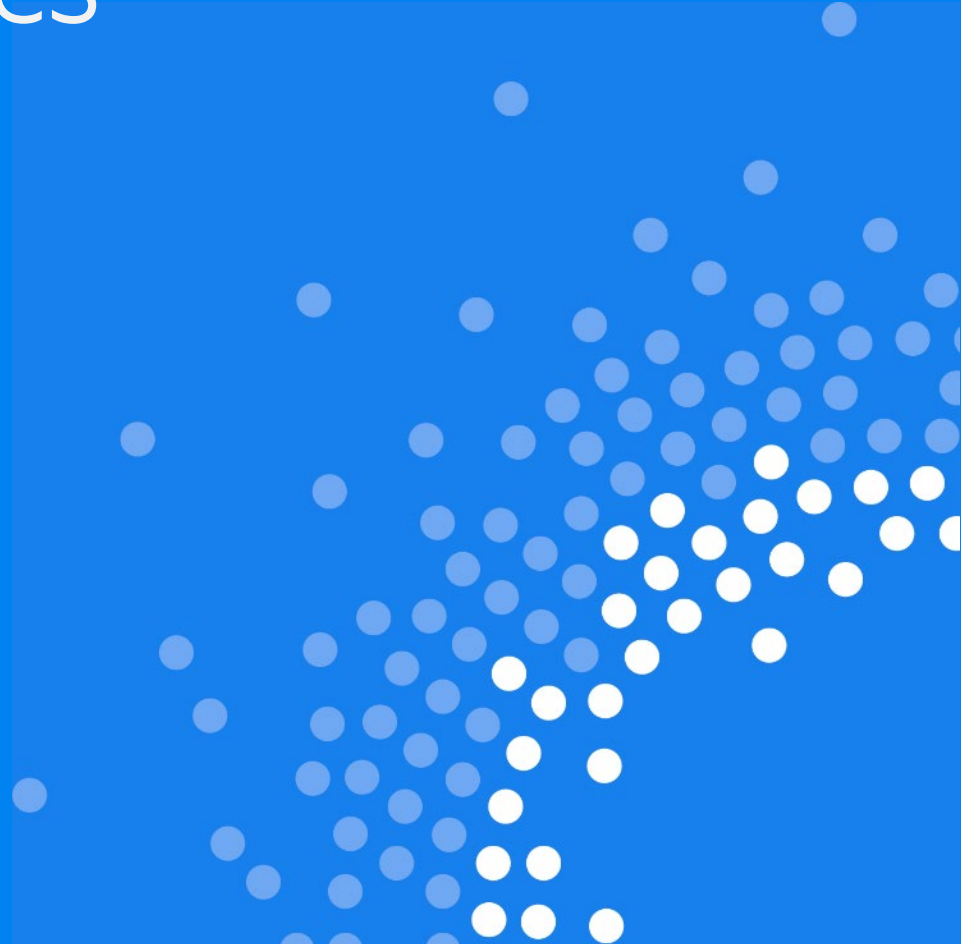# RWA Webinar: Leveraging CBRS services for additional revenues

Ivan Goridkov
Director Network Solutions, Ericsson North America
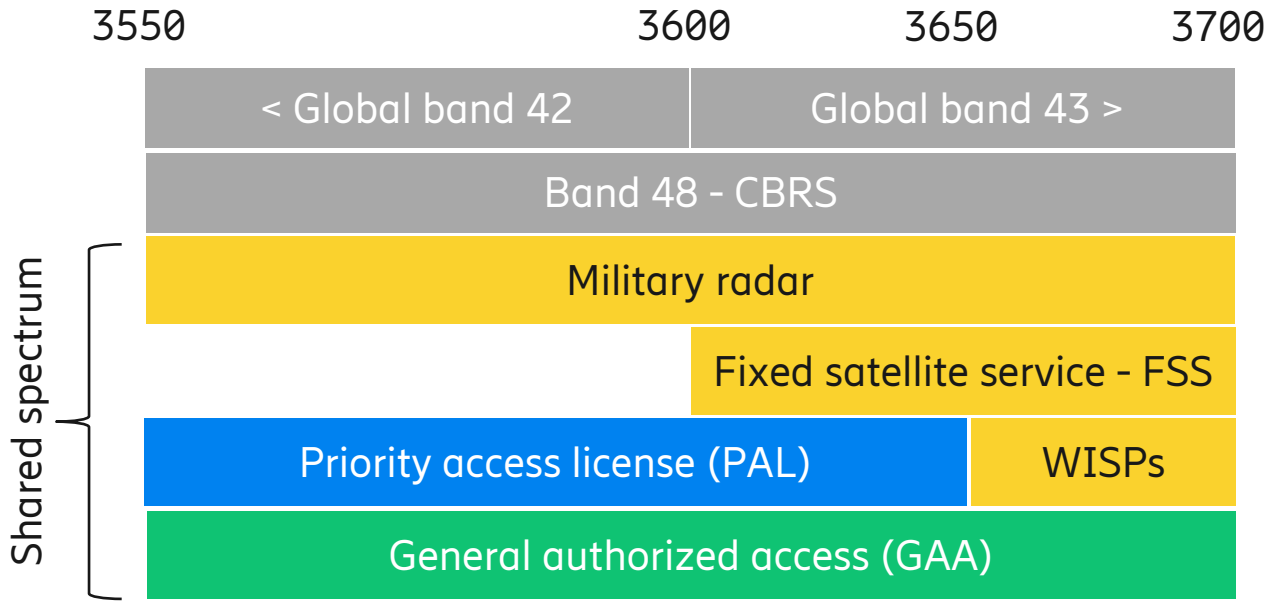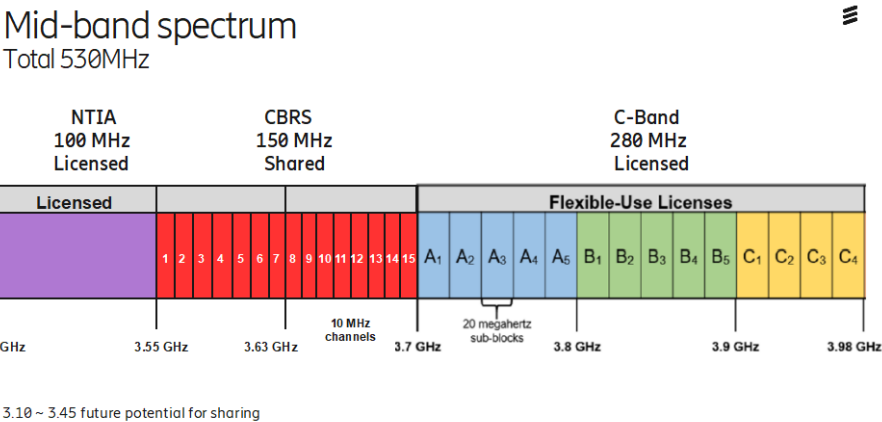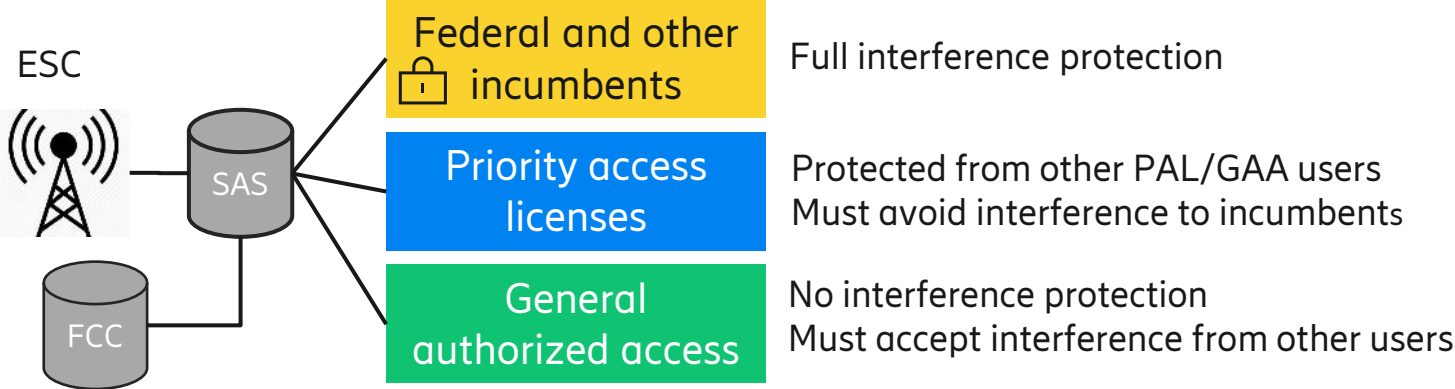
Bert Potts
Board Member, RINA Wireless

Dennie Mecham
COO, RINA Wireless

February 17, 2021

CBRS three-tier shared spectrum

ESC

SAS

FCC

Federal and other incumbents	Full interference protection
Priority access licenses	Protected from other PAL/GAA users Must avoid interference to incumbents
General authorized access	No interference protection Must accept interference from other users

Mid-band spectrum
Total 530MHz

NTIA
100 MHz
Licensed

CBRS
150 MHz
Shared

C-Band
280 MHz
Licensed

Licensed

Flexible-Use Licenses

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 A_1 A_2 A_3 A_4 A_5 B_1 B_2 B_3 B_4 B_5 C_1 C_2 C_3 C_4

3.45 GHz   3.55 GHz   3.63 GHz   3.7 GHz   3.8 GHz   3.9 GHz   3.98 GHz

10 MHz channels   20 megahertz sub-blocks

3.10 ~ 3.45 future potential for sharing

3550   3600   3650   3700

< Global band 42	Global band 43 >

Band 48 - CBRS

Shared spectrum

Military radar

Fixed satellite service - FSS

Priority access license (PAL) | WISPs

General authorized access (GAA)

CBRS current status

- Full commercial deployment [27 January 2020]
- Total ~ 30 thousand CBSDs [SAS admins]
- Generally good experience
- All parts of ecosystem in place
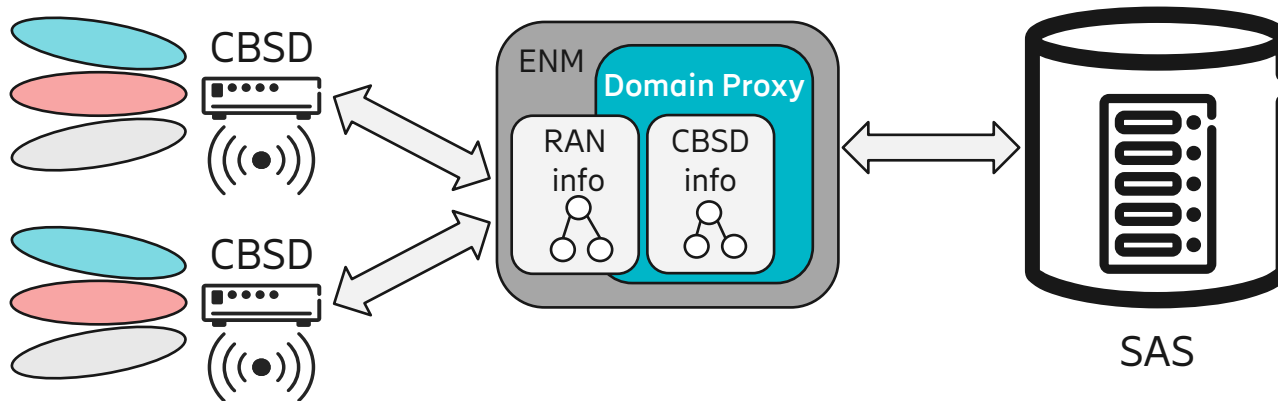
5 SAS vendors   180+ FCC certified devices

CBRS Device Ecosystem — rapid growth and innovation

Regional **Connect**

Increasing numbers of smartphones, IoT devices, routers, CPE, and other devices are being FCC certified under Part 96

Samsung
Galaxy S

Google
Pixel

OnePlus
Pro

Sierra Wireless
EM 7565

Inseego MiFi
8800L

BEC 6900 RUL Series
CBRS Outdoor Router

Cradlepoint
AER2200

LG
G8 ThinQ
V50 ThinQ

5G Moto
Mod

iPhone 11/ 12

HP LTE Module
EL3007565

Inseego MiFi
M1000

Seowon Intech
LTE Outdoor CPE

Cradlepoint
IBR1700

Telit
LM960

Motorola Solutions
Nitro 2 Way Radio

ZyXEL
LTE-A Pro
Outdoor Router

Cradlepoint
MC400

Ericsson products and needs

RADIO
4408

AIR
6488

Dot
4474

ENM
Domain proxy
RAN info
CBSD info

Domain coordinator

Outdoor micro radio
Low power strand version for cable

Outdoor massive MIMO radio
Ongoing features for RC customers and cable

Indoor Radio Dot
NR version in 2021
Multi-operator, neutral host with OAM
IoT features

Domain coordinator software
Cloud architecture, decoupled from ENM, for scale, reliability
Ongoing WInnF / CBRS-A roadmap

CBRS PAL auction

CBRS PAL auction highlights

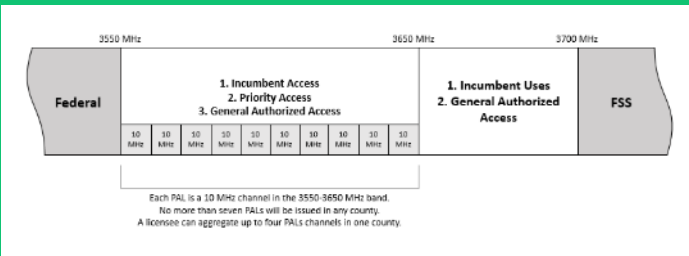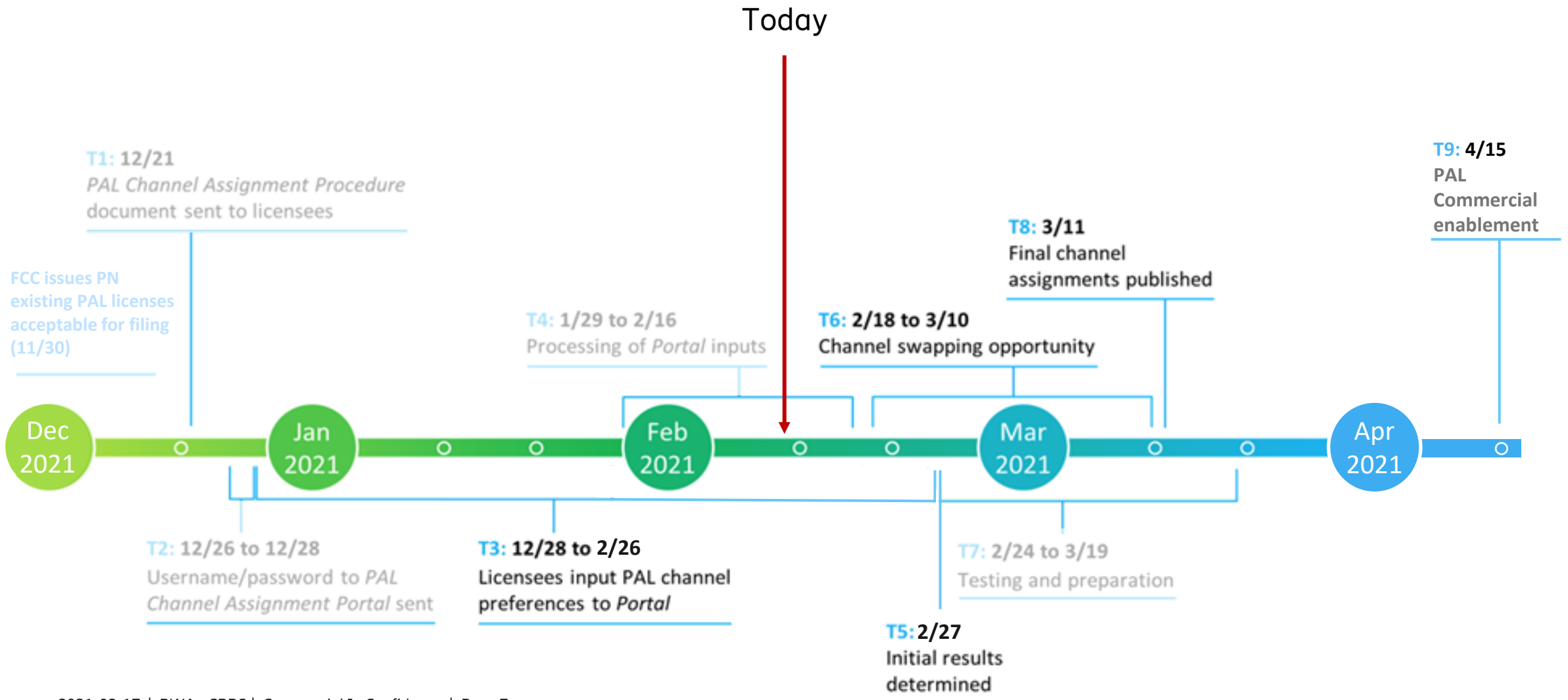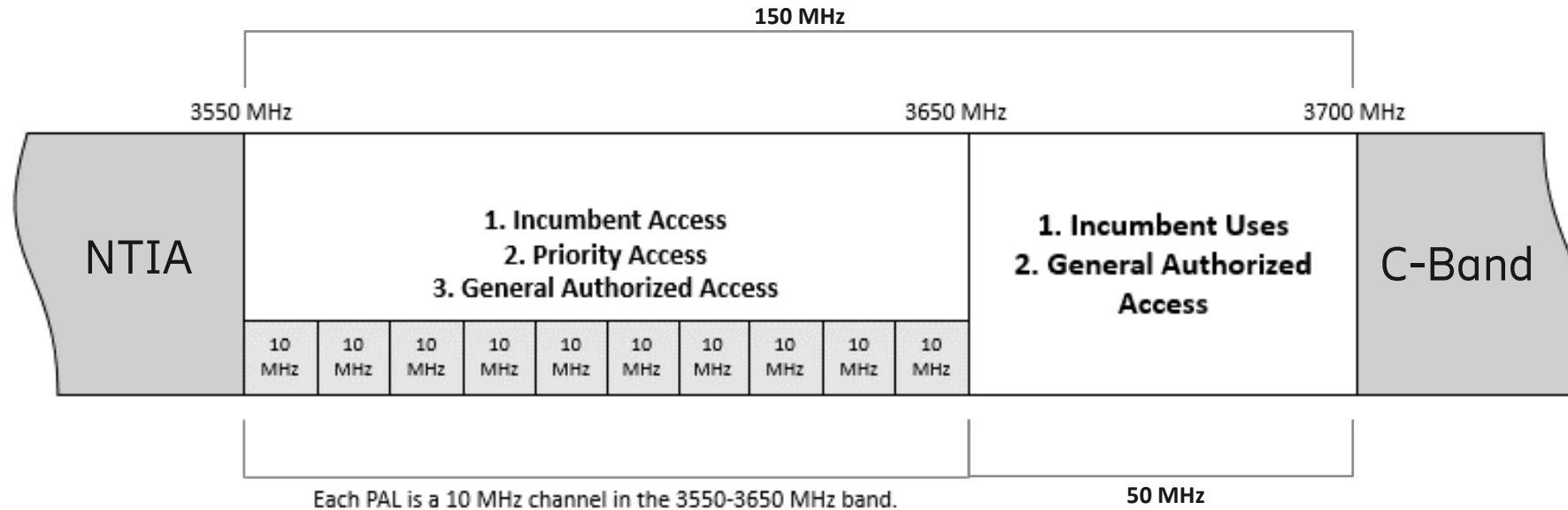|		
Spectrum for auction 70 MHz PAL licenses	Gross proceeds $4.5 Bn $0.217 / MHz-Pop	Qualified bidders 271 Winning bidders 228 Total licenses won 20,625
Verizon with the highest spend of $ 1.8 Bn ~ 41% of total Dish won the highest number of licenses, 5,492 – $0.91 Bn	Cable companies Comcast, Cox and Charter combined spend ~ $1.1 Bn	CBRS and plan

Top 10 contributed to 91% of total spend

PAL enablement timeline

Today

T1: 12/21
*PAL Channel Assignment Procedure* document sent to licensees

FCC issues PN existing PAL licenses acceptable for filing (11/30)

T4: 1/29 to 2/16
Processing of *Portal* inputs

T6: 2/18 to 3/10
Channel swapping opportunity

T8: 3/11
Final channel assignments published

T9: 4/15
PAL Commercial enablement

Dec 2021

Jan 2021

Feb 2021

Mar 2021

Apr 2021

T2: 12/26 to 12/28
Username/password to *PAL Channel Assignment Portal* sent

T3: 12/28 to 2/26
Licensees input PAL channel preferences to *Portal*

T7: 2/24 to 3/19
Testing and preparation

T5: 2/27
Initial results determined

GAA and PAL behavior summary

150 MHz

3550 MHz · 3650 MHz · 3700 MHz

NTIA

1. Incumbent Access
2. Priority Access
3. General Authorized Access

| 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz | 10 MHz |

1. Incumbent Uses
2. General Authorized Access

C-Band

50 MHz

Each PAL is a 10 MHz channel in the 3550-3650 MHz band.

- PAL
  - 7 x 10 MHz licenses auctioned per area
  - Each entity can buy up to 4 x 10MHz licenses
- GAA
  - Can use up to full 150 MHz if no PAL or incumbents deployed in given location
  - Objective is SAS to allocate spectrum evenly between operators
- PAL owner can also get their fair share of GAA spectrum
  - For example, a PAL holder could potentially use 60-80 MHz combined between GAA and PAL
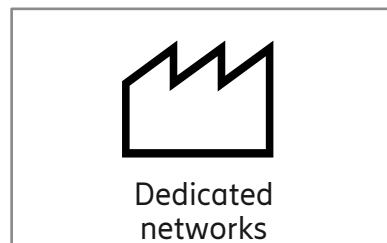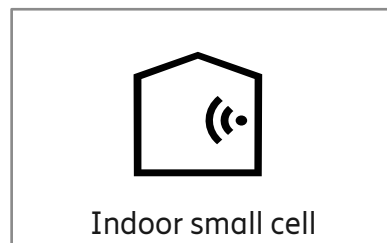
CBRS use cases
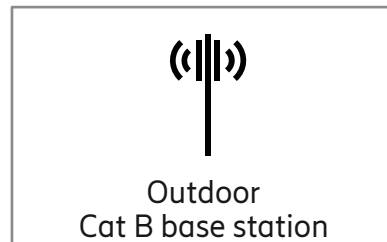
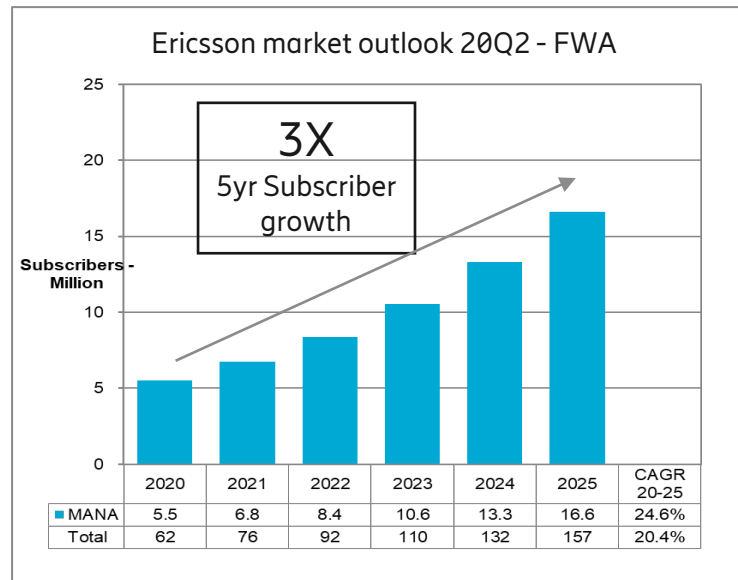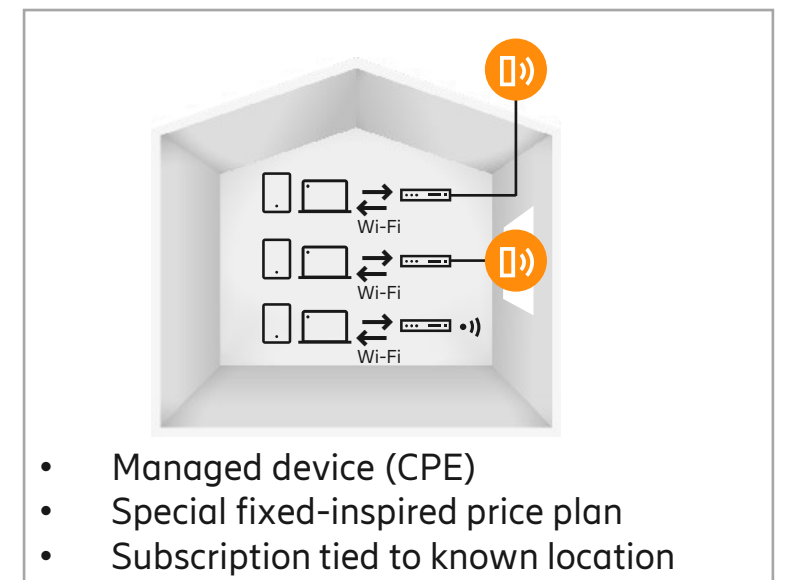|	
Massive MIMO	Fixed wireless access
Outdoor Cat B base station	Outdoor mobility
Dedicated networks	Private LTE
Indoor small cell	In-building Multi-operator neutral host

Fixed wireless access

Opportunity drivers

- Underserved communities
- Work at home
- Government incentives (CAFII, RDOF)
- New cost-effective spectrum
- WISPs must transition from Part 90
- New revenue stream
- Lower cost of entry compared to wireline
- Leverage mobile network
- MSOs expand BB service beyond cable footprint

North America market outlook

Ericsson market outlook 20Q2 - FWA

3X
5yr Subscriber growth

Subscribers - Million

	2020	2021	2022	2023	2024	2025	CAGR 20-25
■ MANA	5.5	6.8	8.4	10.6	13.3	16.6	24.6%
Total	62	76	92	110	132	157	20.4%

FWA deployment model

- Managed device (CPE)
- Special fixed-inspired price plan
- Subscription tied to known location

FWA advantages

Time to market

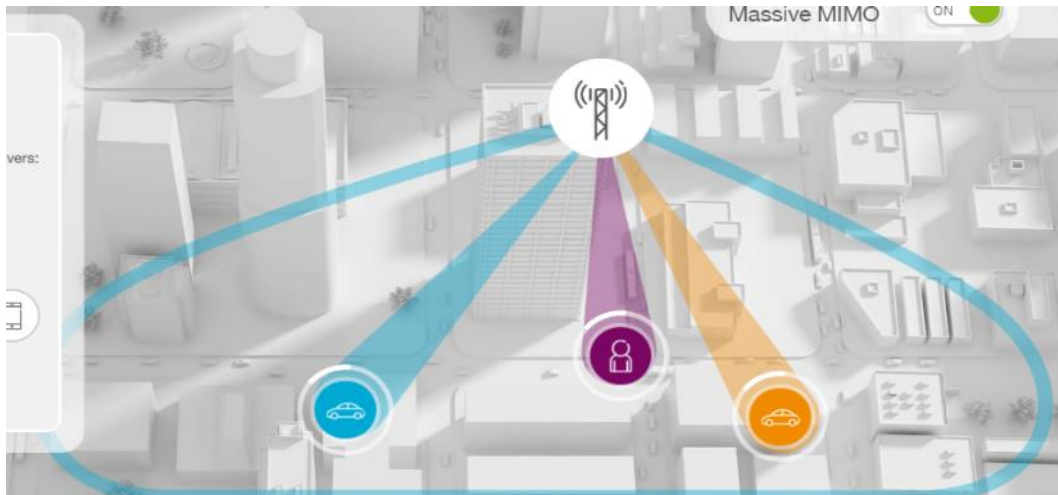### Financial attractiveness

Sustainability

Advanced antenna technology
Massive MIMO - beamforming

- Traditional cell sites project radio waves in a fixed predefined pattern – similar to a flood light

- Massive MIMO cell sites project radio in narrow beams directed to the users – similar to a spotlight
- Multiple beams can be created which will dynamically adjust to user locations and usage
- The result is an increase in signal and a reduction in interference from other users in the sector – improved throughput to each user in the sector

Advanced antenna technology
Multi-user MIMO

- Sector capacity in a traditional cell site is shared amongst all the users of the cell site

- With multi-user MIMO, sector capacity resources can be reused across multiple users in the same sector
- The result is an increase in sector capacity due to the re-use of resources across multiple users – creating virtual sectors within a single sector

Peak sector throughput, average sector throughput and busy hour throughput

- Peak throughput
  - CPE is in great SINR conditions. CPE gets all available LTE resources.
- Average throughput
  - CPEs are distributed throughout the cell under various RF conditions. LTE resources are shared amongst all CPEs
  - Used to dimension the network for capacity planning
- Busy hour throughput
  - Average measured backhaul throughput divided by number of homes connected. Based on industry trends and wireline industry input, it is currently 2–3 Mbps per home

	Peak TDD LTE DL throughput	Peak TDD LTE DL throughput 256 QAM	Peak TDD LTE DL throughput 256 QAM	Average TDD LTE DL sector throughput baseline + fixed + LTE evolution gains	Average TDD LTE DL sector throughput baseline + fixed + LTE evolution gains
Assumptions	4:1 DL:UL ratio 4x2 MIMO 64 QAM DL	4:1 DL:UL ratio 4 x 2 MIMO 256 QAM DL	4:1 DL:UL ratio 64T64R MU-MIMO	4:1 DL:UL ratio 4T4R	4:1 DL:UL ratio 64T64R under 8 layer MU-MIMO
20 MHz cell carrier capacity	111 Mbps	147 Mbps	960 Mbps	50 Mbps	200 Mbps
3 x 20 MHz cell carrier capacity	333 Mbps	440 Mbps	2880 Mbps	150 Mbps	600 Mbps

CBRS cell coverage – rural

Regional **Connect**

4T4R

Town A

100 Mbps
50 Mbps
25 Mbps
10 Mbps
IoT coverage

64T64

Town B
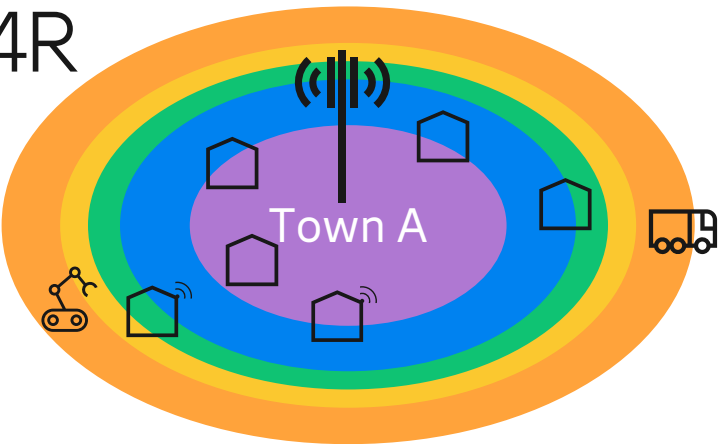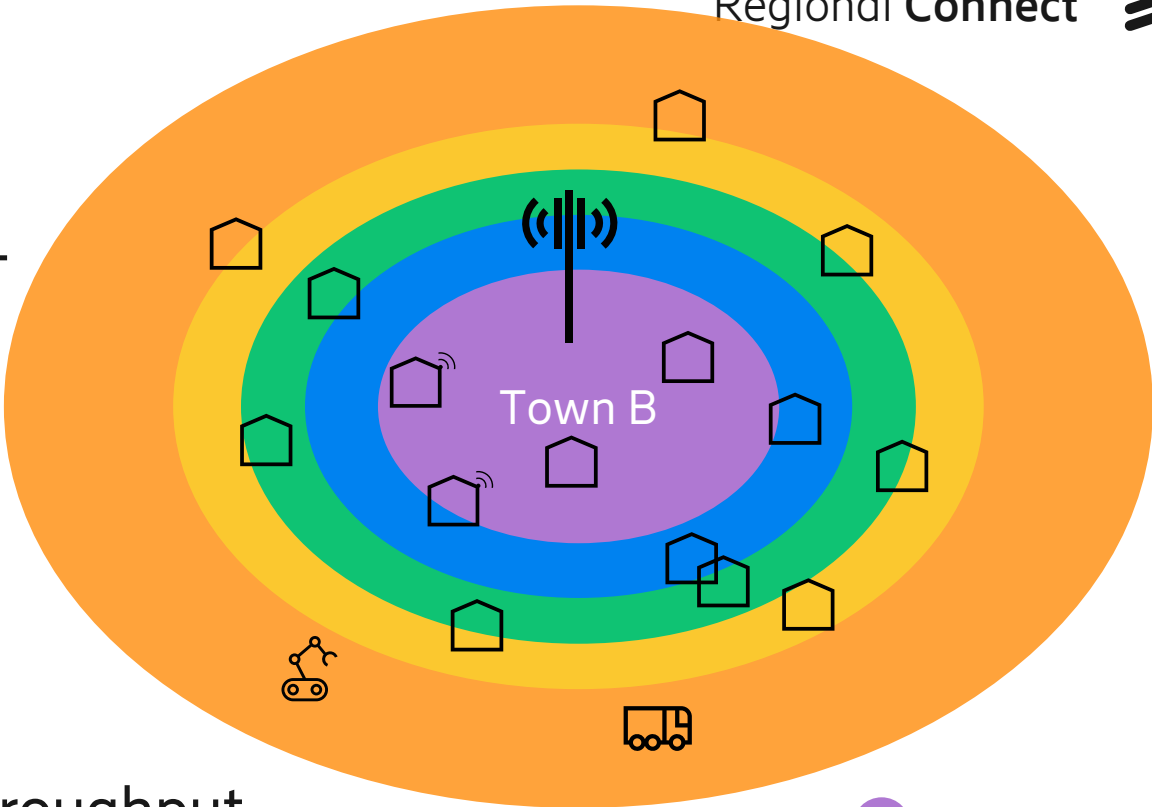
100 Mbps
50 Mbps
25 Mbps
10 Mbps
IoT coverage

Network throughput

=

Cell density X Available spectrum X Spectral efficiency

New Spectrum
Existing Spectrum
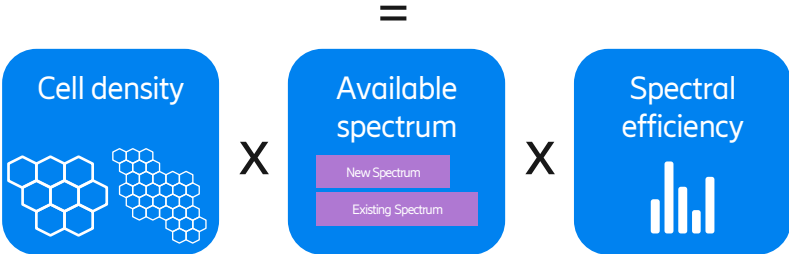
Coverage shown with 3.5Ghz, 3x20 MHz, LoS TDD Frame config 2. Actual results vary based on clutter, terrain and other conditions

Multiple rate services supported on the same cell site

Outdoor mobility - capacity and offload
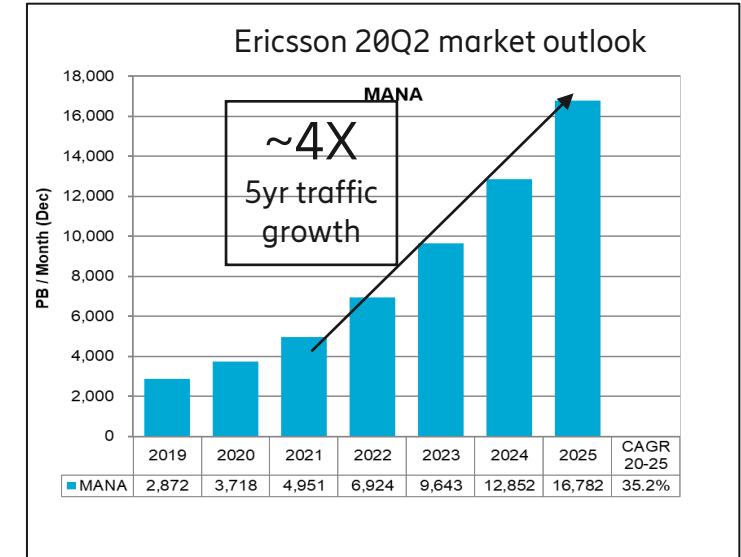
Regional **Connect**

Problem statement

- Operators must grow spectrum portfolio to keep up with demand
- CBRS supplements MNO spectrum
- Primary spectrum for MSO

Opportunity drivers

- Significant mid-band spectrum
- Spectrum unencumbered and centrally managed
- Unlicensed access available now with GAA, licensed with PAL
- Supplement licensed band capacity in high traffic areas
- MSOs reduce reliance on MVNO
- LTE today, NR path
- Device ecosystem in place
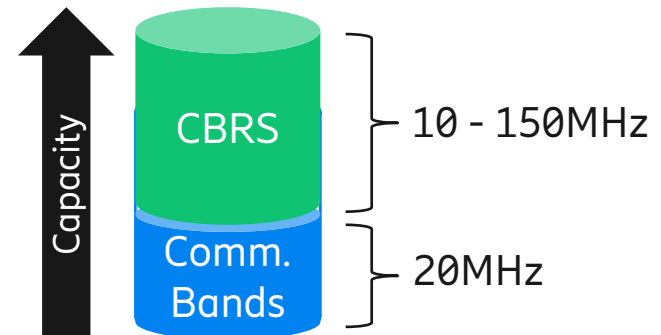- Better coverage characteristics than LAA

MANA mobile data traffic

Ericsson 20Q2 market outlook

~4X 5yr traffic growth

	2019	2020	2021	2022	2023	2024	2025	CAGR 20-25
MANA	2,872	3,718	4,951	6,924	9,643	12,852	16,782	35.2%

Supplement spectrum holdings with CBRS

Base Station

Supplemental band (3.5GHz)

Anchor band (850, AWS, PCS)

Capacity

CBRS — 10 - 150MHz

Comm. Bands — 20MHz

2021-02-17 | RWA - CBRS | Commercial In Confidence | Page 15

CBRS private network use cases

Utilities

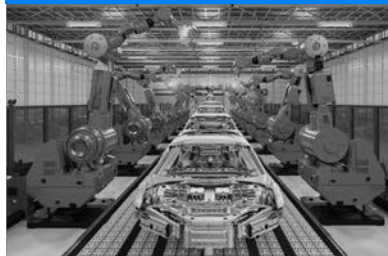**Mining**

Oil and gas

Smart cities

Manufacturing

Public venues

Campus networks

Warehousing

Path to 5G...

- 5G has been defined for CBRS (specifications largely complete)

- Infrastructure and devices introduced over next 2 years

- Stand-alone expected to be deployed architecture for 5G CBRS

RINA Overview

* Founded by Strata and South Central in 2006
* 4 Class A owners and 5 Class B Owners
* Full range hosting services for rural wireless operators, including CBRS
* Carriers helping Carriers

Call us today.

(435) 622-2012

www.rinawireless.com

Why RINA?

Improve your cost efficiency

- Better economies of scale and purchasing power
- Less Staffing resources required
- Current with technology
- Priced affordably

Grow your business

- Offer new CBRS and other mid-band services
- Expand your reach
- We combined our Carrier's resources to help each other
- Become a Member of RINA

Share knowledge and resources

- Become part of the RINA family of rural operators
- You can have ownership in RINA and help direct its future, by representation on the Board of Director's

Sleep better

- Let's you take care of the customer and RAN while RINA handles the CORE and other services
- 24/7/365 NOC Monitoring your system

Call us today! (435) 622-2012

www.rinawireless.com

R·I·N·A
Wireless

One of two Redundant and Secure Facilities of RINA Wireless

RINA provides hosting services to 25 carriers in 21 states including Alaska and the territory of Guam!

RINA's Wireless Operation Center staffed by our Technicians, they are extremely helpful and knowledgeable!
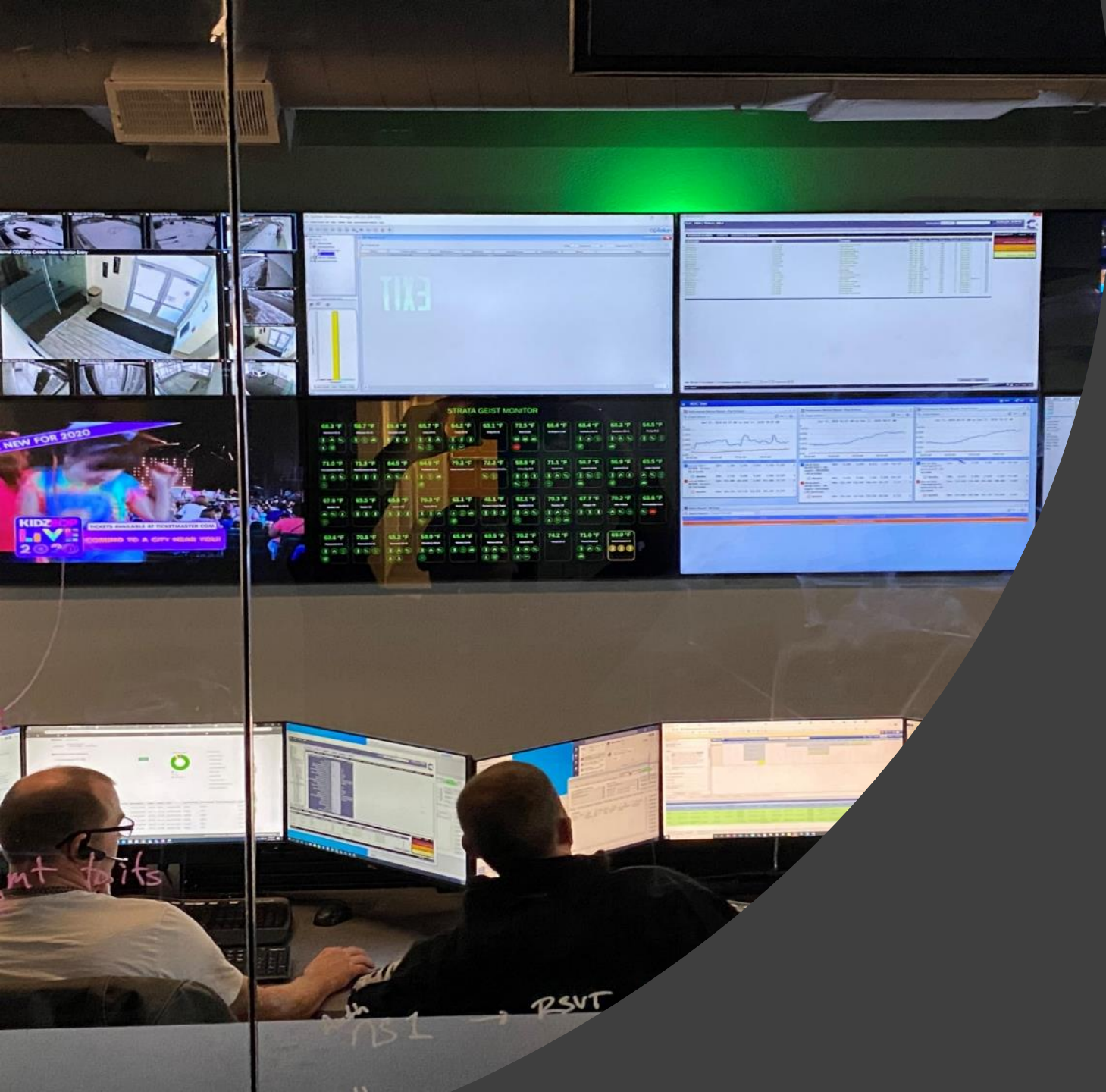
Redundant power at both our locations is essential for all our hosted partners including generator and battery systems.
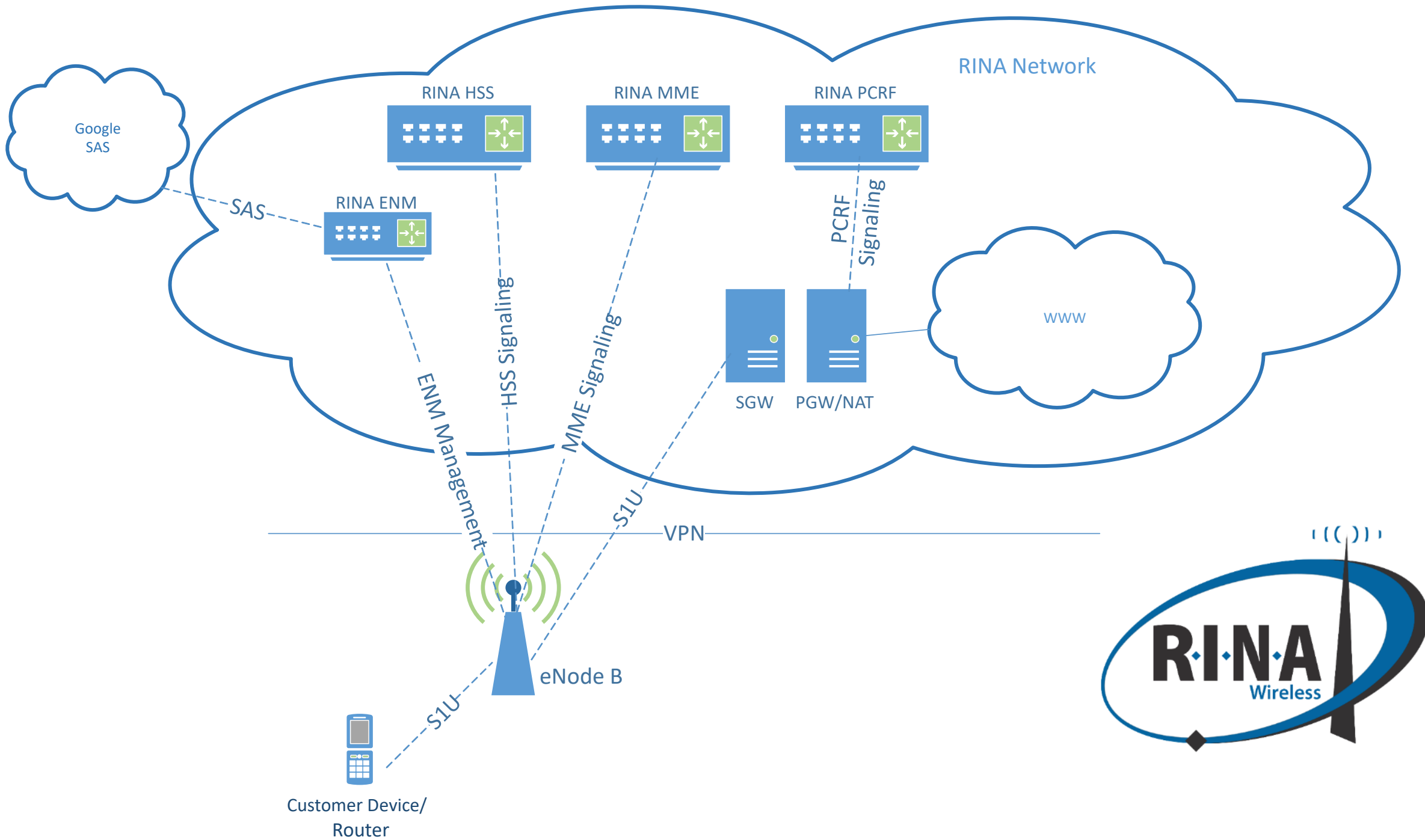
State of the Art Redundant Data Centers in Rural areas with Diverse Fiber Routes through Denver, CO and 2 separate routes through Salt Lake City, Utah for Virtual Hosting Services
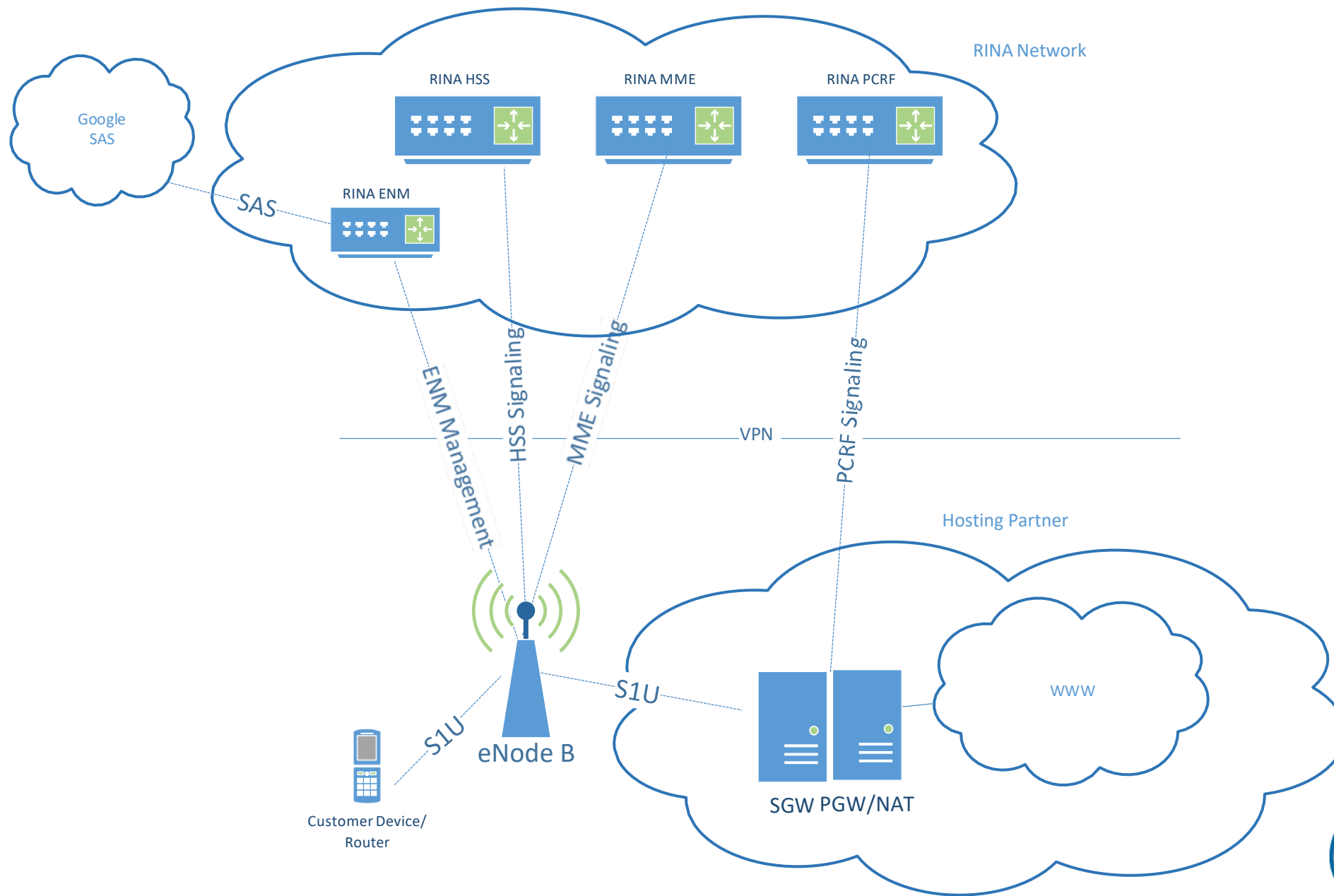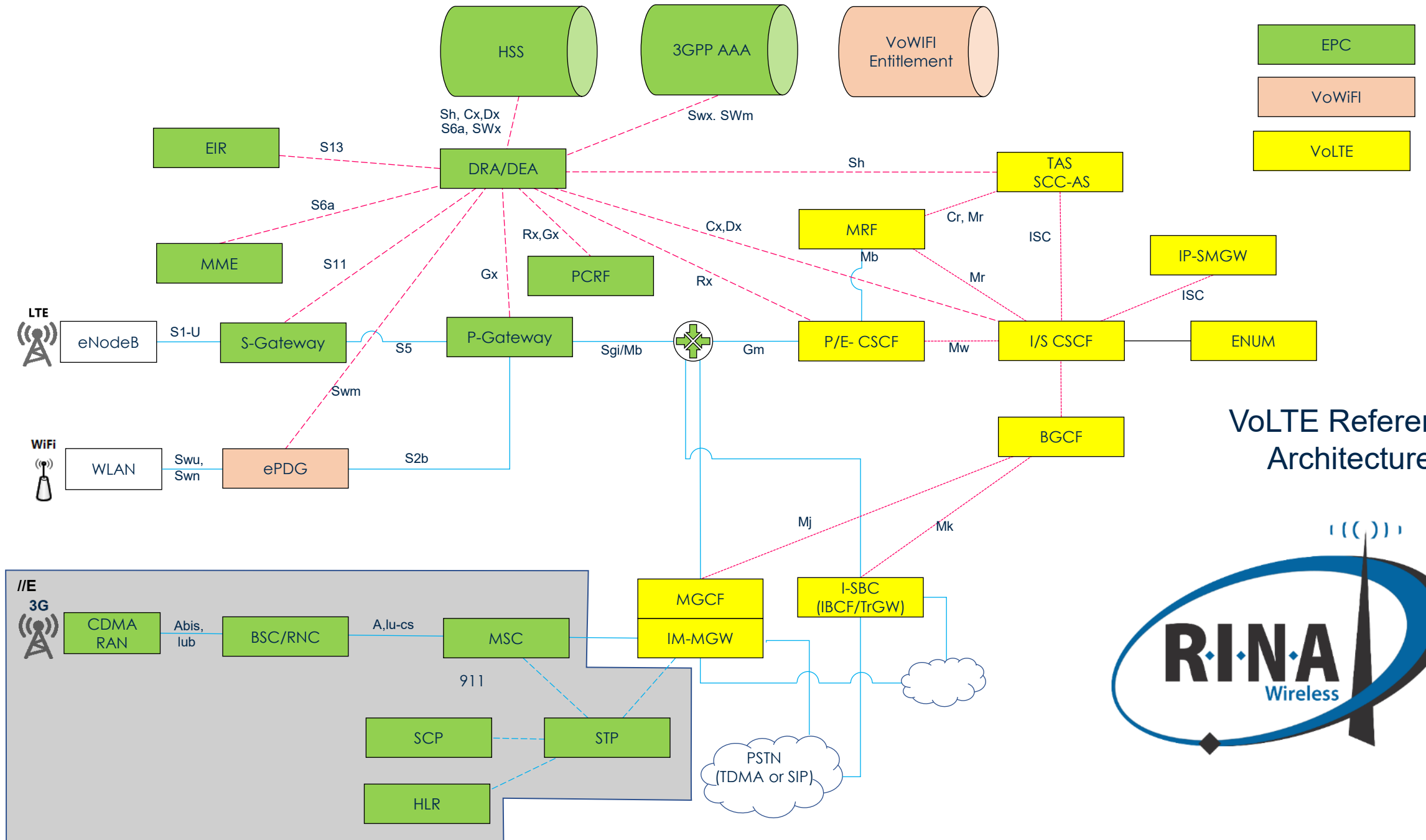
Our 24-hour NOC is exceptional, manned 24/7/365 for any issues that may arise.

R·I·N·A
Wireless

RINA Network

RINA HSS

RINA MME

RINA PCRF

Google SAS

SAS

RINA ENM

PCRF Signaling

WWW

ENM Management

HSS Signaling

MME Signaling

SGW

PGW/NAT

S1U

VPN

S1U

eNode B

S1U

Customer Device/
Router

R·I·N·A
Wireless

VoLTE Reference Architecture

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VoLTE	**CBRS**	**VoWiFi**
E911	**5G NSA**	**Fixed Wireless**
CMAS	pLTE	**Private LTE**
RCS	ELAN	Visual VM
WLNP	RNC	SGW/PGW
ENM	TCAP	Short Codes
SMSC	MMSC	Diameter/STP
IDNS	PCRF	Voicemail
HSS	CALEA	Visual Voicemail
HSS	MME	Record Splitting
IMS	IS41	SIM OTA
WAP	ISUP	TDM/Sonet
NTP	**SAS**	**CBRS/Domain Proxy**
VPN	PDSN	Provisioning
GSMA	IPX Data	Sigtran
MMSC	SS7	Networking
CEMS	**CDMA**	Alarm/Monitoring
AAA	AAA 3GPP	Long Distance
Landline Soft Switch		

RINA & Hosted Entities Wireless Network Partner MAP

Anchorage AK

EPG's
10gig
CDMA/LTE
Other hosted Entities
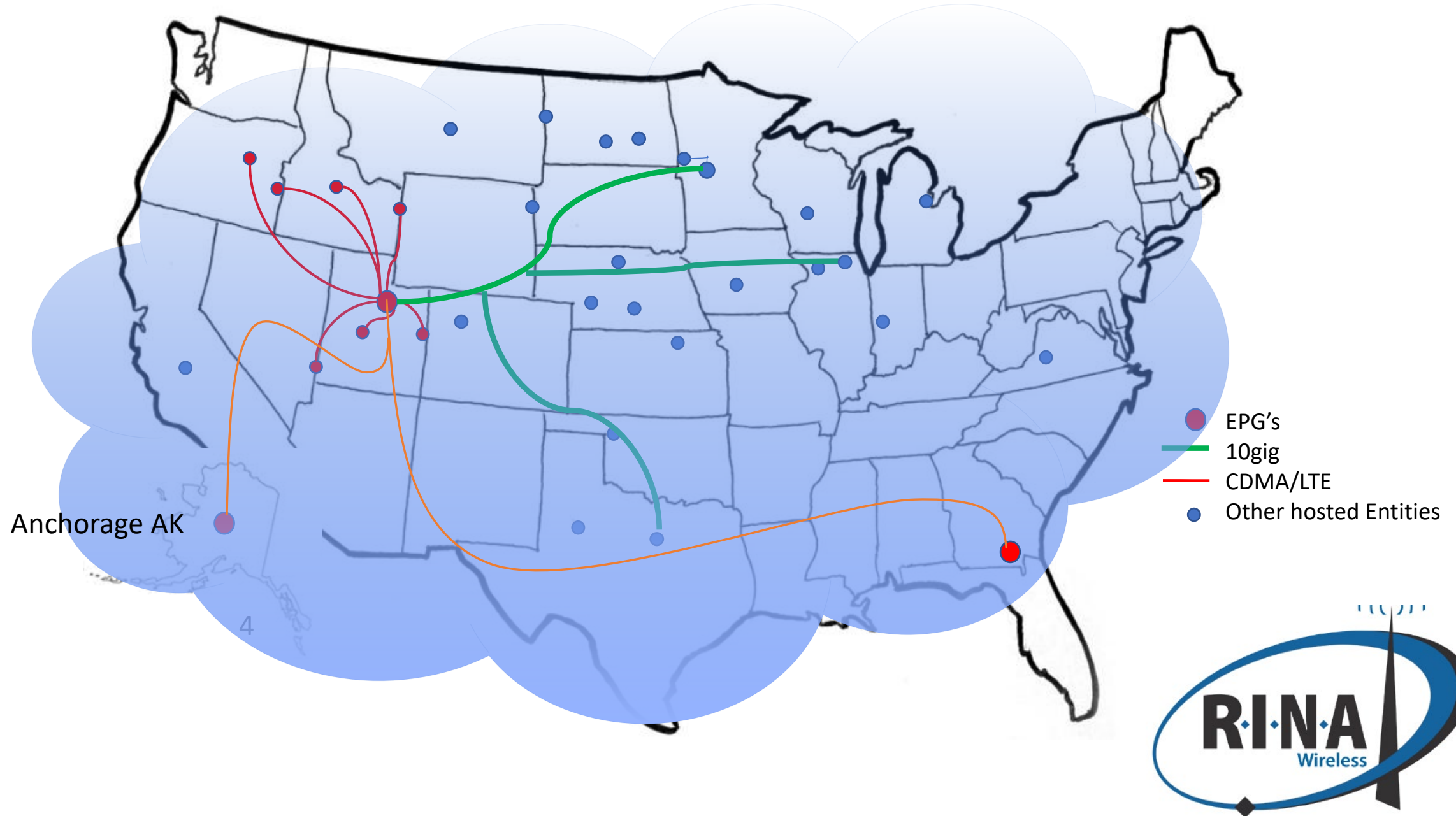
R·I·N·A
Wireless

TEAMWORK

Coming together is a beginning
Keeping together is a process
Working together is success
-Henry Ford

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Questions?