

Navajo Digital Strategic Plan

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Note: the Navajo Nation is a sovereign entity. This plan are the recommendations of a broadcast consultant to the Navajo Nation.

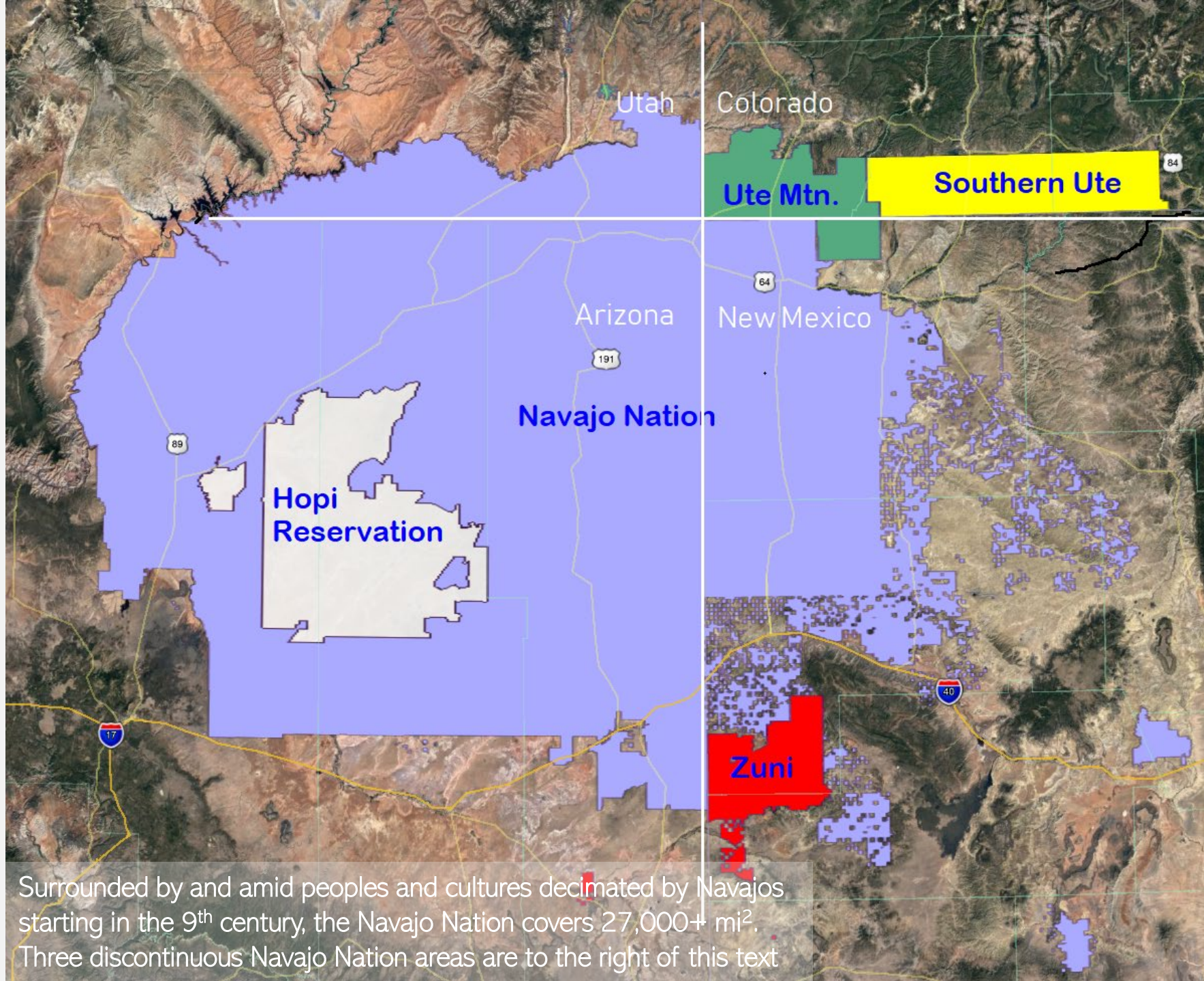


The United States of America is the host for hundreds of indigenous sovereign tribes that existed before the gleam of Cristóbal Colón (aka “Christopher Columbus”) reached Reyna Isabella’s (“Queen Isabella’s”) eyes.

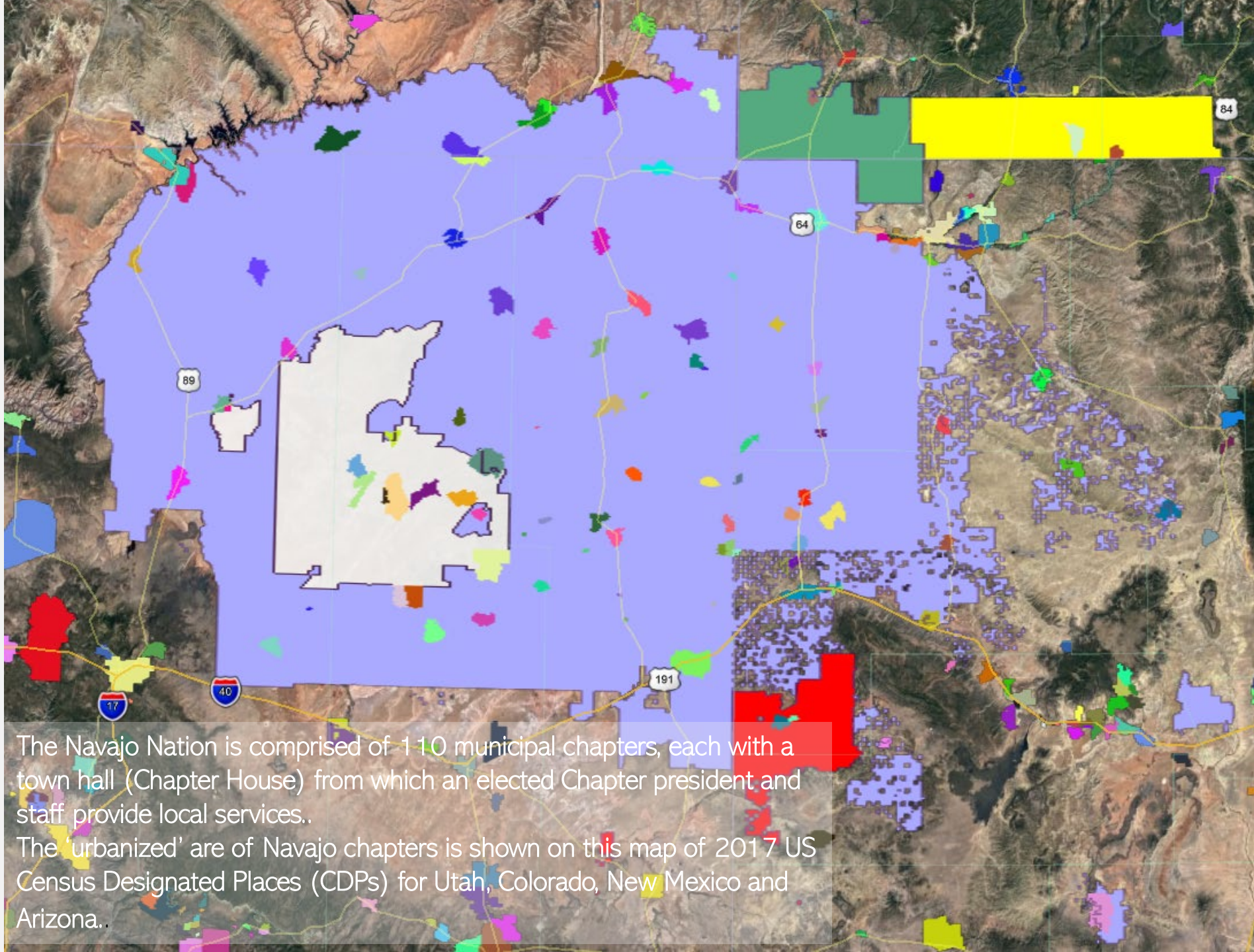
The Navajo Nation, shown here, enacted a treaty with the United States in 1868 that resolved a long and bloody conflict of cultures. That treaty ‘closed the Western frontier’ of the United States.

The Navajo are the most populous of Indian tribes: 332,000 people declared as Navajo in the 2010 census, with 170,000 living on ‘the Rez.’ 67,000 Navajos voted in last Fall’s Navajo presidential election.

Navajos are 10% of the Indian and Native population of the United States, which themselves total around 1% of total US population.



Surrounded by and amid peoples and cultures decimated by Navajos starting in the 9th century, the Navajo Nation covers 27,000+ mi². Three discontinuous Navajo Nation areas are to the right of this text



The Navajo Nation is comprised of 110 municipal chapters, each with a town hall (Chapter House) from which an elected Chapter president and staff provide local services.

The 'urbanized' area of Navajo chapters is shown on this map of 2017 US Census Designated Places (CDPs) for Utah, Colorado, New Mexico and Arizona.

Selected radio frequency digital transmission characteristics

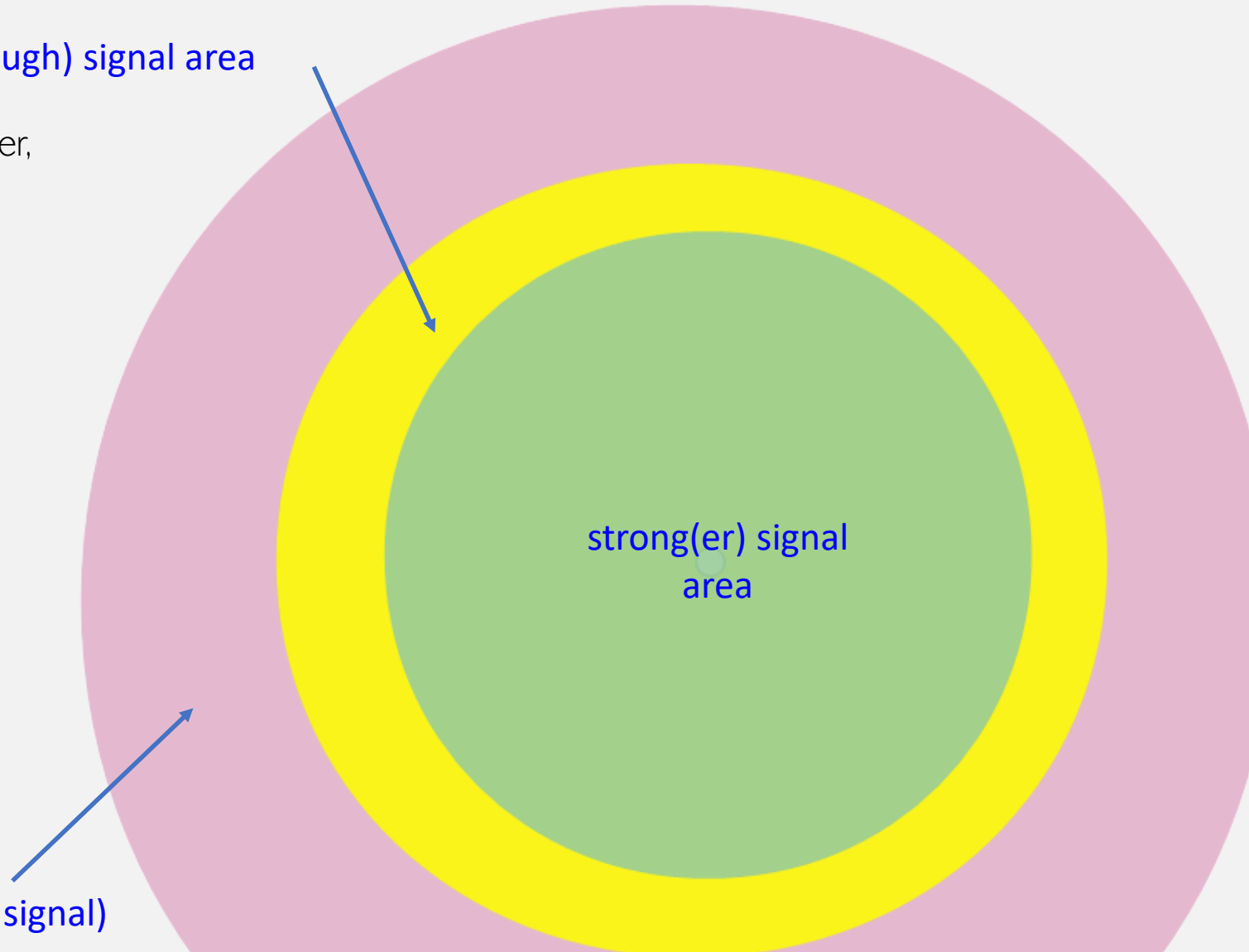
Size of interference area is governed by the ability of TV tuners to discern desired TV signals from undesired signals.

strong (enough) signal area

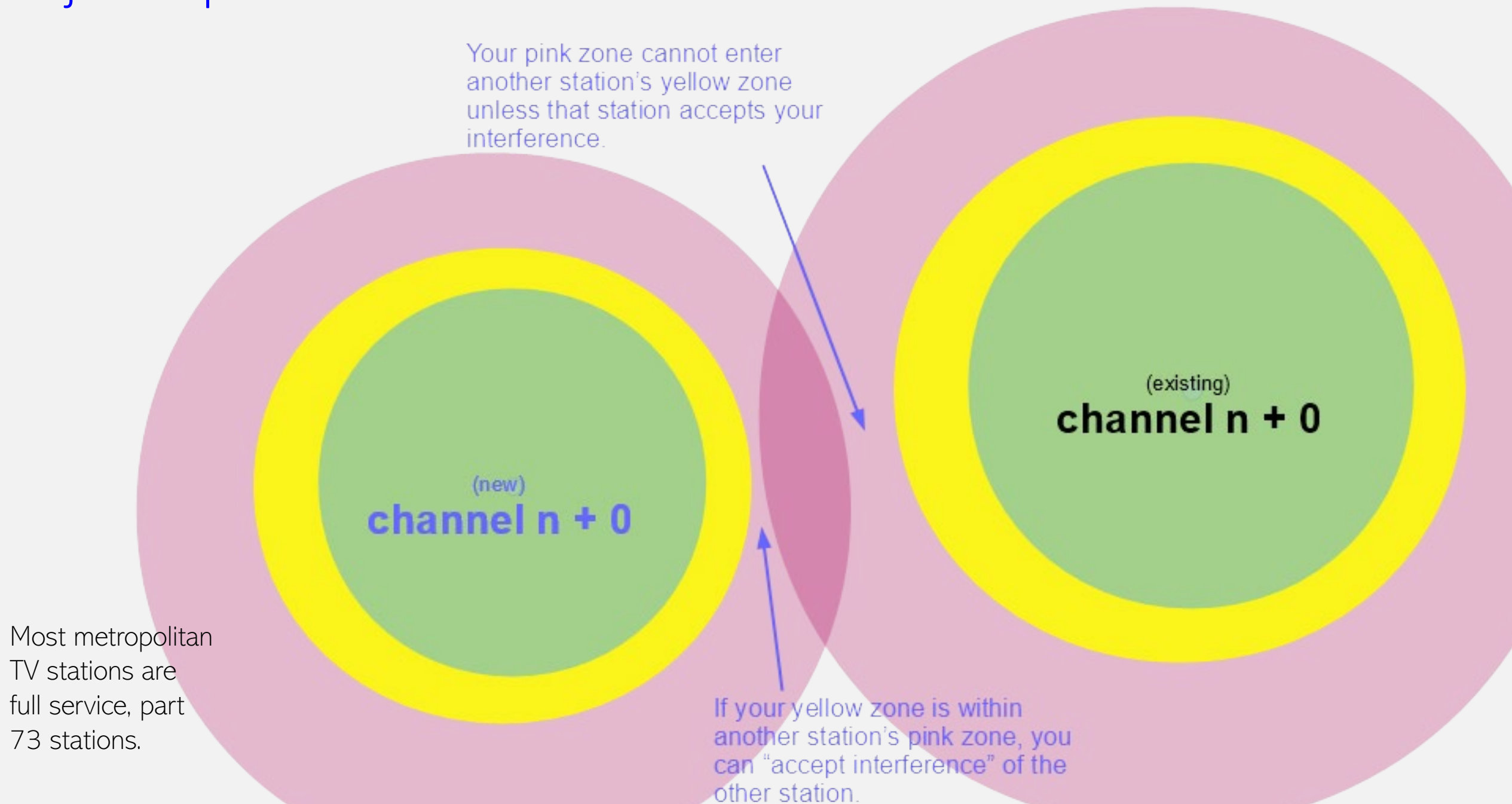
Were TV tuners designed to avoid interference better, more TV transmitters could be erected, extending services and coverage.

The coverage area of Low Power TV stations is generally less than that of licensed Full Service TV stations. LPTV's interference areas are smaller (beyond proportionality) than those of full service stations

Interference area (no usable signal)

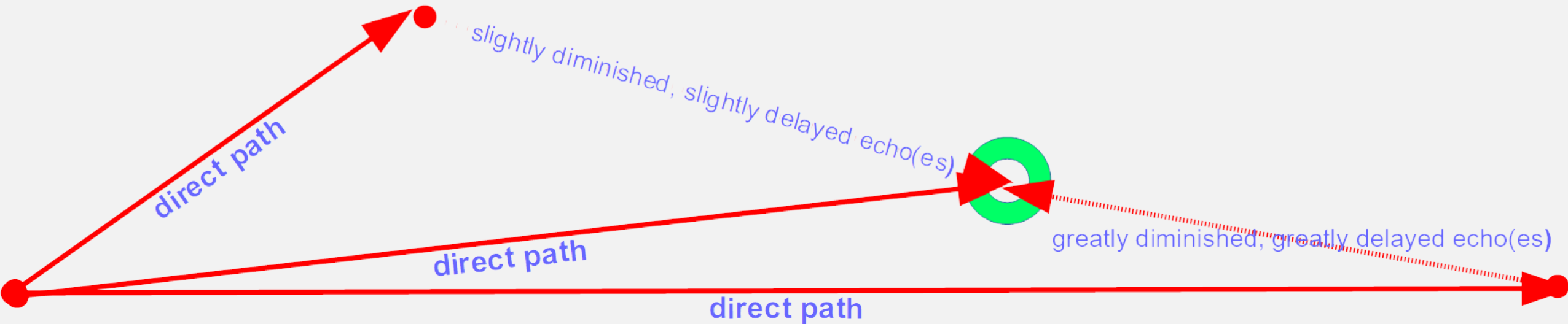


Adjacent part Low Power TV transmitters on same channel



Most metropolitan TV stations are full service, part 73 stations.

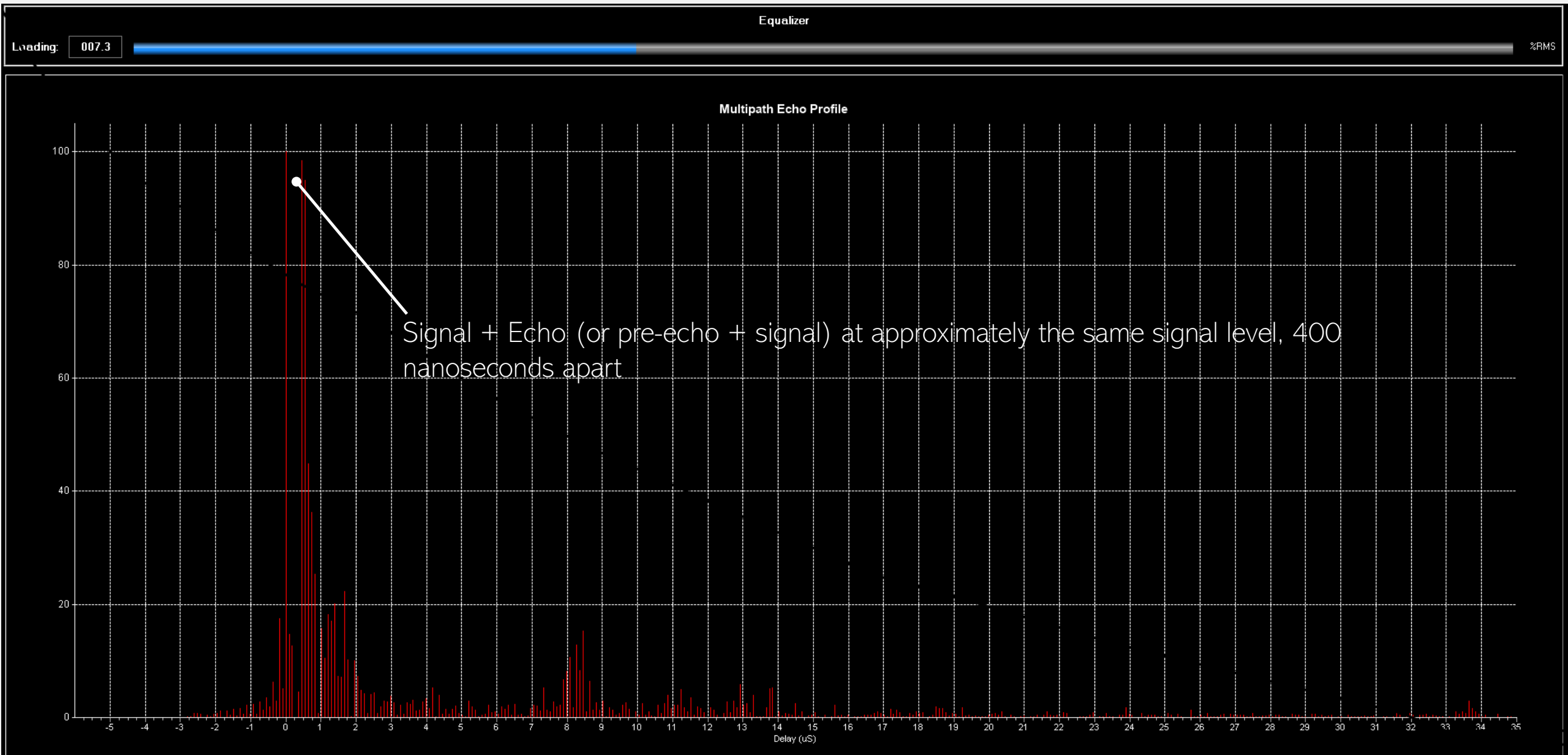
Multipath – two or more paths between transmitter & receiver



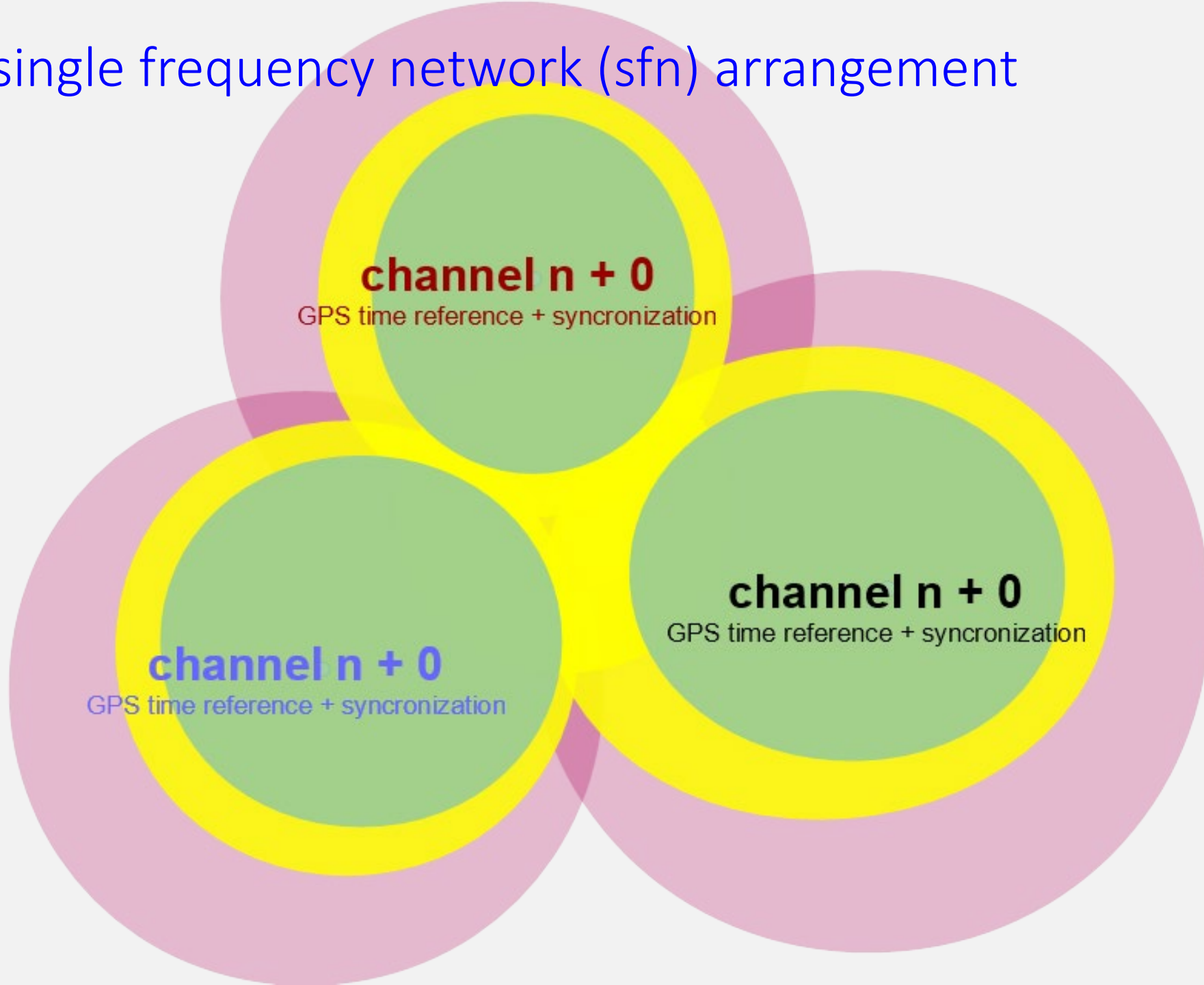
- Mountains, particularly with rocky or granitic facets and little ground cover
- Long distances between transmitter and receiver, over irregular terrain
- buildings, bodies of water, cars, buses, mass transit, planes
- Ionospheric (upper altitude) reflection and seasonal atmospheric ducting (low altitude)

Multipath can vary by receiver, location, channel, time of day, terrestrial/solar weather, atmospheric conditions, etc.

Severe Multipath – 0.4 microseconds / ~ 400 feet (San Diego)



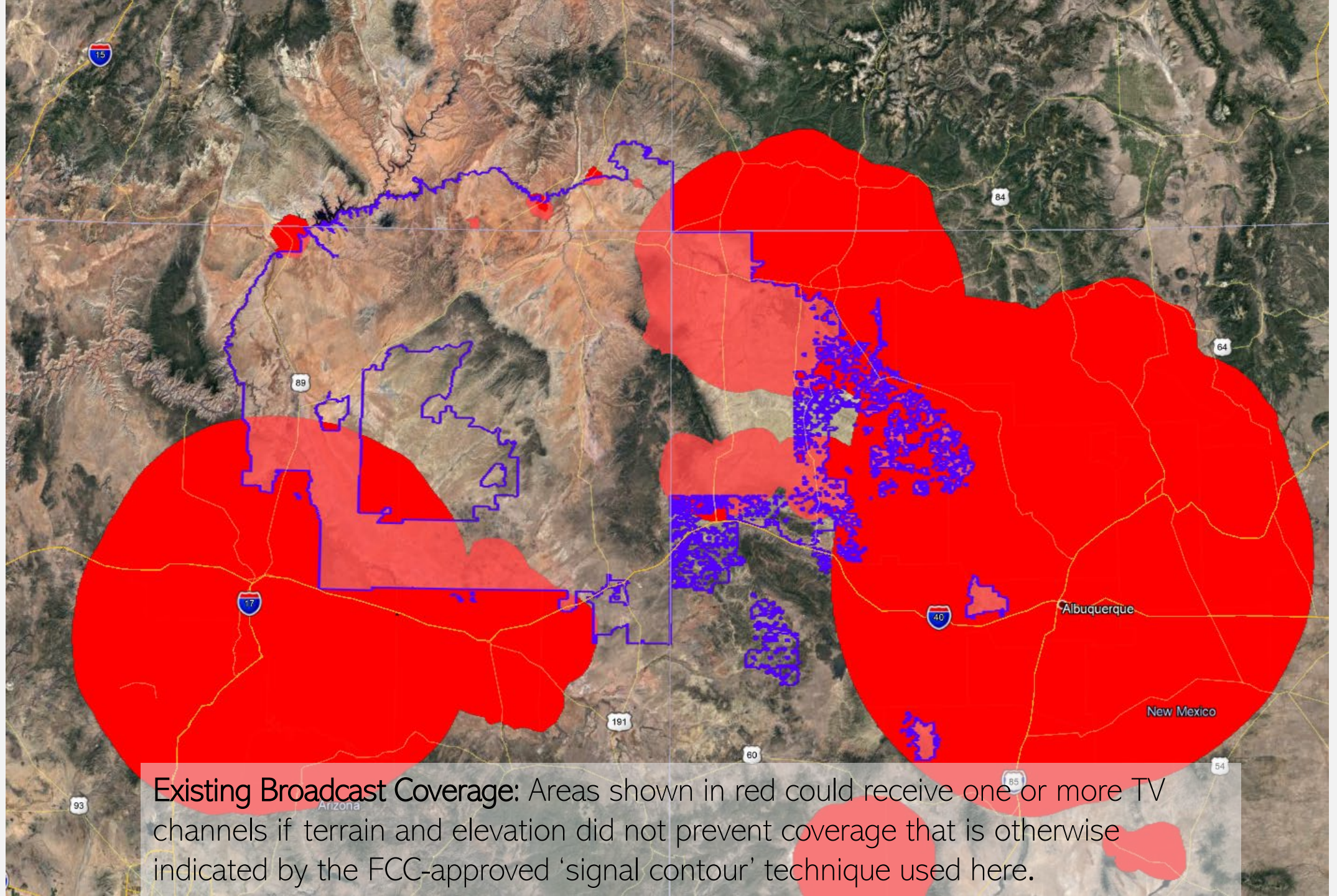
A simple single frequency network (sfm) arrangement



Telecommunications options on the Navajo Nation

1. No cable television service. Analog cable was sparse in the 1980s.
2. No consumer-facing wired broadband aside from telco-provided DSL.
3. DirecTv and dish network (satellite direct-to-home aggregators/resellers).
4. Spotty 4G/3G wireless cell phone coverage.

How many homes with TVs?



Existing Broadcast Coverage: Areas shown in red could receive one or more TV channels if terrain and elevation did not prevent coverage that is otherwise indicated by the FCC-approved 'signal contour' technique used here.

Transmitter Site Coverage Maps using 'prototypical facilities'

To determine feasibility and scope-of-work budgeting on a minimum number of transmission facilities, all FCC-identified transmitter sites on the Navajo Nation were analyzed for coverage potential and the ability to be interconnected through practical microwave paths.

Eventually, 33 potential, practical transmitter sites were identified.

The following technical facilities were developed at potential transmitter sites:

Frequency Band: UHF (channels 14-36) [VHF bands were and are available & suitable]

Effective Radiated Power: 15,000 watts or so

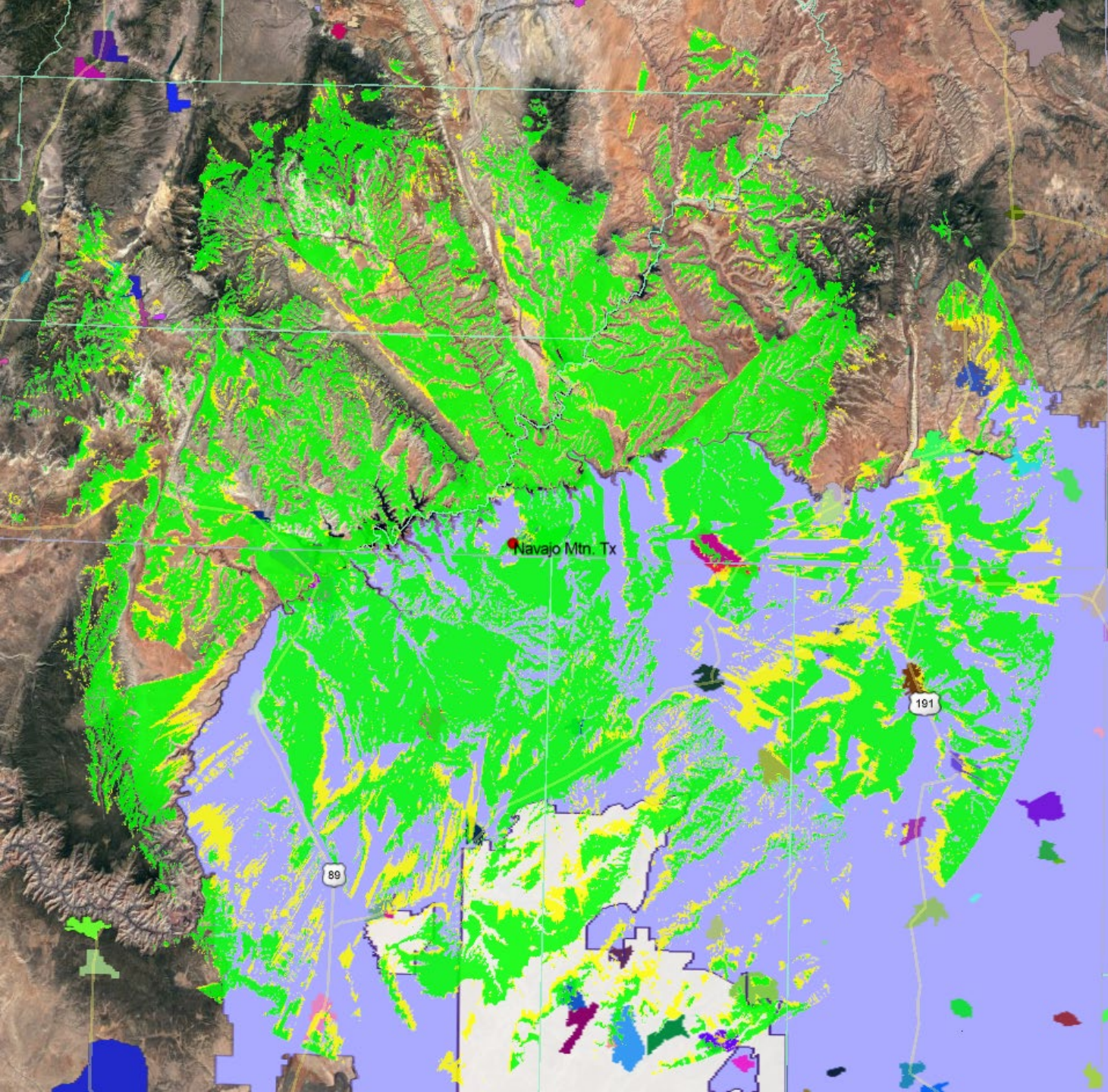
Antenna Pattern: Omnidirectional

Antenna Gain: 11x or so

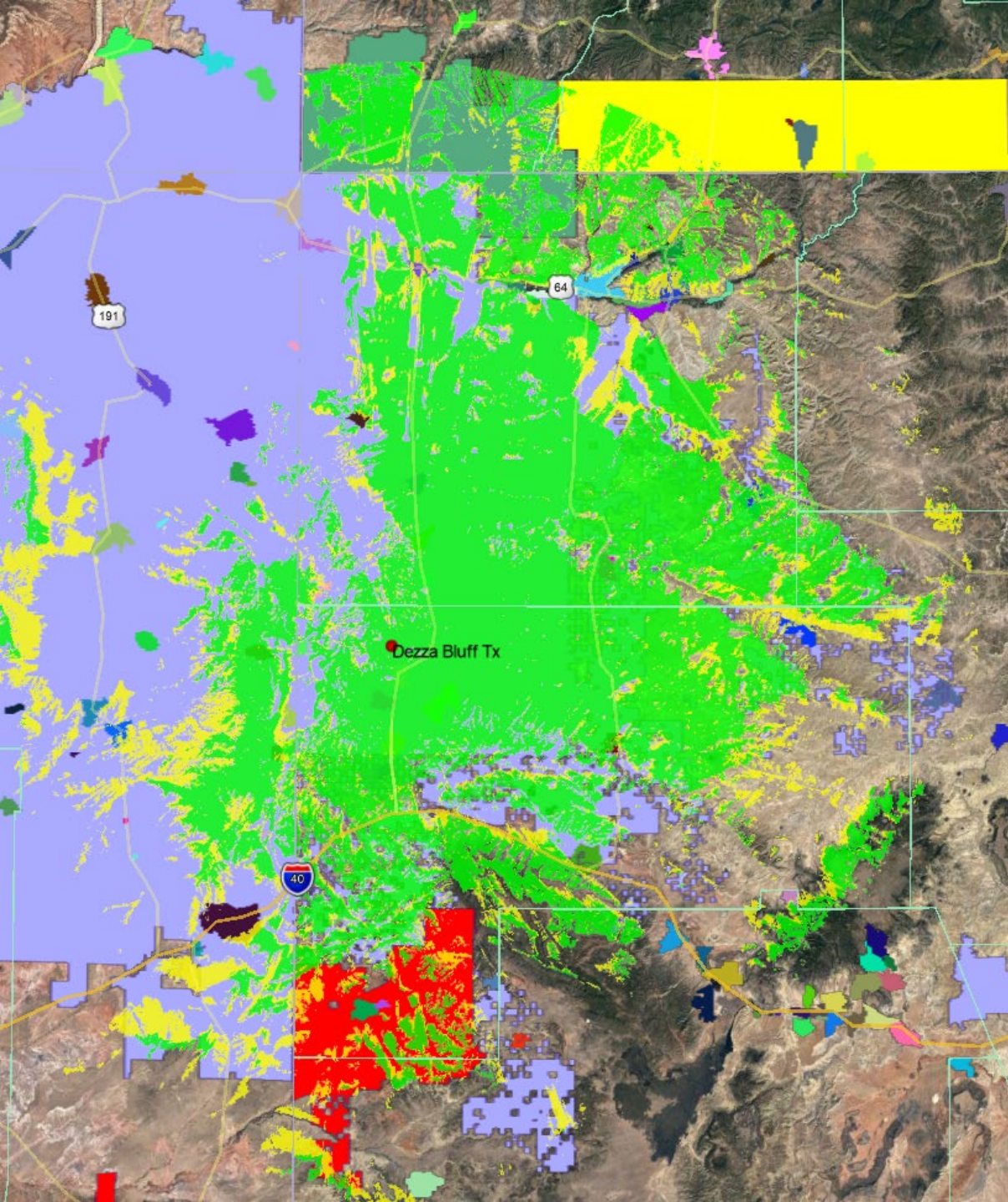
Radiation Center Above Ground Level: 95 meters, 314 feet or so

Criteria used for feasibility and cost-efficiency purposes. Final facility plan is likely to employ shorter towers and somewhat less transmitter power at some transmitter sites.

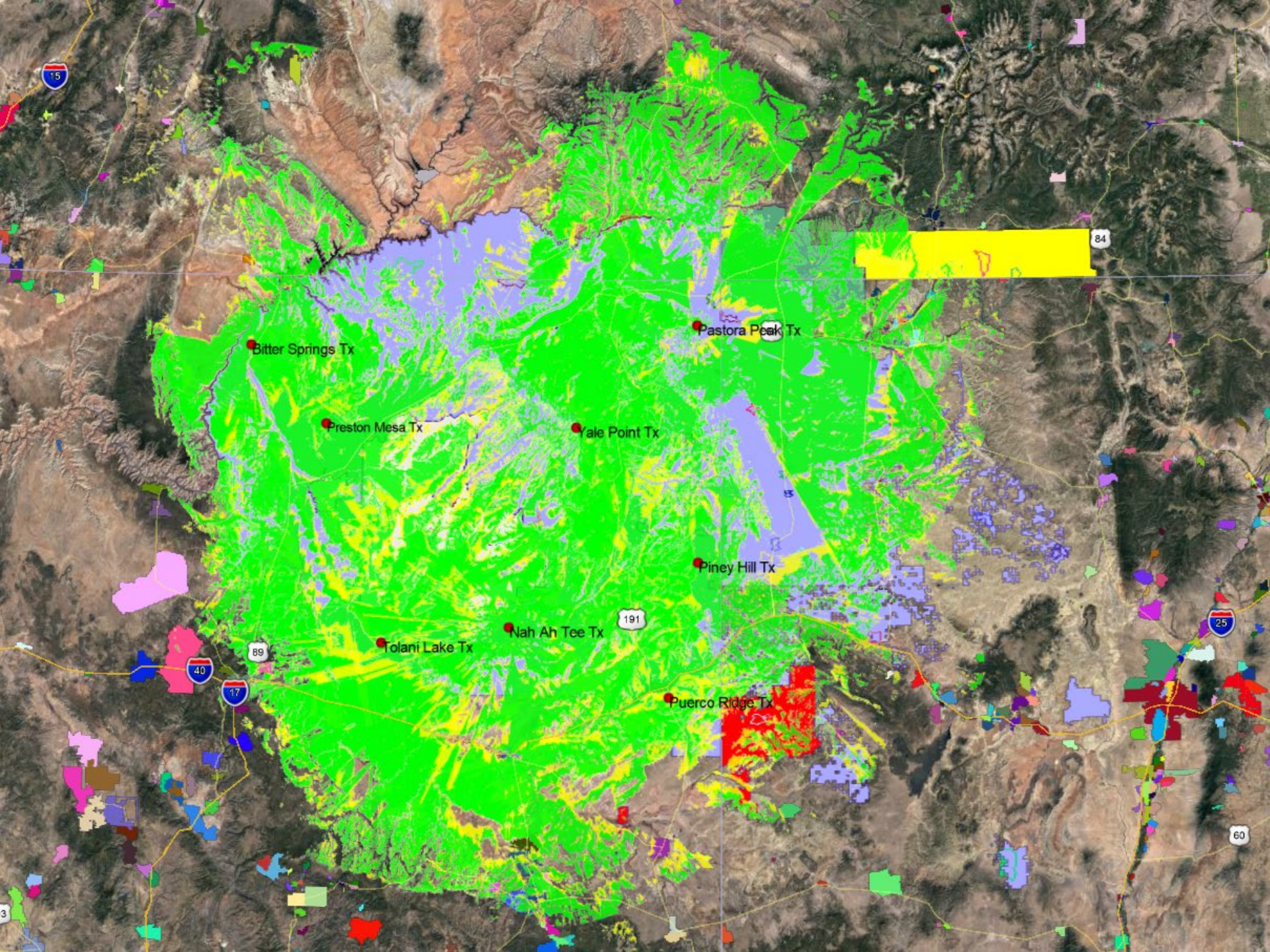
Utah – Navajo Mountain



New Mexico – Dezza Bluff



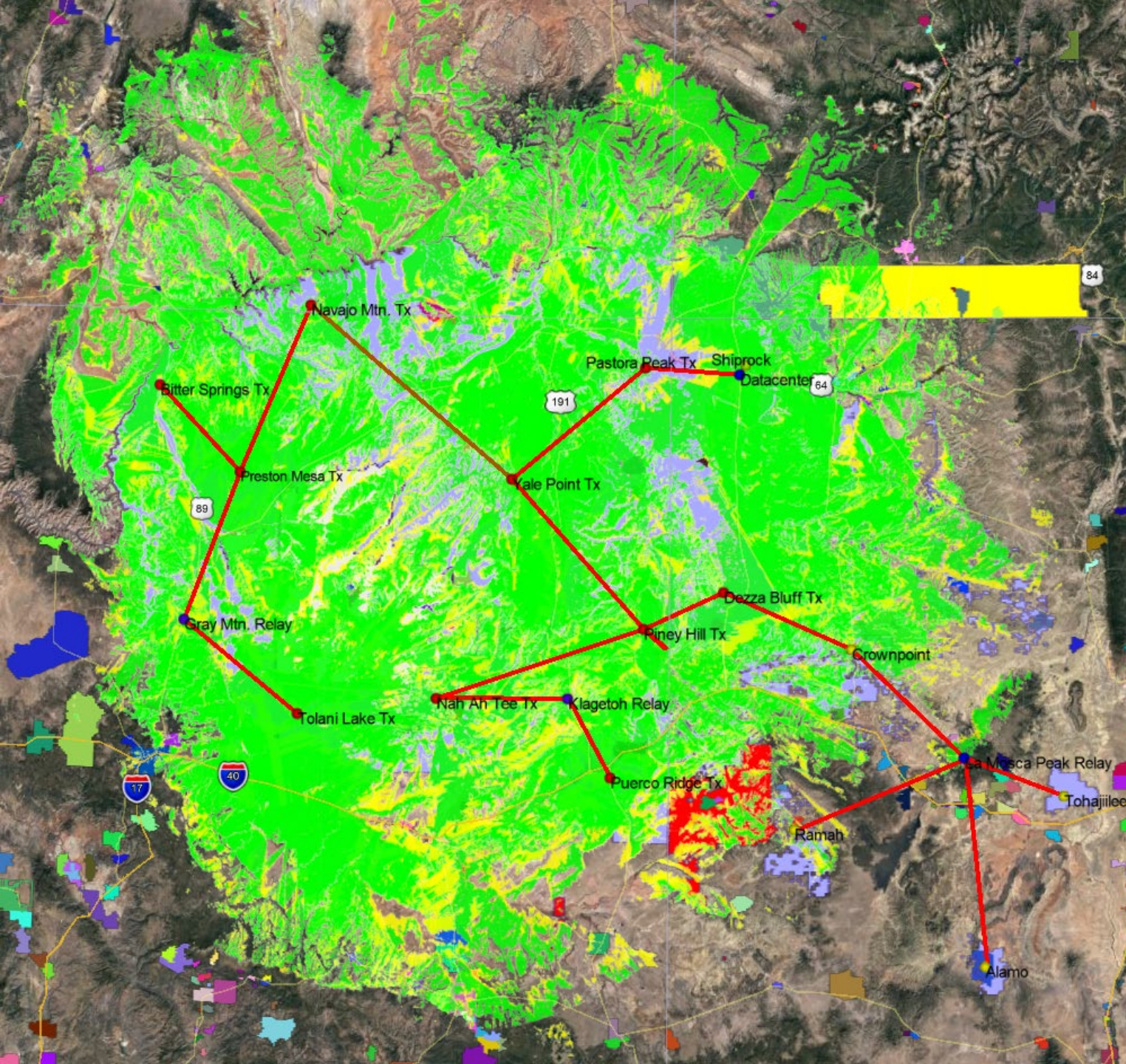
Arizona Sites



Principal Transmitter Sites

10 Low Power TV sites: greater than 96% coverage of the Navajo Nation's homes, plus coverage extending 75-100 miles or more beyond the reservation using low power TV transmitters.

Additional 'very low power' transmitters and antennae atop utility or light poles will be needed; possibly a dozen or more "gap filler" or "on-channel repeater" sites.

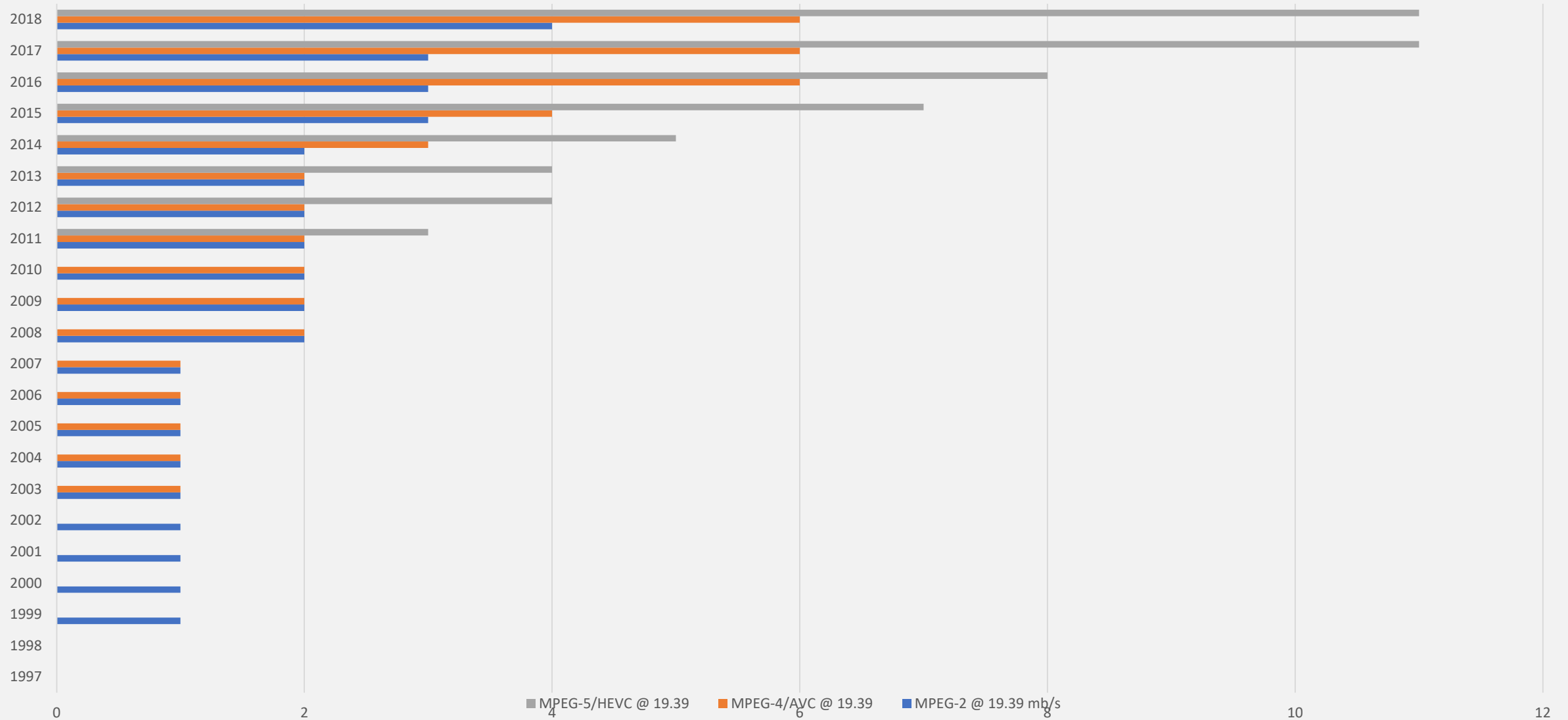


Legend

- Red dots – principal transmitter sites
- Blue dots – relay sites
- Orange dots – other sites
- Red lines – microwave relay paths

Video codec (coder/decoder) broadcast capabilities

Maximum possible 1080i programs in an ATSC 1 channel, per video codec, over time



Candidate standardized transmission technologies

SDO	Modulation	Video Compr.	Audio Compr.	Conclusion
ATSC	8-VSB	H.263	AC-3	Single Frequency Network capabilities provided by multiple vendors. No standardized support for HEVC compression.
DVB	DVB-T2	h.263, h.264, h.265	AC-3, MP3, AAC	Difficult to acquire operational expertise for DVB and to conform to US broadcast workflows through people living in the Western Hemisphere.
ATSC	8-VSB+M/H coding	H.264	AAC	No Single Frequency Network capabilities provided by multiple vendors. No standardized support for HEVC compression.
ATSC	NextGen/3.0 (various)	H.265/HEVC SHEVC	AC-4 / MPEG-H	Practical and manageable support for HEVC compression, dynamic (if need be) single frequency networks, two-way wireless broadband capabilities.

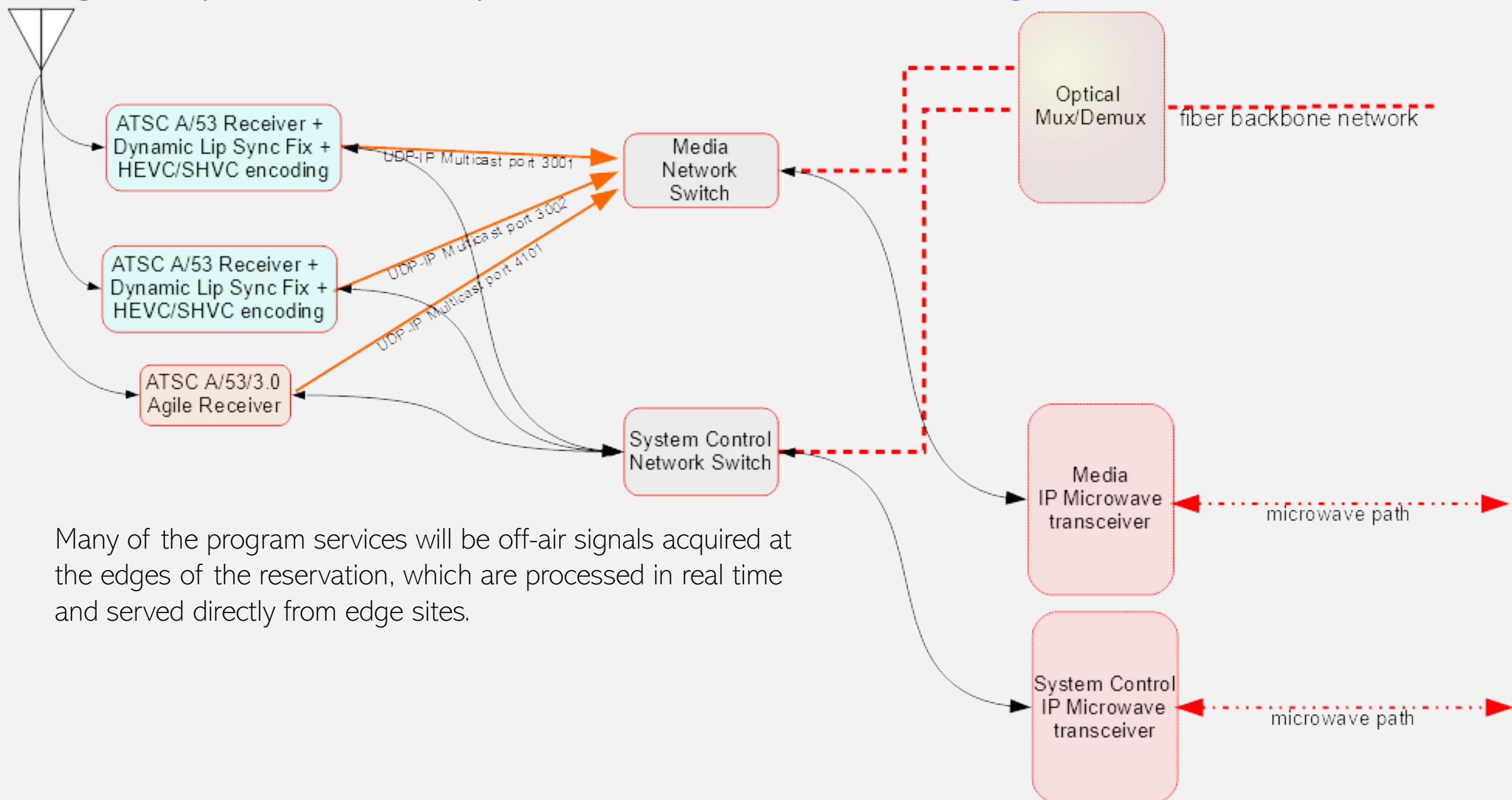
ATSC 3.0 NextGen advantages for the Navajo Nation

- Extensive, flexible system of digital broadcasting and wireless broadband connectivity will provide TV, radio channels everywhere.
- Many tools and standardized features to assist in managing multipath statically and dynamically if needed.
- **ATSC Dedicated Return Channel (DRC)** wireless technology will enable every home or Hogan to enjoy wireless Internet access, even without electrical service.
- **Software Defined Radio (SDR)** tuners and ATSC 3.0 software-defined transmitters enable modulation changes to be deployed immediately.
- Home Media Hub devices, TV sets and mobile devices to be manufactured and assembled at Tooh Dineh Industries at Leupp, AZ on the Navajo Nation.
- Internet-Protocol (IP)-base lowers interconnection costs between media devices and computing devices, and system (core) interoperable, if needed, with wireless broadband.

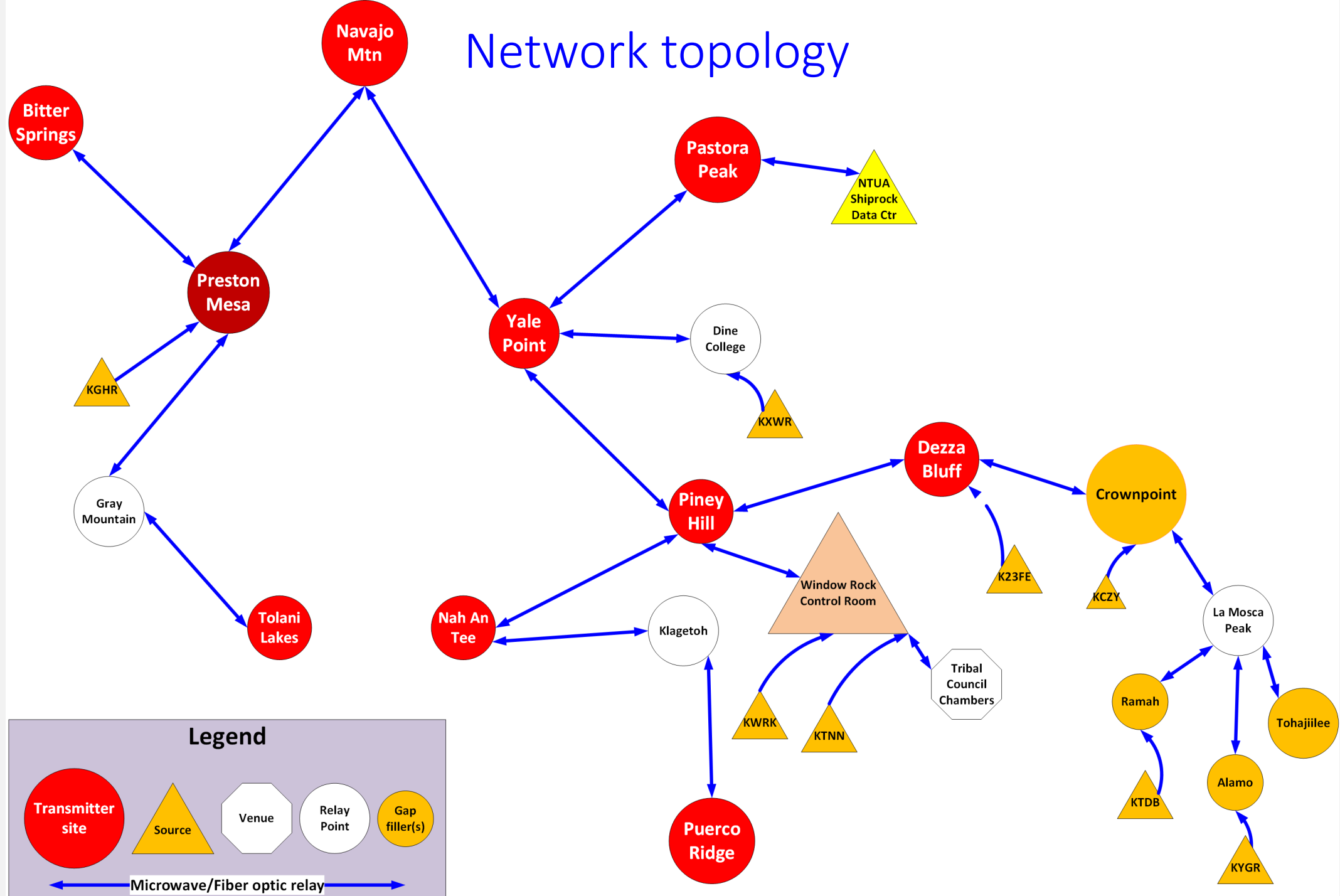
Navajo-manufactured modern home media devices

- Built-in TV/broadband tuner(s)
- Wi-Fi 'Hotspot'
- Two-way emergency alert capability
- An "Ethernet" internet connector
- Support for indoor (passive) and outdoor antennae
- Scheduling system that 'captures' programs and stores for later viewing ('digital video recorder' or DVR)
- High-quality signal conversion with connectors to supply any new or old TV set
- Complement of devices could include tablets, 'modern TV sets', mobile phones, and converter boxes/'home media hubs.'

Edge acquisition and presentation of ATSC 1 signals



Network topology



Architecture and Design

Indigenous Design Studio + Architecture

Principal: Tamarah Begay, AIA , NCARB, AICAE, CDT, LEED AP BD+C

- Headquarters/Network Operations Center
- Distinctive Navajo broadcast towers
- Communications shelters
- Master Facilities Plan
- Branding
- On-air 'look and feel'

<https://www.ids-a.com/>

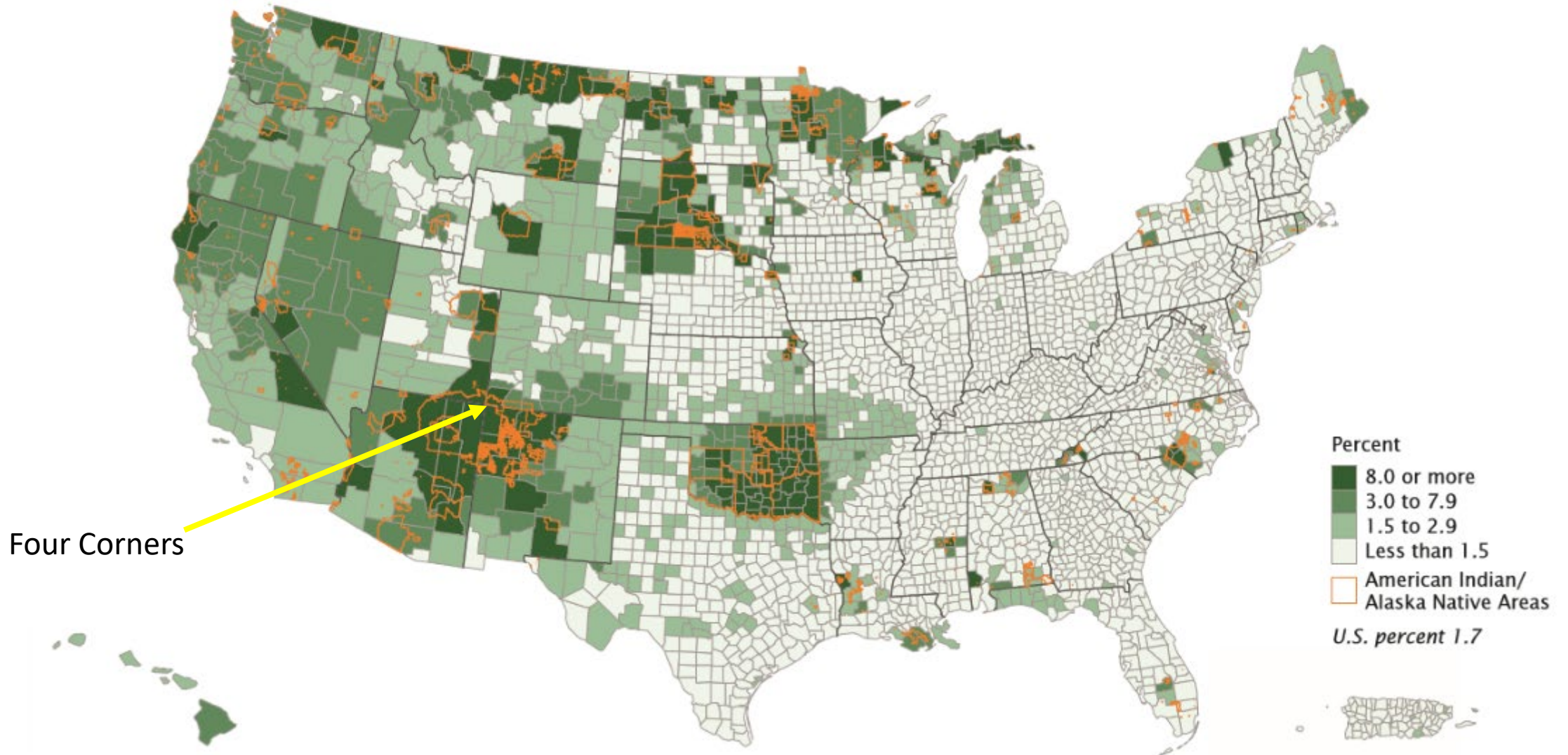


Costs

Principal & Gap-filler transmission and interconnection facilities	<\$8,000,000*
Headquarters, Network Operations Center, Studio and support facilities	~\$4,000,000
Education/Production/Training courses and facilities at Dine College and Navajo Technical College	~\$6,000,000
Tooh Dineh Industries improvements	~\$2,000,000
Media Hub and other devices for entire on-reservation population	<\$9,000,000
Purchase or acquisition of existing licensed full-service commercial TV stations in Phoenix, Albuquerque, Salt Lake City (all of Utah+) and Southern Colorado TV markets	<\$35,000,000
Founding the 'Indian Country TV' broadcast and cable TV network	<\$5,000

* Possibly much less, depending on timing, provisioning and possible business relationships.

US Counties, by percentage of Indian or Native population, 2010



Indian Country TV will reach

- 100% of the homes on the Navajo Reservation
- More than 35% of all off-reservation Navajo homes
- More than 40% of the population on Indian Reservations and Alaska Native areas in the US
- Circa 20 percent of all Indian and Alaska Native homes in the US

Through commercial arrangements and partnerships with other indigenous tribes on the mainland, Hawaii and Alaska, the network's content providers and service 'footprint' can be extended.

Proposed Business Arrangements

- **Technical facilities** owned, maintained and managed by Navajo Tribal Utility Authority (NTUA) which also provides electrical, water, police/governmental radio and communications facilities on the reservation.
- **Cultural and language programming** to be produced and **education and training** in production and operations to be provided by Dine (Navajo) Education and on-reservation community and technical colleges.
- **Management, operations, production, sales and marketing** to be contracted to Four Corners Broadcasting, Inc., a for-profit, Navajo-controlled tribal entity to be formed under Delaware law.

What is the Navajo Nation's 'broadcasting model'?

- **State-owned** and/or **State-controlled** – examples: Russian TV, North Korea, China, some African nations
- **Public Service** – State-funded, operated by independent management. Examples: BBC, CBC (Canada), IPN (Mexico)
- **Commercial** – INDEPENDENTLY funded of the state, with freedom of expression. Examples: NBC, TV Azteca (Mex), Globo TV (Brasil), ITV (UK)
- **Non-Commercial** State-, program-sponsor and local underwriter funding, with occasional flashes of independent thought. Example: PBS (US), National Polytechnic Institute (Mexico)

The Navajo Nation owns and operates both non-commercial and commercial licensed radio stations on the reservation. This suggests that Navajo Nation operates under what I call the 'citizen's services' model.

- **Citizen's Services** – State-funded technical facilities operated by employees and volunteers provide citizens with many services and views, with the Navajo Nation having limited opportunities to influence programming.

Navajo Digital Strategic Plan's non-technical aspects

- Freedom of expression guarantees
- Leveraging the sovereign advantages and 'domestic subsidized, yet tax-free (Federal/State) haven' status of the Navajo Nation
- Right to contract with ability to resolve contractual disputes quickly and efficiently in independent legal fora.

Acknowledgements

Roger Atkinson, communications system architect and the principal of RF Atkinson Designs, insisted that the transformational power of two-way wireless broadband be considered in this plan, for which I am grateful.

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