



Enterprise neutral host deployments: Real world solutions

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MOBILIZING
ENTERPRISES &
COMMUNITIES

Intro: Crown Castle



Company

- In the United States
- 40,000+ towers
- 80,000+ route miles (~129,000 km) of fibre
- 900+ connected data centres, PoPs, and colocation
- 47,000 on-net buildings with more than 50 cloud access points
- 115,000 small cells on air or under contract
- ~5,000 employees
- 25+ years owning and operating network assets
- \$91.9b (~ £74.4b) enterprise value

- Since 1994, Crown Castle has worked around the United States to build and maintain the infrastructure behind the world's most revolutionary technologies.
- Our nationwide portfolio of towers, small cells, and fiber connects cities and communities to essential data, technology, and wireless service - bringing information, ideas and innovations to the people and businesses that need them.

SCF membership benefits to Crown



- What others are doing globally
- Perspectives from
 - telecoms experience
 - manufacturers
 - developers
 - neutral hosts
 - enterprise-focused service providers
 - mobile operators
- Sharing of ideas and pushing the envelope of small cells and technologies to bring value to the telecoms industry



Total spending for outdoor small cell actuals by spectrum (\$ millions), 2020-2025. Source: iGR, 2021

New Small Cells Business Case - development



We decided we needed a customer-partner with the following characteristics:

- Owns or manages premium properties
- Has strong IT resources and capabilities
- Is curious and willing to trial a private CBRS network
- Is willing to work towards 5G in the future

Our OEM partners needed to be just as progressive:

- Experienced with operators in the United States
- Experienced in private network deployments
- Cost effective solution
- Software upgradeable from 4G to 5G
- Responsive to our neutral host provider needs

How do we monetize new or updated technology?

How should we apply our assets to maximise our investments?

What are gaps to get there?

How long before commercially ready?

Our customer-partner is very valuable



- Rudin Management company:
 - Rudin is advancing smart building management solutions, improving building intelligence
 - 345 Park Avenue in NYC (44 stories)
 - Rudin's building has high-value tenants
 - NFL hq, KPMG, Blackstone
 - Use case testing and optimisation in the lobby and mezzanine levels
 - Mostly during the COVID 19 pandemic
 - Health and safety protocols
- Operators are interested
 - Need to improve in-building coverage

In 2021, Crown Castle and the Rudin Family announced that 345 Park Avenue has become one of the first multi-tenant commercial office buildings in the United States to enable Citizens Broadband Radio Service (CBRS).

Drivers for this solution



- Rudin private network
 - Local data security – retain full control of information
 - Building management system to support eco-friendly initiatives
 - Support for tenant use cases
- Operator coverage
 - Extending their 5-bars service into buildings
 - Capacity offload from the outdoor macro network
 - Upper floors typically suffer from poor coverage



The solution

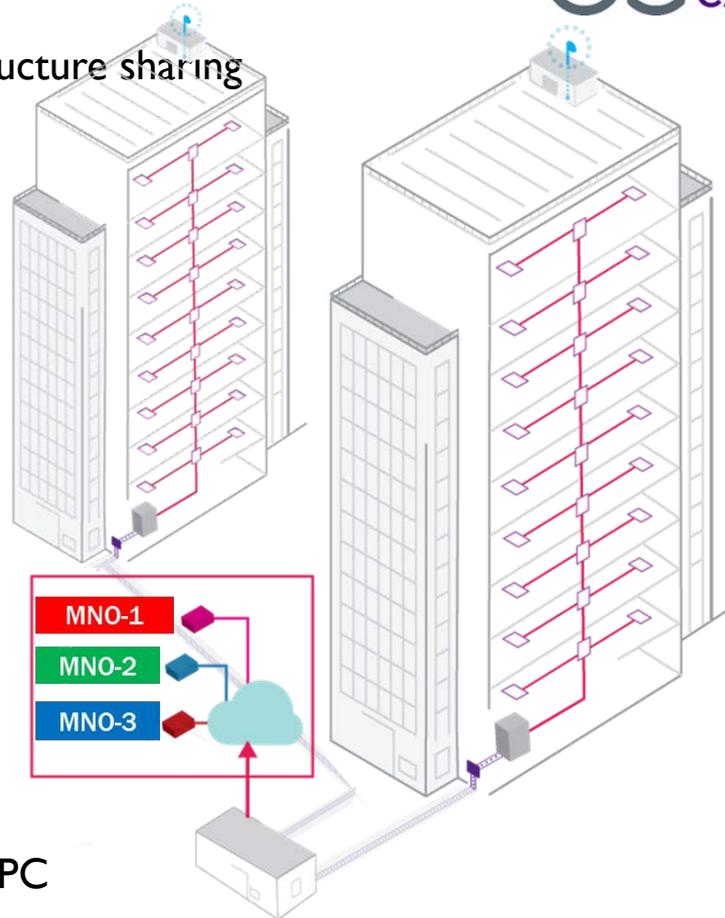


- Private multi-tenant LTE on CBRS
 - Use cases
 - Integration with building management system
 - Package delivery tracking within the building
 - Floor-by-floor occupancy data, indoor air quality, lobby occupancy and elevator wait times
- Performance and scalability
 - Local DU for security and performance
 - CU in Edge data centre to support multiple customers and for scalability
- Synergies with our customer-partner
 - IT network resources and expertise
 - Willing to share and test smart building tech
- Neutral host
 - Support for multiple carriers
 - Pre-installed indoor cable plant

The neutral host platform

A CBRS network that maximises infrastructure sharing

- Shared Components
 - Wiring
 - Remote Radios/Antennas
 - MOCN function
 - Network Management
 - Servers to host Radio SW
 - Radio SW: DU/CU
 - Colocation Center
 - Transport from Building to Colo
- Not Shared
 - MNO EPC
 - Transit from Colo to each MNO EPC



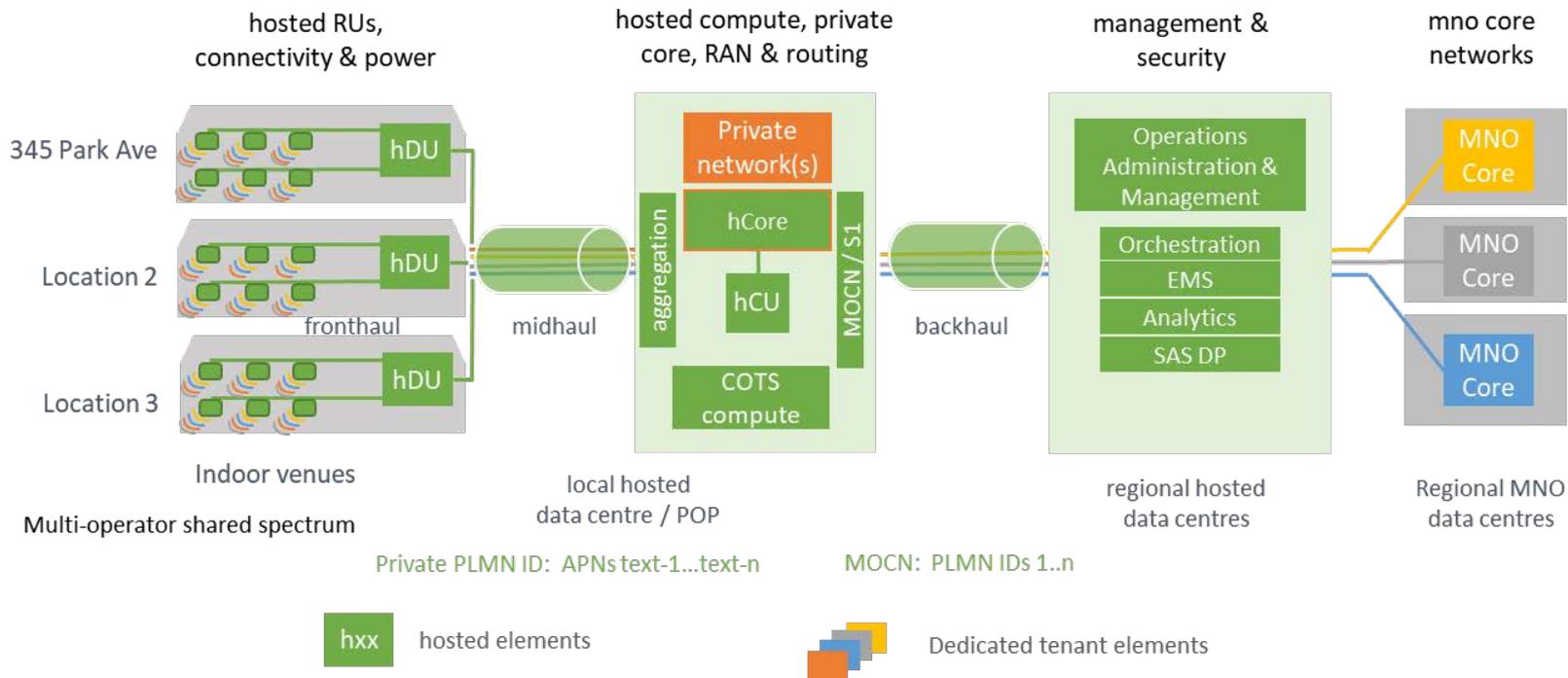
Shared Components

- Wiring
- Radios/Antenna
- Transport to Colo
- Colo Center
- Servers on & off Prem
- CU/DU SW
- Network Management

Not Shared

- MNO EPC
- Transit Colo=> MNO

The architecture



Lessons learned



- Tenant approval affects the deployment timeline
- Building approvals for antenna mounting and other logistics
- Neutral Host-specific features that needed to be evolved
 - Capacity allocation
 - TAC coordination
- Provisioning interfaces and alarms

More learnings



- Use APNs to route enterprise subscribers to different parts of the enterprise IP network
- Emergency services
 - Public operators manage emergency services
 - What about private networks?
 - Granularity in location information reporting
 - Regulations continue to evolve
- Laboratory testing proved to be valuable
 - During lab testing we were able to change configurations and validate requirements
 - Validation of operator connectivity without impacting commercial traffic

In summary



- Deployed a private network that supports multiple enterprise tenants using the CBRS band
- This private network was built on a flexible architecture that allows for scalability
- Enabling neutral host support for multiple operators over the CBRS band
- Maximising use of shared small cell infrastructure for new use cases
- Being prepared to upgrade to 5G when our customers are ready
- The CBRS network at 345 Park Ave was designed with the infrastructure to meet future demands
- Fostering innovation for private enterprises and public mobile operators

Questions

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The architecture

A distributed architecture that provides **flexibility** and **scalability** for

- Shared Neutral Host
- Private solutions

