



Economics of C-V2X: The Mobile Network Operator and Support for Alternative Deployment Models

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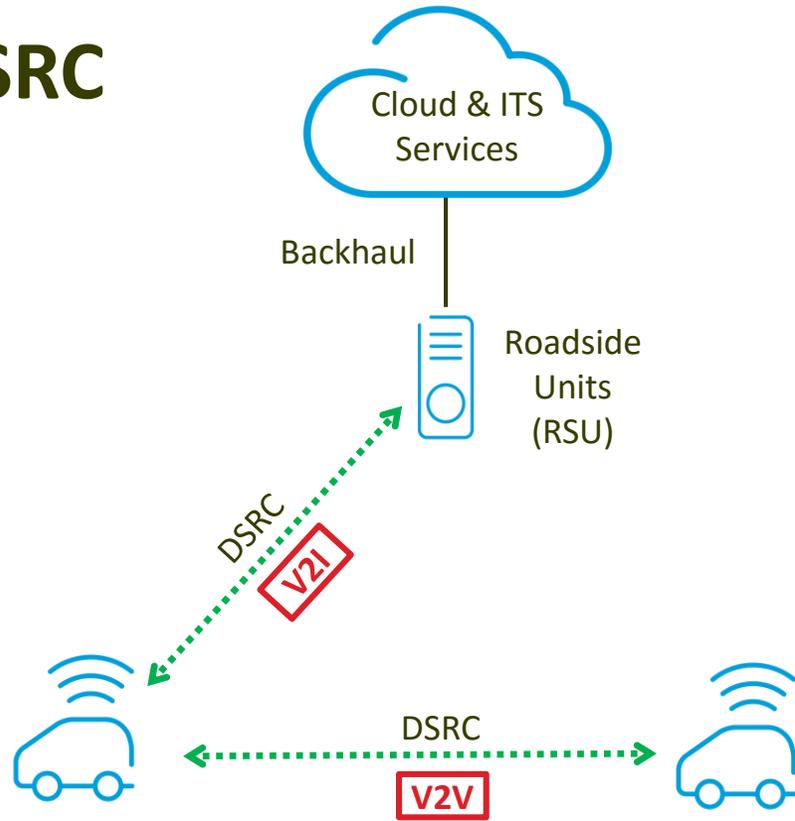
26 April, 2018

FCC Auction 903 Admonishment Statement:

I have been asked to remind everyone at the outset of our session that the 'quiet period' for FCC Auction 903 (also known as the CAF II Auction) is now in effect. During the quiet period, auction applicants are required to avoid discussions of bids, bidding strategy, and post-auction market structure related to CAF II with other auction participants. Our agenda will avoid these topics. While we encourage participation through questions, please avoid asking questions or raising issues about these topics.

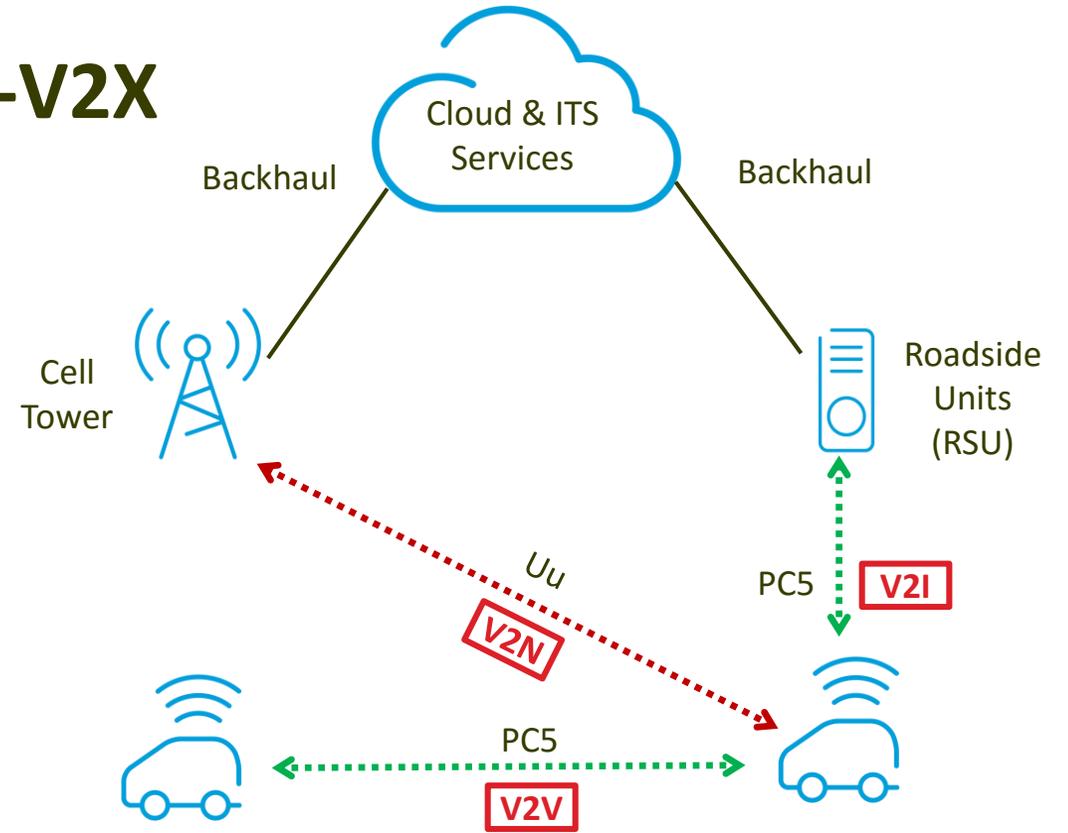
DSRC and C-V2X: Delivering V2V and V2I Communications Without a Cellular Subscription

DSRC



- Direct short-range communications for V2I and V2V
- No standards based integration to connect via V2N

C-V2X



- Direct short-range communications for V2I and V2V
- Standards driven integration to connect via V2N

V2N: Augmenting and Complementing V2V and V2I

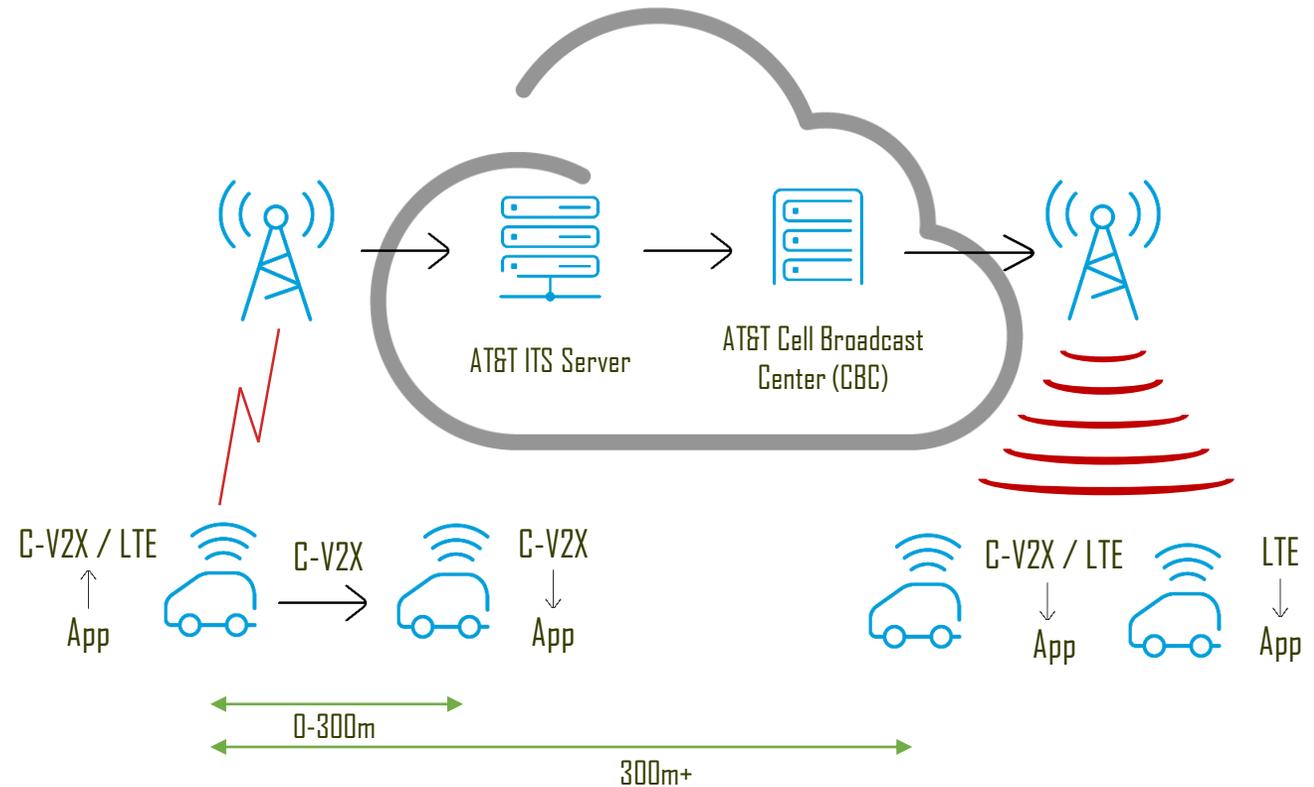
The Number of V2N Connected Vehicles Continues to Grow

AT&T Added +6 Million Connected Vehicles in 2017 and Now Connect 17.8M Vehicles*

- Extending Range
- Expanding the Audience
- Selective Geo-targeting

*Figures Taken From 4Q17 Public Earnings Disclosures

Example: Event Notifications



V2N Increasing the Effectiveness of Roadside Units (RSUs)

V2N Augmenting RSUs

- Redundancy for Missing/Inoperable RSUs
- Supporting Security Credential Management System (SCMS)
 - Enrollment / Certificate Top Off
 - Certificate Revocations Lists (CRLs)
 - Misbehavior Reporting
- Event Notifications

V2N Complementing RSUs

- Supporting Cross-Jurisdictional & Nationwide Coverage
- Privacy/Security Services
- Broadcasting Traffic/Transportation Management Info
- Over-the Air (OTA) Updates

As a Mobile Operator, We Understand Networks...

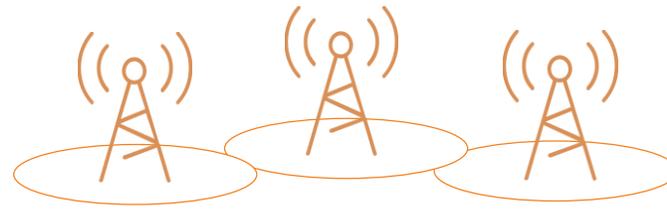
- Planning, Building, Maintaining and Upgrading Networks are Costly and Complex
- AT&T Has Invested More Capital Than Any US Public Company:*
 - *“AT&T invested more than \$200 billion in capital in our U.S. networks over the past 10 years.”*
 - *2018: “Capital expenditures approaching \$25 billion; \$23 billion net of expected FirstNet reimbursements and inclusive of \$1 billion incremental tax reform investment.”*

*Numbers and Figures Referenced Taken From the 2017 AT&T Annual Report and 4Q2017 Earnings Disclosure

V2N and V2I Also Align With Mobile Operator's Goals to "Densify" Mobile Networks for 5G

Traditional Cell Sites

- Expand Coverage
- Increase Capacity
- Support Diverse Mobility Use Cases



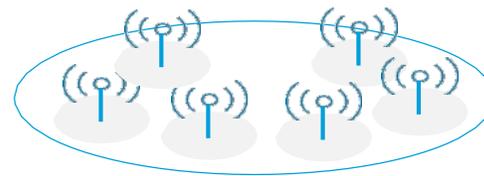
Broad (Km)

~150K

Estimated US Macro Towers Deployed 2007-2017*

Small Cells

- Increase Capacity
- Support Hyper Local Deployment
- High Bandwidth Via Point-to-Point Connections (including mmWave)



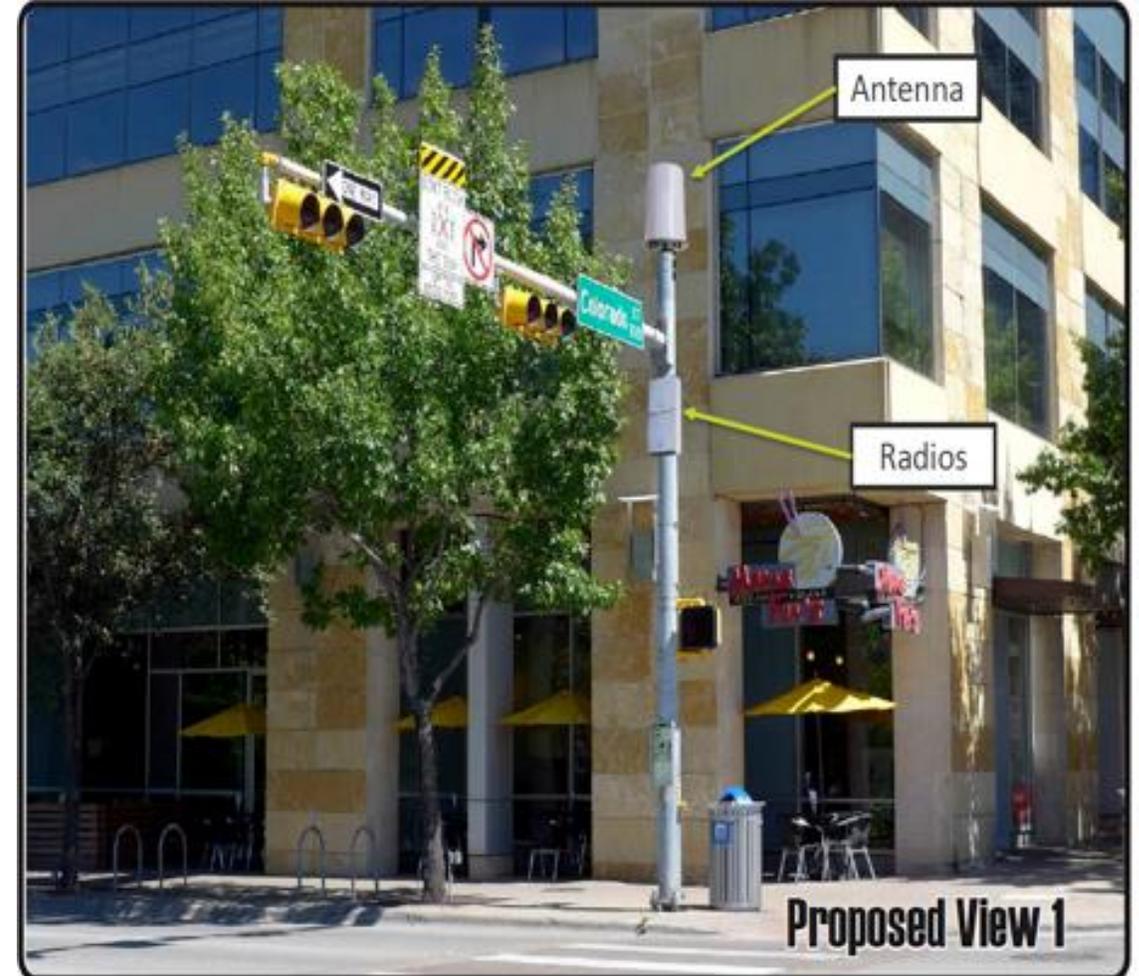
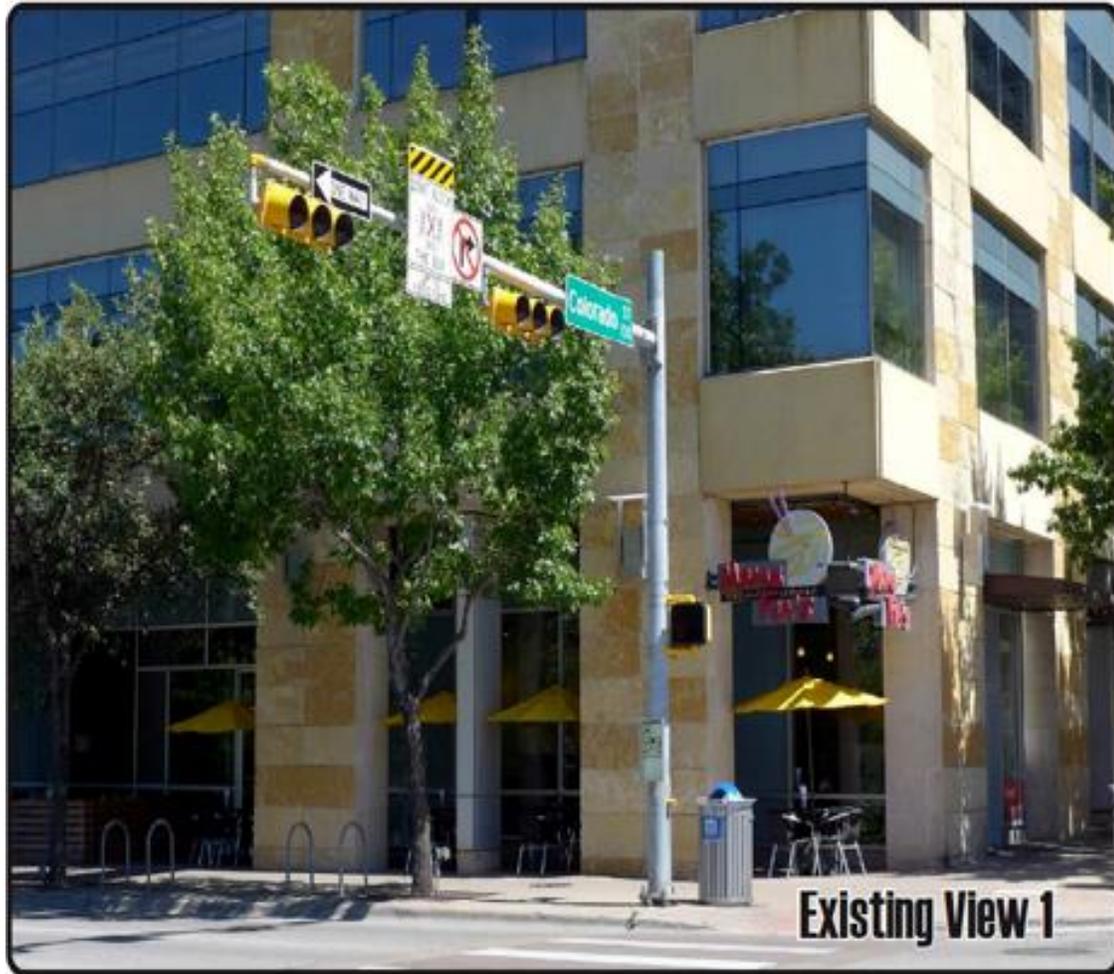
Dense (000s of m)

+770K

Estimated US Small Cells to be Deployed 2018-2026*

*Numbers and Figures Taken from CTIA Conducted Research

Illustration: Leveraging Common Infrastructure to Implement Small Cells



FirstNet – A Privately Built Network for Critical Communications

AT&T was selected in 2017 to build and manage FirstNet, a nationwide public safety broadband network, services, and solutions platform dedicated to First Responders and those that support them. All 50 US States, 5 Territories, and Washington D.C. have opted in to FirstNet.

Relevance of FirstNet to Road Operators?

- Example of a Public-Private Partnership (PPP) for Critical Communications
- FirstNet will Expand Coverage to Where First Responders Need It
- Certain Road Operator Users May be Eligible to Participate as “Extended Primary” Users

Ensuring Support for Cellular Infrastructure in Funding Models

- Transportation funding mechanisms may be applied to support communications infrastructure and deployment
- By involving mobile network operators in conversations around ITS deployments, opportunities may exist to better optimize funding and impact
- Mobile network operators and Road Operators will need to work together to develop successful business models, including discussing PPPs



Thank You