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October 11, 2018
VIA ECFS

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

REDACTED – FOR PUBLIC INSPECTION

Re: Notification of Oral *Ex Parte* Presentation
Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations; WT Docket No. 18-197

Dear Ms. Dortch:

Pursuant to Section 1.1206(b) of the Commission's Rules, 47 C.F.R. § 1.1206(b), notice is hereby provided of oral *ex parte* communications in the above-captioned docket. On October 9, 2018, Neville R. Ray, the Executive Vice President and Chief Technology Officer of T-Mobile US, Inc. ("T-Mobile"), members of his team, and other representatives of T-Mobile and Sprint Corporation ("Sprint")[1] met with members of the FCC Transaction Team (a list of FCC participants is provided in Attachment A). During the meeting, the Applicants presented information in the deck appended hereto as Attachment B. The parties discussed an overview of the network engineering model previously provided to the Commission.

In particular, T-Mobile and Sprint described how the combined company would be uniquely positioned with complementary spectrum assets in the low, mid, and high bands to drive a robust, nationwide 5G network to the benefit of consumers. The transaction would allow for a multiplicative effect for capacity due to the increase in number of cell sites, amount of spectrum available per cell site, and increases in spectral efficiency. The aggregation of these resources would enable New T-Mobile to deliver unprecedented capacity and performance.

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[1] Those representatives included David Miller, Kathleen Ham, Mark McDiarmid, Ankur Kapoor, Karri Kuoppamaki, Melissa Scanlan and Steve Sharkey of T-Mobile, Charles McKee of Sprint, Reinhard Wieck of Deutshe Telekom, Inc., Mike Senkowski, Edward Smith, Nancy Victory and Thomas Dombrowsky of DLA Piper LLP, Mark Nelson and Dan Culley of Cleary Gottlieb Steen & Hamilton, LLP, Thomas Peters of Hogan Lovells US LLP, Christopher Helzer of Quadra Partners LLC, Bryan Keating of Compass Lexecon LLC, Gina Keeney of Lawler, Metzger, Keeney & Logan, LLC, Steven Sunshine, Matthew Hendrickson and Joseph Rancour of Skadden, Arps, Slate, Meagher & Flom LLP, and David Meyer of Morrison & Foerster LLP.

Additionally, the Applicants provided an overview of the network model submitted to the Commission. As explained in the attached presentation, the network model is based on three key steps: (1) determination of capacity, (2) quantification of forecasted customer demand and experience along with network congestion, and (3) application of solutions to mitigation network congestion. The Applicants noted that the network model is built upon T-Mobile's ordinary course practices and models standalone T-Mobile, standalone Sprint, and New T-Mobile for both LTE and 5G. 5G functionality was developed to include congestion mitigation and quantification of user experience for 5G subscribers. The Applicants reviewed in detail the assumptions and methodologies utilized to develop the network model, as described in the presentation deck.

This filing contains information that is "Highly Confidential" pursuant to the Protective Order filed in WT Docket No. 18-197. Accordingly, pursuant to the procedures set forth in the Protective Order, a copy of the filing is being provided to the Secretary's Office. In addition, two copies of the Highly Confidential Filing are being delivered to Kathy Harris, Wireless Telecommunications Bureau. A copy of the Redacted Highly Confidential Filing is being filed electronically through the Commission's Electronic Comment Filing System.

Please direct any questions regarding the foregoing to the undersigned.

Respectfully submitted,

DLA Piper LLP (US)

/s/ Nancy Victory

Nancy Victory
Partner

NV

cc: David Lawrence
Kathy Harris
Linda Ray
Kate Matraves
Jim Bird
David Krech
FCC participants listed in Attachment A

ATTACHMENT A

LIST OF FCC PARTICIPANTS

David Lawrence
Charles Mathias
Kate Matraves
Dana Shaffer
Ronald Repasi
David Sibley
Kirk Arner
Saurbh Chhabra
Matthew Collins
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Max Staloff
Thuy Tran
Weiren Wang
Joseph Wye
Aleks Yankelevich

ATTACHMENT B

PRESENTATION DECK

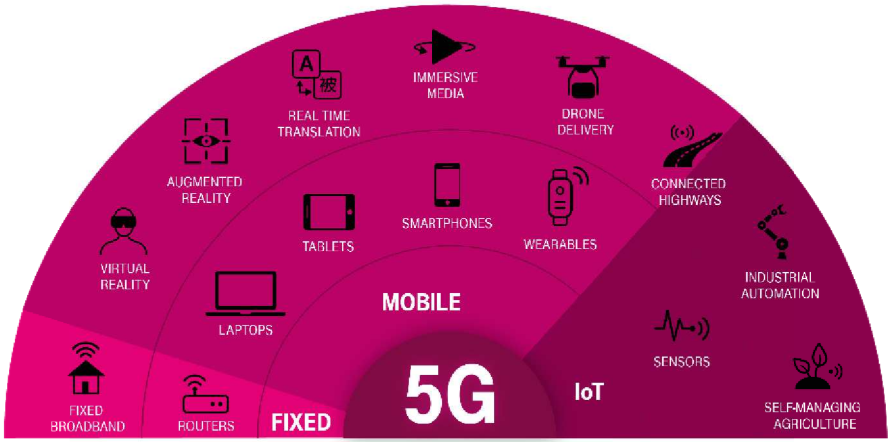
Overview of Network Model

Agenda

- **5G Vision and Opportunities**
- **Network Model Overview**
- **Key Network Model Inputs and Assumptions**
- **Network Model Schematic**

New T-Mobile 5G Vision

New T-Mobile is uniquely positioned with complementary spectrum assets in the low, mid, and high bands.

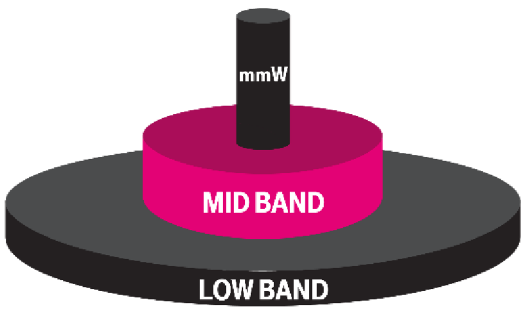


Each band provides **unique and complementary** benefits to fulfill the 5G promise of support for a **broad set of use cases**

New T-Mobile 5G

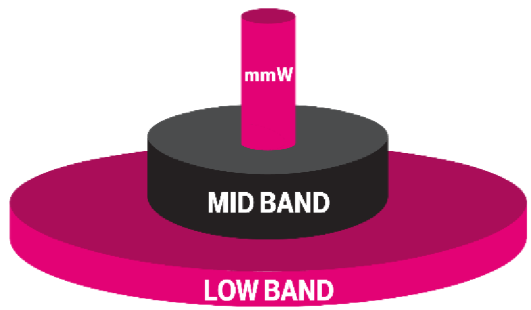
Uniquely Positioned with Multi-Band Spectrum Portfolio

Sprint



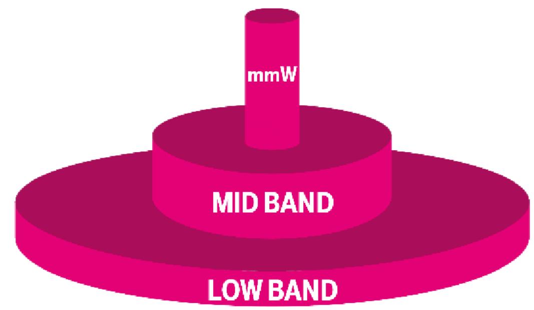
- Plan to use 2.5 GHz for both 5G and LTE
- 2.5 GHz propagation characteristics presents economic challenges in providing broad or consistent coverage

T-Mobile



- Utilize 600 MHz low-band spectrum for wide area coverage and IoT, but lacks capacity
- Augment with millimeter wave spectrum for additional speed and capability limited to dense urban areas

New T-Mobile



- Creating a platform for unrivaled mobile 5G offering
- Best starting point for 5G with spectrum across all bands
- Addresses all aspects of 5G; enhanced mobile broadband, massive connectivity for IoT, and other applications

New T-Mobile Network's Capacity Driven by Three Key Factors

COMBINATION OF COMPLEMENTARY SITES

Combination of T-Mobile and Sprint networks will utilize [redacted] sites by 2024 on a dense mid-band grid to benefit 5G

COMBINATION OF MULTI-BAND SPECTRUM

Combination of Sprint's 2.5 GHz spectrum with T-Mobile's 600 MHz and millimeter wave spectrum will provide unparalleled 4G/5G breadth and performance to users

ACCELERATION OF ENHANCED SPECTRAL EFFICIENCY

Accelerated re-farm to 5G enables higher spectral efficiency, deliver capacity and performance benefits sooner

Bring first robust, nationwide 5G network to benefit consumers

Highest capacity mobile network in U.S. history, providing unmatched coverage, capacity, speed, and consistency of user experience

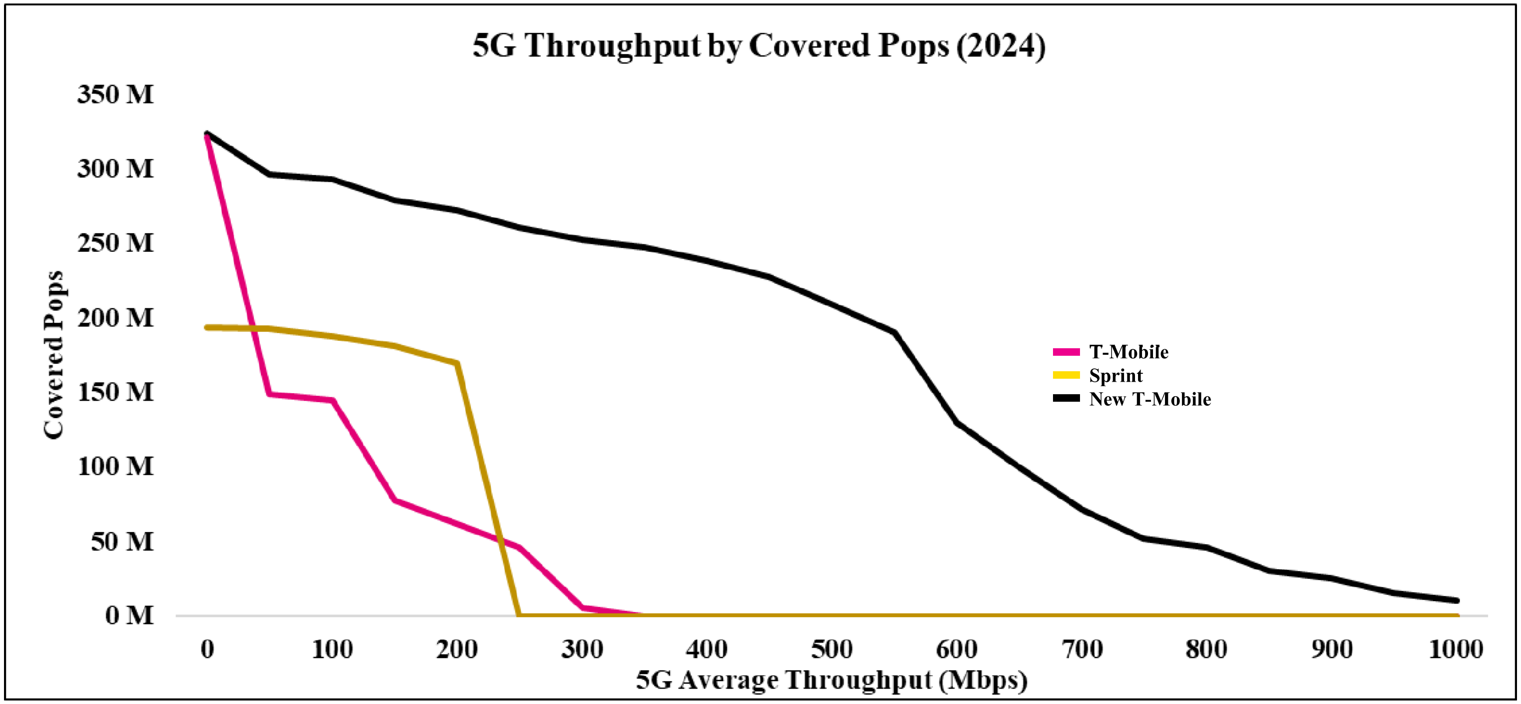
New T-Mobile Creates Massive 5G Capacity, Performance and Reach

New T-Mobile will deliver unprecedented capacity and performance

2024

5G Capacity	21 Exabytes 5G Offered Traffic (monthly) Compared to [redacted] T-Mobile and [redacted] Sprint
Average Throughput	Average Throughput of 451 Mbps Compared to 100 Mbps T-Mobile and 116 Mbps Sprint
Peak Throughput	Peak Throughput of 4.2 Gbps Compared to 2.8 Gbps T-Mobile and 0.7 Gbps Sprint
Coverage	293M Pops with throughput > 100 Mbps

Comparison of Throughput Between New T-Mobile and Standalone T-Mobile and Sprint



2024	T-Mobile	Sprint	New T-Mobile
Pops with > 100 Mbps	144.7 M	187.8 M	293.1 M
Pops with > 150 Mbps	77.7 M	181.4 M	279.0 M
Pops with > 300 Mbps	5.9 M		252.8 M
Pops with > 500 Mbps			209.2 M

Agenda

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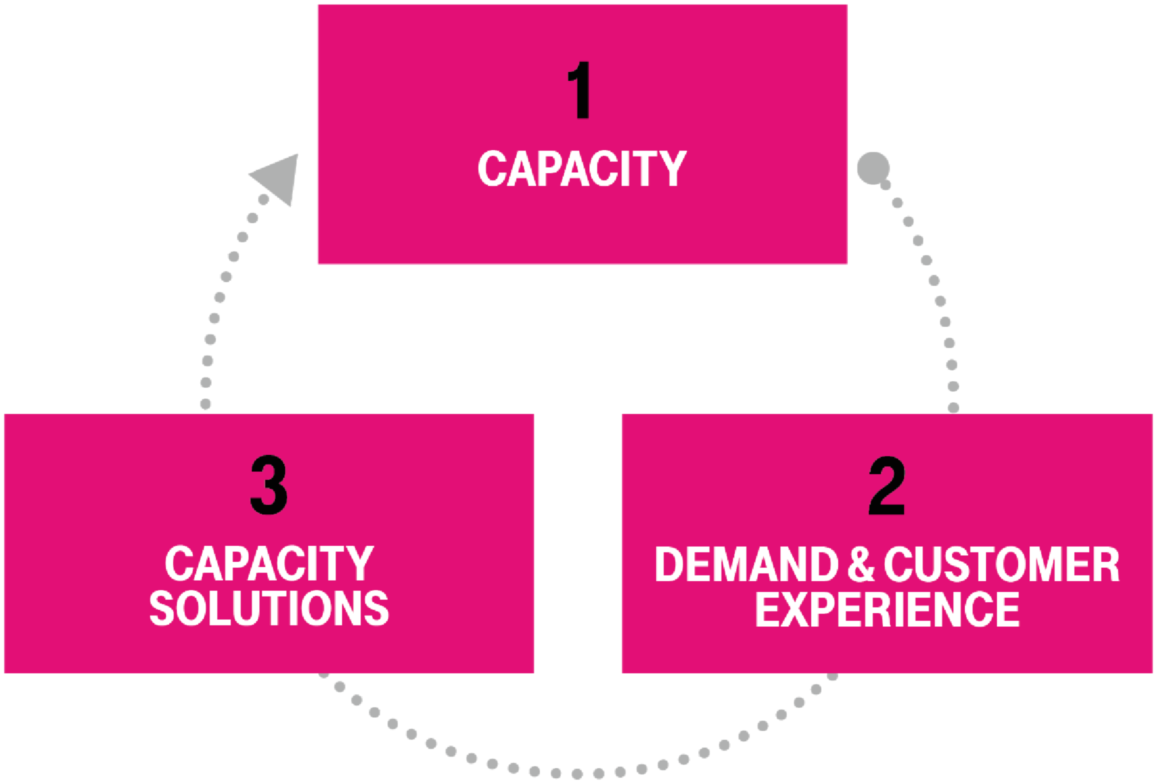
- Key Network Model Inputs and Assumptions
- Network Model Schematic

Network Model Methodology Overview

Normal course network plans are based on model outputs



Capacity Evaluation
STEPS

1. Determine capacity
2. Quantify forecasted customer demand, customer experience & associated network congestion
3. Apply capacity solutions to mitigate congestion

Established Network Model Delivers Proven Result

Our Network Modeling has had a transformational effect

[redacted] Congestion Reduction with [redacted] Traffic Growth

National Congestion & Traffic Trends

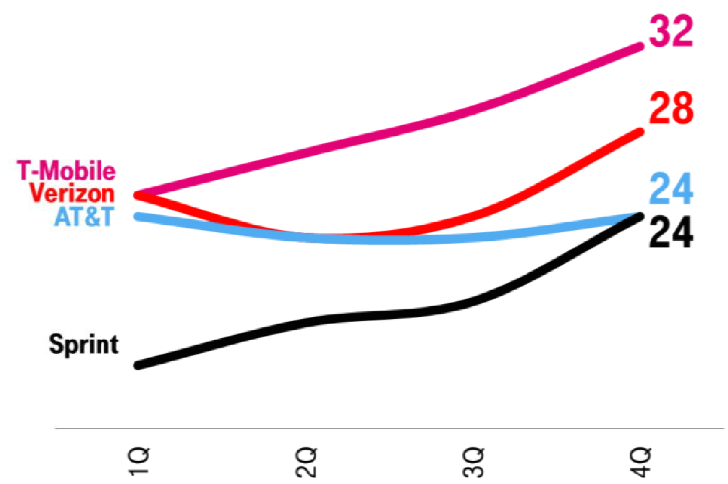
[redacted]

33M to 74M

Customers in 5 years (2.25x)

17 Quarters Ookla Speed Leadership

Avg. Ookla TLE DL Speeds [Mbps]



Fastest LTE Network

According to Several 3rd-Party Studies

Our network model has driven **over** [redacted] **in network investment** in last 5 years.

Network Model Design Assumptions

T-Mobile | Sprint | NEW T-Mobile

T-Mobile Network + **Spectrum and Keep Sites** = **New T-Mobile Network**

- Network becomes Anchor for New T-Mobile
- "As built" configuration plus planned builds and spectrum re-farms

- ~11k Sprint keep sites; [redacted] retained for capacity and [redacted] for coverage
- 2.5 GHz and PCS spectrum applied for capacity
- Ultimately decommission non-keep sites to produce network synergies

- Combination of T-Mobile Anchor and Sprint Keep Sites
- Spectrum allocated to drive 5G capacity and performance
- LTE performance maintained

Same Network Model Utilized for All Scenarios

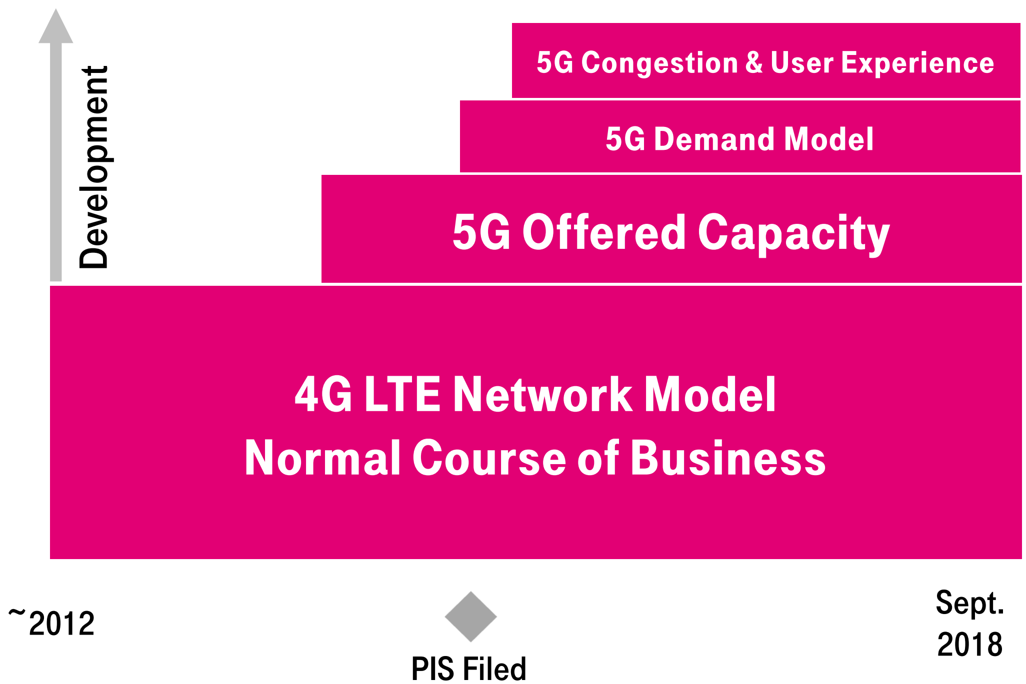
Details of the network model are explained in ‘Network Model Schematic’ section

Three Networks	T-Mobile Standalone; Sprint Standalone; New T-Mobile
Two Technologies	LTE; 5G
Outputs	Supply (Offered Capacity); Congestion; Capacity Solutions; User Experience (UX)

Network Model Developed to Comprehensively Model 5G

Model development and improved calibration resulted in minor output changes

- Network Model fully incorporates physical site data, network traffic and congestion measurements
- Network Model is built on Normal Course of Business practice of examining connected users and user throughput
- 5G functionality added to size critical capacity and performance benefits of merger
- Further developed to include congestion mitigation and quantification of user-experience for 5G
- 4G and 5G modules are integrated in the network model



Agenda

5G Vision and Opportunities

Network Model Overview

Key Network Model Inputs and Assumptions

Network Model Schematic

Supply

Review of data and processes used to calculate Capacity

Keep Sites

[redacted]

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Spectral Efficiency Assumptions

- Spectral Efficiency is a metric used by industry to compare different radio technologies.
  - Vendor simulations are used so that new radio technologies can be assessed.
- 5G has higher spectral efficiency than LTE, resulting in higher capacity per unit of spectrum (Hz)
- Average Spectral Efficiency is used to represent what a "typical" network cell will operate under an average network traffic loading.

		Average Spectral Efficiency (bps/Hz)		% Increase
Spectrum	**Antennas**	**LTE**	**5G**	
Low band	4x2 MIMO	2.1	2.5	19%
Mid band	4x4 MIMO	2.5	3.8	52%
mmWave	mMIMO	N/A	7[1]	N/A

[1] mmWave sites assumed to have ~10% of coverage compared to low/mid band

Spectral efficiency numbers based on vendor simulations, & T-Mobile internal studies

For details, Refer to "Document 3: 5G Performance Expectations" from model documentation

ITU Objectives IMT-2020 DL eMBB Urban: "LTE to 5G: Cellular and Broadband Innovation", Rysavy Research, August 2017.

Spectrum & Capacity Solutions

The resulting spectrum is the combination of the holdings from both companies.

Spectrum

T-Mobile network

Spectrum Additions

5G	LTE
T-Mobile mmWave	Sprint 2.5 GHz
Sprint 2.5 GHz	Sprint 800 MHz
Sprint PCS	Sprint PCS
T-Mobile Mid Band	T-Mobile Mid Band
T-Mobile Low Band	T-Mobile Low Band

Capacity Solutions

[redacted]

Demand

Review of data and process used to calculate consumption

New T-Mobile Handset Penetration Assumptions

- 5G handset adoption will be significant **starting 2021**
- New T-Mobile will drive **faster 5G handset adoption** compared to stand-alone networks by **10%**

5G 4G

[redacted]

Source: North American Data; GSMA "The 5G Era in the US" 2018
Ericsson Mobility Report (June 2018) "Mobile Data per Active Smartphone, 2017 vs 2023;
Various external studies shows that T Mobile customers use more data than competition on average

T-Mobile

New T-Mobile Customer Usage Demand Forecast

Forecasted 5G Usage Per Sub

[redacted]

5G Demand Drivers

Increased speeds
- Low latency
- Higher capacity

New Products
- Virtual reality
- Augmented reality

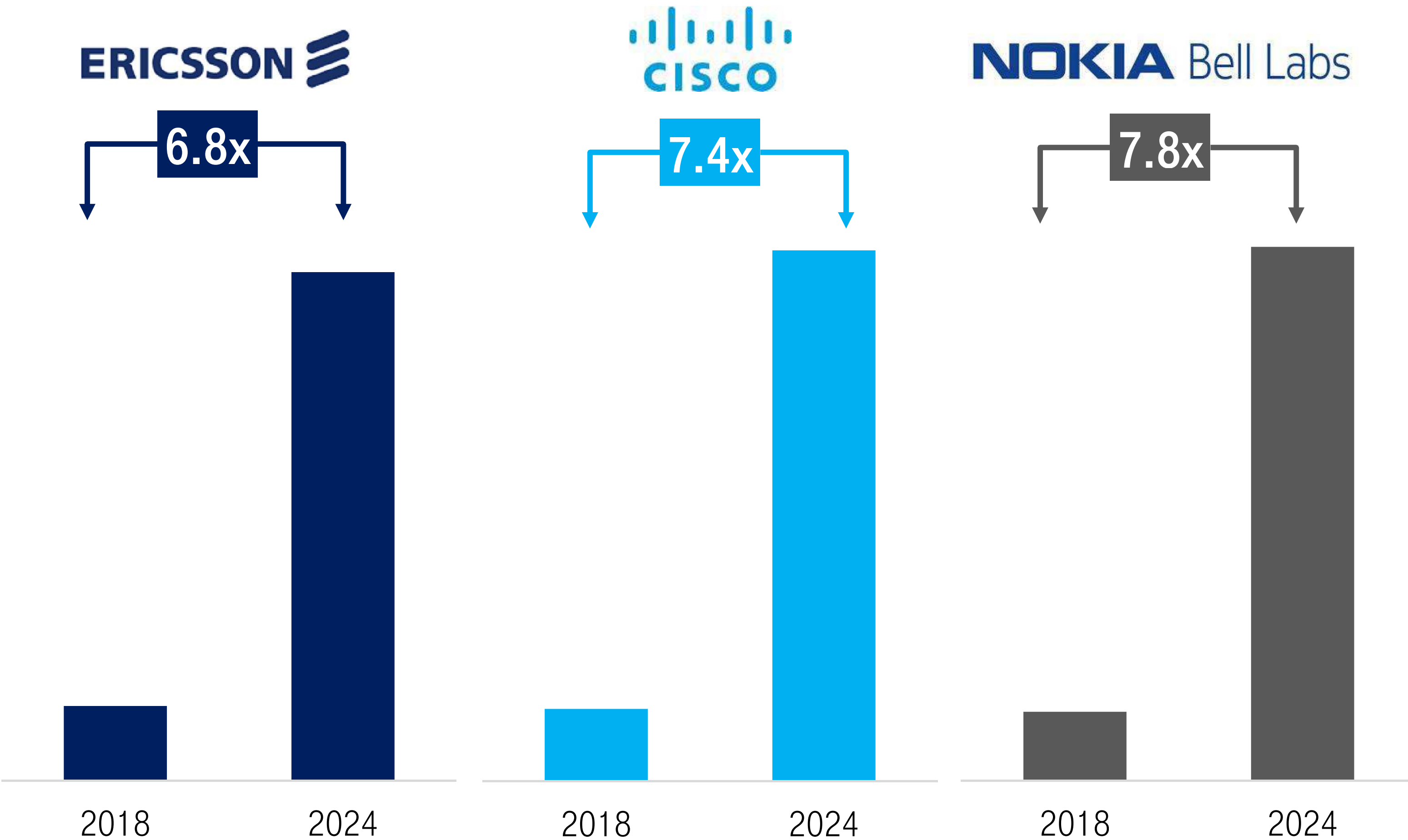
Content transformation
- 4K video

IoT Services
- Consumer-focused
- Commercial

Market reach
- Rural America
- Enterprise
- Broadband

Industry Forecasts reflect similar growth trend from 2018 to 2024

North American Mobile Traffic Forecast Growth (2018 to 2024)



[redacted]

Source: North American Data; TMUS Analysis of Industry reports
Ericsson Mobility Report (June 2018) "Mobile Data per Active Smartphone,
Estimated Cisco "Average Mobile Connection Traffic Per Month" (retrieved May 2018);
Estimated Nokia-Bell Labs (Consulting Report 2016) "Wireless Data Demand per Device"
Various external studies shows that T-Mobile customers use more data than competition on average

Congestion

Calculating congestion and the derivation of user experience

Network Model Uses Number of Users To Determine Congestion on LTE

LTE Dimensioning required a utilization metric with:

- Availability across both network vendors
- A normalized view across different cell configurations
- Statistical significance for current & forecasted analysis

→

Normalized Number of Users
Our number of users metric provided the best fit for our LTE network, calculated as described below

Background on determination of numbers of users

- Created a measure of LTE resource utilization based on a normalized number of users on the network.
- To measure the number of users per sector, we measured the number of radio resource control ("RRC") connections during the busy hour as a proxy for users in the sector
- Because sites have different bandwidth & users, we then normalize to # users per 5 MHz

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Increasing Video Resolution Drives Bandwidth Needs

- As per the common course of business, T-Mobile threshold is [redacted] to support Full HD & modern Applications
- With the continued evolution of video into Ultra HD (4K), 5G will need to support [redacted] of speed

[redacted]

5G congestion is triggered when 5G User throughput during Busy Hour falls below [redacted]

Calculation of Loading and 5G User Throughput

[redacted]

Calculation Method for 5G User Throughput

[redacted]

Agenda

- 5G Vision and Opportunities
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- **Network Model Schematic**

Network Model Flow Summary

[redacted]

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Model Inputs

[redacted]

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[redacted]

Model Calculations

[redacted]

T · · Mobile ·

[redacted]

T · · Mobile ·

[redacted]

T · · Mobile ·

[redacted]

Model Outputs (1 of 2)

[redacted]

Model Outputs (2 of 2)

[redacted]

[redacted]

[redacted]

4G/5G Worked Examples

Introduction to Worked Example

[redacted]

- Real Network Examples from Network Model Calculations
  - 4G example of congestion mitigation illustrating solutions and relative benefits
  - 5G example of congestion mitigation illustrating solutions and relative benefits

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[redacted]

[redacted]

Q&A