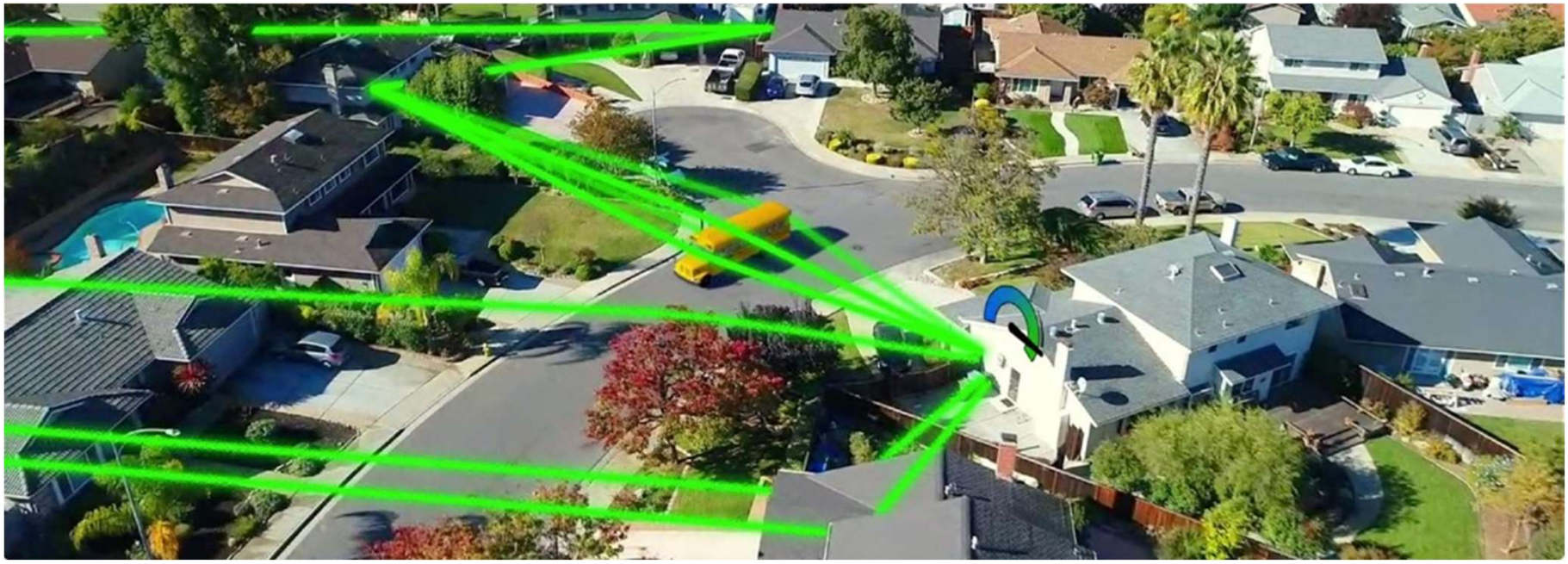
Asynchronous Burst Interference Cancellation (ABIC)

What all other radios hear in busy, unlicensed bands

What G1 radios hear — enabling unprecedented, full, unfettered use of the spectrum (results may vary)

NLoS Capabilities

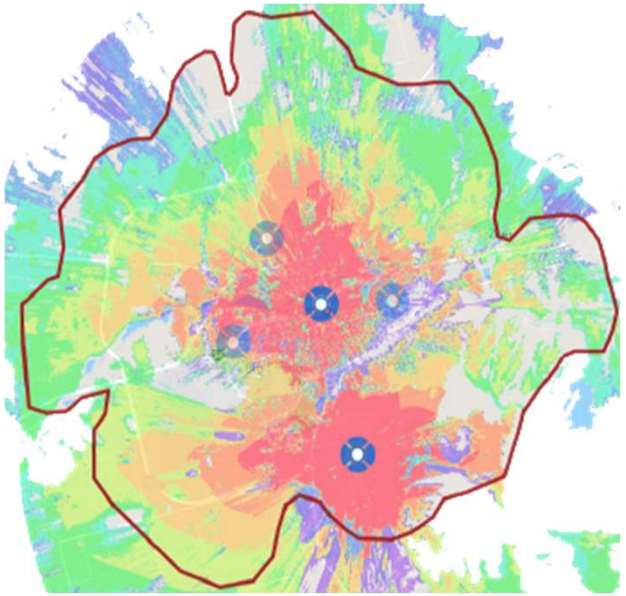
Line-of-sight between endpoints is simple an easy. Non-line-of-sight is hard. We've mastered non-line-of-sight with unprecedented precision.



Subscriber Capacity and Efficient Scaling

Single-Town Deployment Example

	Tarana	**Alternative**
Total Subscribers	1,600	1,600
Coverage Area (km^2)	20	20
Subscribers Per Sector (100/20 Mbps baseline service)	200	<40
Towers Required (4 sectors per tower)	2	>10
Service Plan Offered	Up to 500/110	Up to 100/20



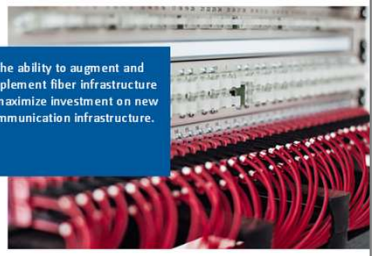
Examples

Augmenting Fiber Deployments

A tribe was deploying fiber broadband infrastructure. There we groups homes and businesses that were away from the fiber deployment area. It was too time consuming and expensive to deploy fiber to these locations.

FWA was deployed to service these locations, efficiently expanding broadband connectivity to deliver fiber-like performance.

The ability to augment and supplement fiber infrastructure to maximize investment on new communication infrastructure.



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Closing the Digital Divide

With the pandemic, it became apparent that not all individuals had access to broadband at their homes.

Utilizing the grant funds that are available the tribal communities, they built a FWA network that enabled children to attend school from home, when necessary.

The ability to deploy broadband economically and quickly allowed the tribal community to offer remote learning to members of the tribe.

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Video Surveillance

A tribal community was deploying broadband throughout the community. They decided to take advantage of the infrastructure to deploy video surveillance.

The tribe deployed video surveillance at multiple locations using their FWA network.

The bandwidth and reliability enabled with FWA allowed the tribe to increase safety for the tribal members.

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Augmenting Other Wireless Deployments

A tribal community secured a grant utilizing a different frequency. It was determined quickly that the radios planning to be used were not going to meet the needs of the community.

A more superior and innovative 5 GHz FWA network was deployed on the same infrastructure to fill the holes of the original plan.

The ability to augment other FWA radios, Tarana offers the best solution to provide fiber-like performance and reliability

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Low Earth Orbiting Satellites:

Cisco volunteers connecting Tribal Governments in remote Alaska

Path 4

Building a sustainable business

Building a sustainable broadband business

Managing business levels to grow revenues faster than costs

Design

Revenues

Operations

Funding

Design & construction levers

- Location, users & growth
- Equipment & technologies
- Existing assets & rights of way
- Engineering & construction firms
- Data centers, operation centers & interconnection

Revenue Levers

- Tribal Broadband – Business & Residential
- Government Services
- Wholesale & Managed Services
- Industry Solutions
- Off Reservation Services

Operating levers

"*If we approve this network construction project and budget, how much operating revenue will it generate over time, and when will it cover its operating expenses such that it can sustain itself without additional tribal capital or investment?"*

- Customer Acquisition Costs
- Interconnection Costs
- Network Operations Costs
  - planning, design, maintenance and transmission
- Customer Care and Churn Costs
- Staff Costs / What to outsource and timeframes

Federal Grants with funds dedicated to tribal communities and broadband

- The Coronavirus Aid, Relief, and Economic Security Act of 2020 (“CARES Act”)
- Coronavirus Response and Relief Supplemental Appropriations Act of 2021
- The American Rescue Plan Act of 2021 (“ARPA Act”)
- The Tribal Broadband Connectivity Program of the National Telecommunications and Information Administration (NTIA) of the US Department of Commerce
- The Tribal Priority Window Program of the Federal Communications Commission which granted tribes licenses to use unassigned 2.5Ghz Frequency channels on Tribal land)
- The Infrastructure, Investment and Jobs Act of 2021
- The Consolidated Appropriations Act of 2023
- The Affordable Connectivity Program (formerly the Emergency Broadband Benefit program)

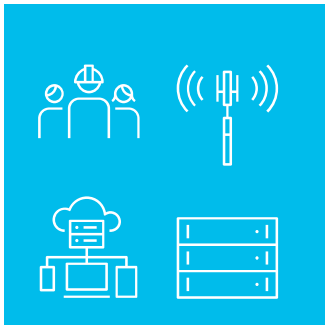
Combine different funding sources to support broadband business

Global Infrastructure Funds

	Equity	Debt	Grants	Revenues Share
	The business sells a % ownership stake in exchange for funding	Borrowed money that must be repaid over time with interest	Funding is awarded to businesses, usually by governments or nonprofits	Upfront infrastructure funding in exchange for partial revenues
Minimal economic dilution		☑	☑	☑
Limited financial covenants	☑		☑	☑
Outcome-driven repayment terms	☑		☑	☑
Attractive cost of capital		☑	☑	☑
Overall flexibility				☑

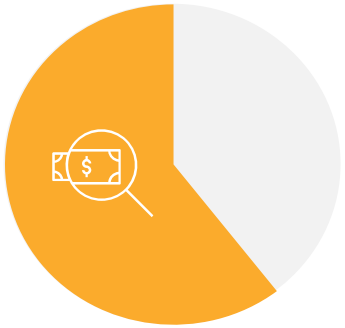
Revenue share: upfront infrastructure funding in exchange for a share of revenues

Investor provides capital for broadband build-out: technology, installation, sales & marketing



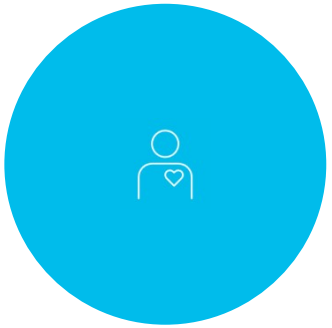
The network is owned by tribal operator

Investor receive a share of the revenues the infrastructure generates



Risk-sharing with the Investor

Investor stops receiving revenues when a predetermined amount or period is reached

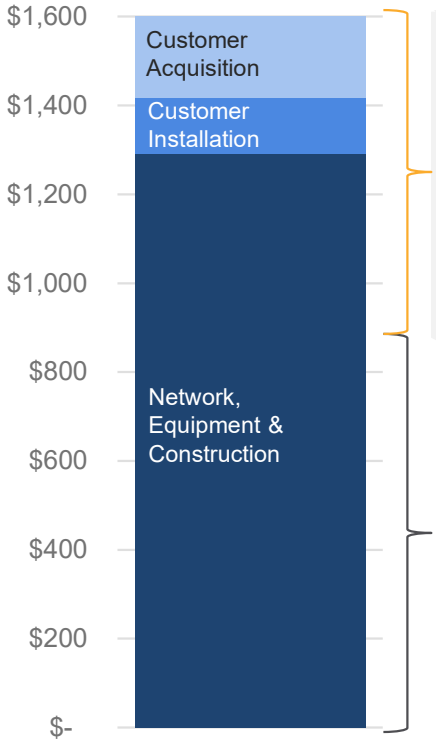


100% monetized by tribal operator

Revenues share as matching funds with grants
An illustrative example of subscriber economics

$1600
total costs to build ngFWA network and to connect a subscriber

$75 / month
broadband subscription (ARPU)



Funding gap:
$625/subscriber
funded by Investor

Assumption:
75% of the network build-out is covered by **grant funds**

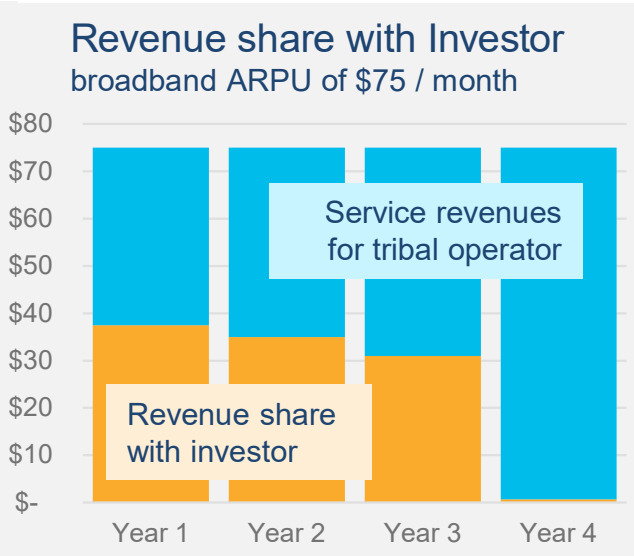


Illustration includes assumptions on costs, grants, revenues and revenues share model. Everything on this slide are variables.
Illustration in partnership with Digital Alpha Advisors.

Networking Academy

The bridge to career possibilities for people everywhere

Sara Shreve, Business Development Manager, sashreve@cisco.com

Networking Academy

We transform the lives of learners, educators, and communities through the power of technology, education, and career opportunities to create an inclusive future for all.

Cisco Networking Academy is the company's largest and longest purpose-led corporate social responsibility program.

Our impact

Creating a skills-to-jobs pathway for 17.5 million students since 1997.

Our aspiration

Prepare an additional 25 million learners with digital skills by FY25.*

**FY21 – End of 2025*

Our Partnership

Partnered with the Southern California Tribal Chairmen's Association & Tribal Digital Village offering NetAcad courses for all, available here: (ADD BOX Shortened URL)

Contact Information: Sara Shreve, sashreve@cisco.com

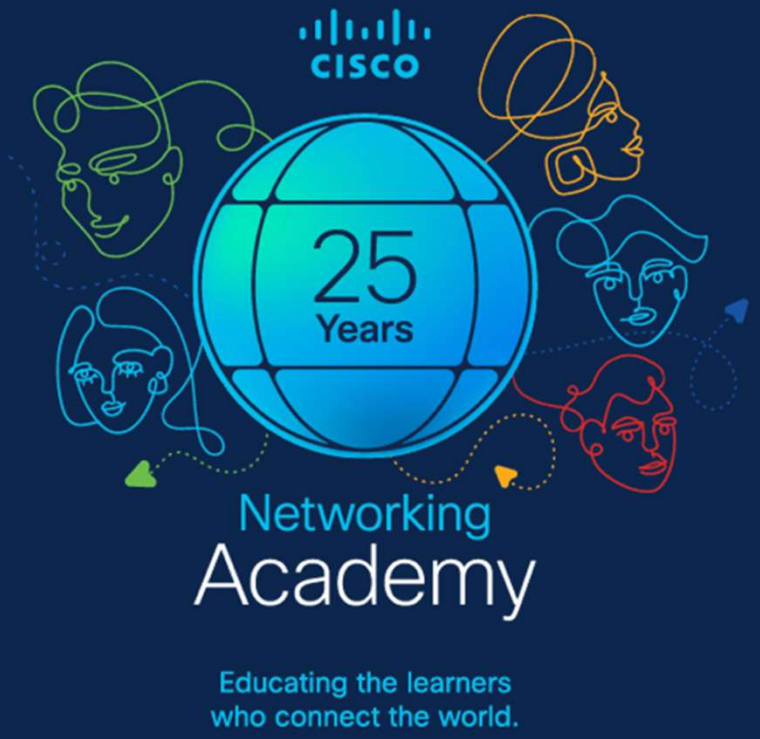
Certification Portfolio for All Audiences

Cisco Networking Academy	Cybersecurity	Networking	Data Science	DevNet
Professional Universities	CyberOps Professional No course Available	CCNP ENCOR & ENARSI	CCNP Data Center No course Available	DevNet Professional No Course Available
Associate Community Colleges	CyberOps Associate	CCNA 1-3	Data Science Essentials & Data Engineering Essentials Coming soon	DevNet Associate
Entry Vocational Training Centers High Schools	Cybersecurity Essentials (3.0)	Networking Essentials (3.0)	Data Analytics Essentials	Python Essentials 2
Awareness Upskill for All Large Scale Projects	Introduction to Cybersecurity	Networking Basics	Introduction to Data Science	Python Essentials 1

Cisco Networking Academy aims to provide digital skills training to

25 million

people over the next 10 years, to help position them for in-demand jobs and educational opportunities in our efforts to help build an inclusive workforce.



Next Steps

Thank you, and what’s next?

Potential areas of Cisco support for Tribal broadband

Broadband Technologies

- Internet for the Future
- Fiber / Wireless / Mobile
- Broadband Innovation Center

Broadband Solutions

- Residential & Business
- Government Services
- Education & Healthcare

Partner Ecosystem

- Prepare / Plan / Design
- Implement / Delivery
- Operate / Support / BOT

Pilots

- Country Digitization Acceleration
- Social Justice Programs through the Cisco Foundation

Skills & Training

- Cisco Networking Academy
- Cisco Certifications
- Native American Network

Funding

- Public Funding Office
- Global Infrastructure Fund
- Cisco Capital

A blueprint for broadband on Native Nations

@AtLink BROADBAND & BEYOND

cisco

TARANA

A Broadband Blueprint for Native Nations

Scan to download

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- Tim Jaeger, tim@taranawireless.com
  - Business Development Executive
- Vladimirs Sazonovs, vsazonov@cisco.com
  - Global Infrastructure Funds

The bridge to possible