
Qualcomm
Needham & Co. 4th Annual Automotive Tech Conference
June 3, 2020 / New York, NY
Patrick Little
Senior VP & GM, Automotive
Qualcomm Technologies, Inc.

Automotive industry transformation

- Technology drivers: electrification, connectivity, autonomy redefining the value chain
  - Opportunity and threat: Challenging OEMs to rethink everything: products, processes, organizations, business models
- Electrification: accelerating shift in cost structure of vehicles from mechanical systems to electrical systems and software
- Connectivity: bringing our digital lives into the car (new business models will rise)
  - OEMs focused on differentiated digital experiences: transforming UX/UI (compute, software, AI, data)
  - Connected services, upgradeable functionality increase agility and profitability (mobility service providers)
  - 85% of OEMs agree that digital ecosystem will generate higher profit than car itself - *KPMG Auto Executive Survey*
- ADAS/AD: promises new levels of safety, efficiency and convenience

Qualcomm® Automotive Solutions

Scalable platforms enabling accelerated innovation



Telematics | C-V2X

Snapdragon Automotive 4G/5G platforms

Qualcomm RFFE technology

Qualcomm® C-V2X platform

In-car Wi-Fi6/BT5.1 connectivity

Integrated GNSS precise positioning

100M+ cars on road with Qualcomm modems

Digital cockpit

Infotainment and instrument cluster SoC

Passenger and rear seat entertainment

Driver and occupant monitoring

Cockpit system software: Virtualized and containerized RTOS/Oss

19 top OEMs have adopted Snapdragon

ADAS and autonomous driving

Family of high-performance safety SoCs

Safety accelerator (NP) for L4/L5 workloads

Open and programmable ADAS stack

Safety software platform, HIL/SIL toolchain

Car-to-Cloud Service

Secure, connected car services and lifecycle management

Cloud connectivity

OTA updates

Feature and SKU management

Qualcomm Automotive Solutions, Snapdragon Automotive 4G/5G platforms, Qualcomm RFFE products and Qualcomm® C-V2X platforms are products of Qualcomm Technologies, Inc. and/or its subsidiaries.

Qualcomm



Digital Transformation

Intelligent Connected Cockpit:

Performance compute, AI, 5G transforming the user experience



Applications

- Face recognition
- Augmented reality
- Natural language understanding
- Multimodal interfaces
- Multiple high res displays
- Integrated surround view
- Premium sound
- Driver monitoring



Compute-intensive vehicle experiences

- Panoramic Displays
- Multi-Configurable Displays
- Multiple cameras
- Premium Audio



Foundational technologies

- Artificial intelligence
- Heterogeneous computing
- Computer vision
- Audio
- Video
- Location
- Security
- Connectivity

Personalized experiences

In-car virtual assistant

Adaptive HMIs

Personalized, multi zone audio

Gesture control

Natural language understanding

Voice/speech recognition

Voice/noise cancellation

Fingerprint recognition



Face Detection & Recognition

Object classification

Scene understanding

Sensor processing & fusion

Contextual Safety

Driver behavior monitoring

Surround view monitoring

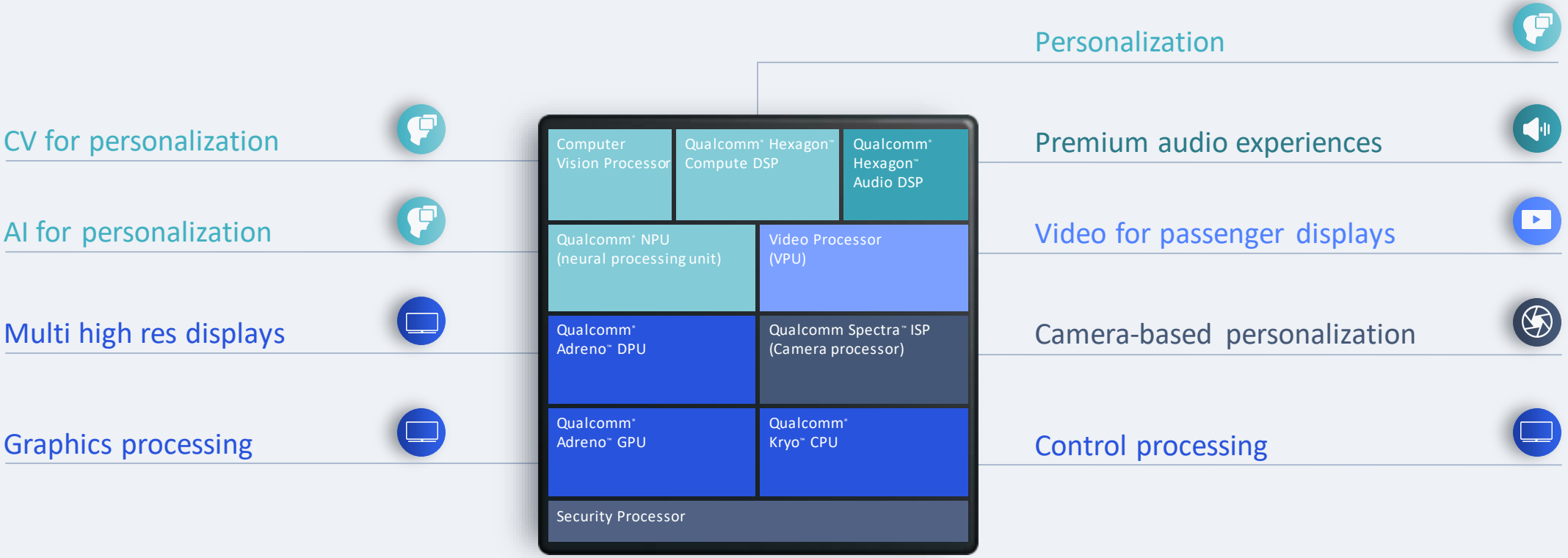
AR-based navigation

Intelligent ADAS

AI plays a central role in advanced use cases

Qualcomm® Snapdragon™: extreme integration and performance

Heterogeneous compute delivers integration and performance; virtualization for multiple OSs



High resolution multi-displays | Video for passenger displays | Premium audio experiences | Personalization | Camera based Personalization

Qualcomm Spectra, Qualcomm Snapdragon, Qualcomm Adreno, Qualcomm Hexagon, and Qualcomm Kryo are products of Qualcomm Technologies, Inc. and/or its subsidiaries.



Car connectivity in the 5G era

Heterogeneous connectivity

Secure, virtualized wireless links

Advanced positioning

Multi-environment implementation



C-V2X

Rel 14/15 C-V2X established basic safety

Rel 16 NR C-V2X saw continued evolution for advanced use cases

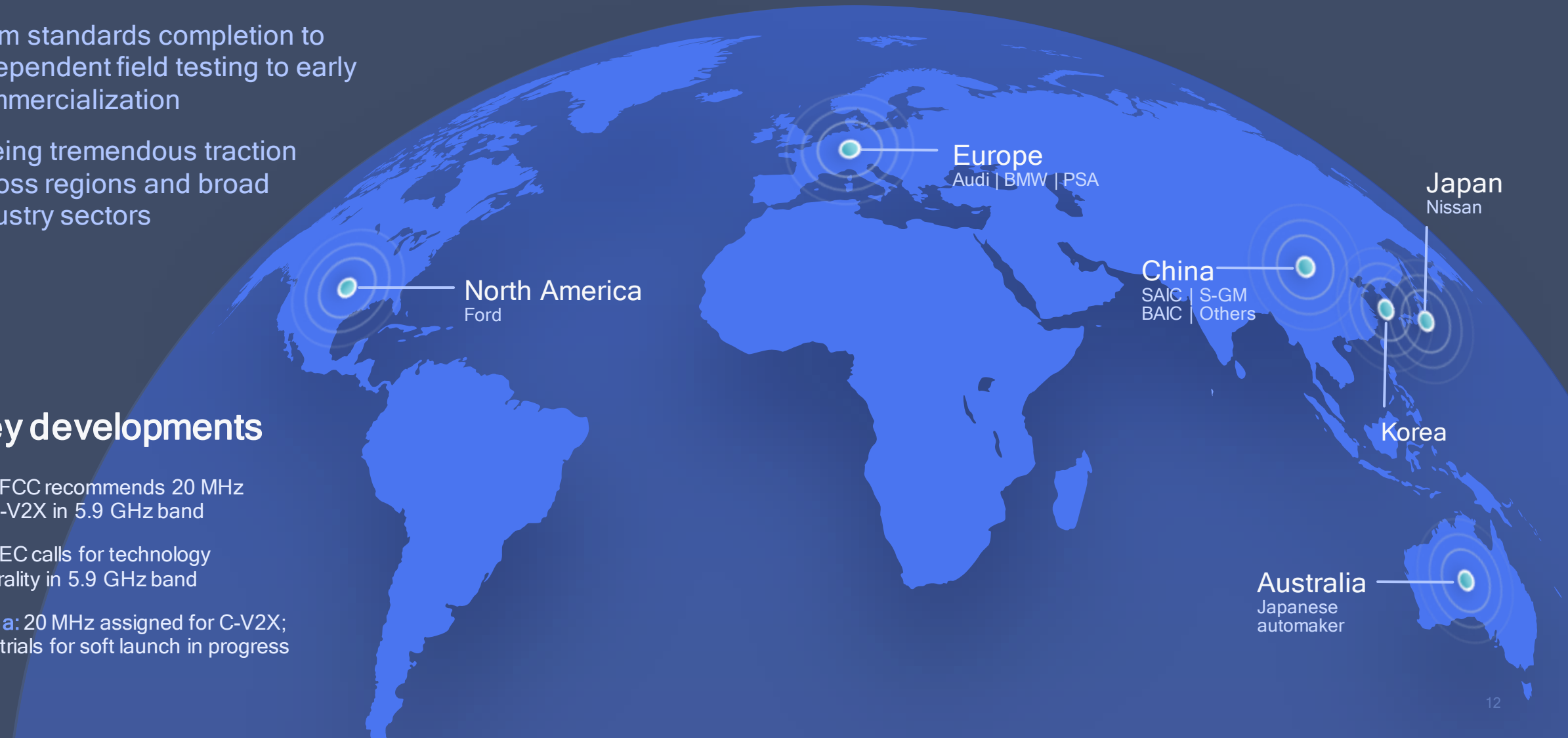
- Release 14/15 C-V2X standards completed
- Broad industry support with 5GAA
- Global trials started in 2017; first commercial deployment expected in 2020
- Qualcomm® 9150 C-V2X chipset announced in September, 2017
- Integration of C-V2X into the Qualcomm® Snapdragon™ Automotive 4G and 5G Platforms announced in February, 2019

Qualcomm 9150 C-V2X and Qualcomm Snapdragon Automotive 4G/5G Platforms are products of Qualcomm Technologies, Inc. and/or its subsidiaries.

Driving C-V2X globally

From standards completion to independent field testing to early commercialization

Seeing tremendous traction across regions and broad industry sectors



Key developments

US: FCC recommends 20 MHz for C-V2X in 5.9 GHz band

EU: EC calls for technology neutrality in 5.9 GHz band

China: 20 MHz assigned for C-V2X; pilot trials for soft launch in progress

Enhanced road safety

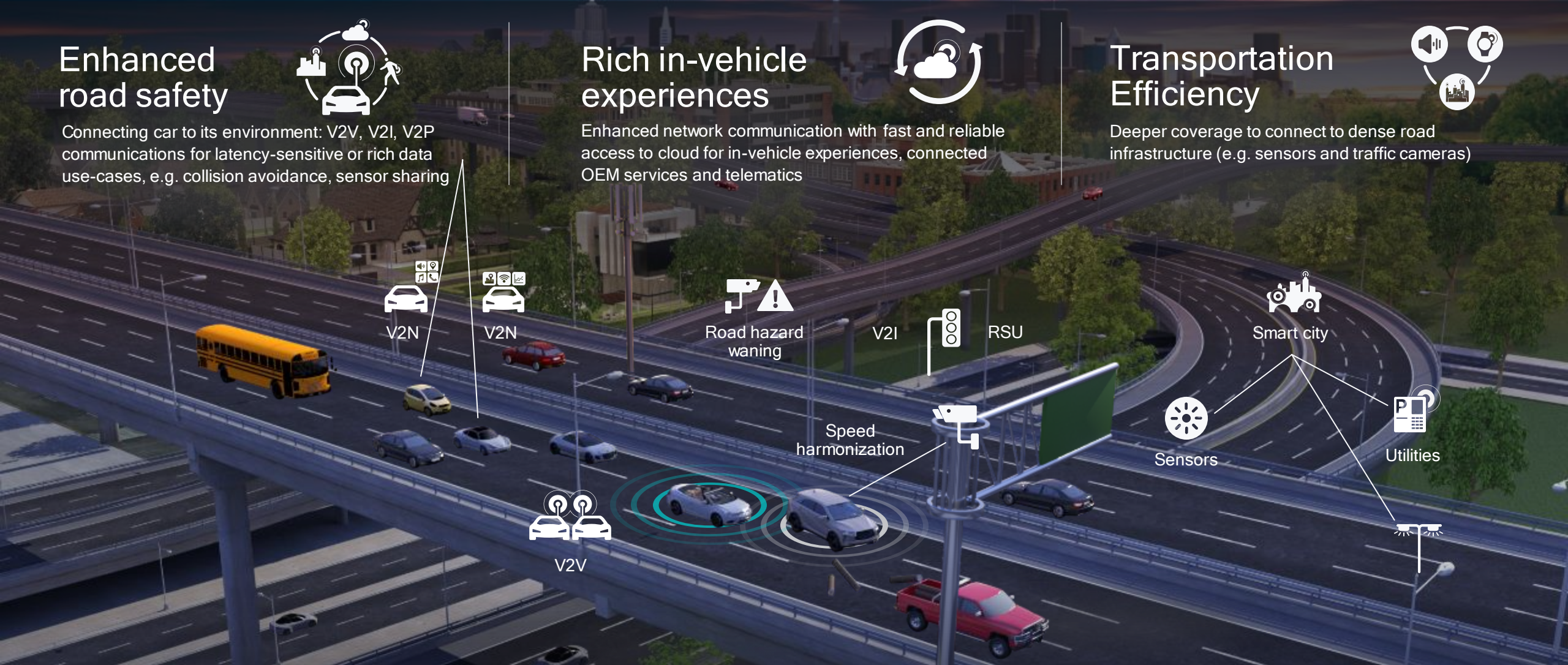
Connecting car to its environment: V2V, V2I, V2P communications for latency-sensitive or rich data use-cases, e.g. collision avoidance, sensor sharing

Rich in-vehicle experiences

Enhanced network communication with fast and reliable access to cloud for in-vehicle experiences, connected OEM services and telematics

Transportation Efficiency

Deeper coverage to connect to dense road infrastructure (e.g. sensors and traffic cameras)



Qualcomm 5G enables smart transportation use cases

10x Decrease in end-to-end latency

10x Experienced throughput

3x Spectrum efficiency

100x Traffic capacity

100x Network efficiency

10x Connection density

5G adoption faster than 4G at automakers

4G — 2013-2014

2 Licensees developed

LG

gemalto a Thales company

2 Automakers launched

GM

Audi

5G — 2021-2023

~8 Licensees developing

Continental, LG, QUECTEL, Ford, LG Innotek, SIERRA WIRELESS, ALPSALPINE, GOSUNCN

18+ Automakers awarded/RFx

BMW, GM, VW, Audi, VOLVO, Ford, HYUNDAI, DAIMLER, TESLA, RENAULT NISSAN MITSUBISHI, PSA GROUPE, 华人运通 HUMAN HORIZONS, JAGUAR, LAND ROVER, GEELY, WELTMEISTER 威马汽车, SHANGHAI GM, Ford 进无止境, Great Wall, GAC MOTOR

Source: Qualcomm Technologies data

Automakers targeting 2021-2023 launches (5G launch +2-4 years) underscores tremendous momentum with 5G

Introducing

Qualcomm Car-to-Cloud Service

Secure, connected-car services and lifecycle management for

Infotainment

Telematics



- Integrated connectivity
- Content, services and application bundling
- Flexible configuration and faster TTM
- Secure and attested communication
- Personalized user experience
- New services and revenue opportunities
- Cost-efficient operation
- Actionable insights

5G / Wi-Fi hotspot enablement

Service description

- Customer is presented with an offer to upgrade to Wi-Fi hotspot package
- Customer accepts the offer
- Wi-Fi hotspot is enabled
- Highest data rate is chosen intelligently based on available MNO capabilities in customer's driving area, routes, and time-of-day

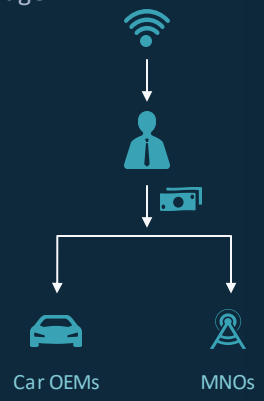
Business model

Monetization options

- Customer is charged for the Wi-Fi hotspot package subscription
- The package is bundled with other services for high end customers

Revenue share

- Revenue share with content providers, MNOs, and car OEMs



How to enable

MODEM Upgrade

HW connectivity

- Upgrade to 5G for highest data rate on TCU
- Intelligently choose highest data rate

Connectivity plans

- Provide data for movie streaming
- Data consumed charged to separate APN and adjust billing

Virtual assistant service

Service description

- Customer is presented with an offer to upgrade to virtual assistant package
- Customer accepts the service
- The virtual assistant service is enabled on existing HW without adding additional HW (with data service bundled)

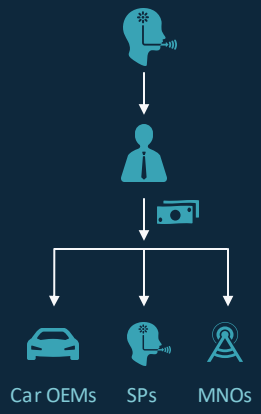
Business model

Monetization options

- One-time or recurring charges are added to the customer bill
- Service can be offered for free to high end customers/market segments

Revenue share

- Revenue share with cloud providers, MNOs, and car OEMs





How to enable

Upgrade

HW connectivity

- Enable natural language processing package

Connectivity plans

- Provide data that enables the virtual assistant service

SW upgrade

- Enable the SW for NLP/voice-controlled virtual assistance services

Movie streaming on-demand

Service description

- Movies are recommended to customers based on data collection and analytics
- Customer selects a movie from movie library
- High resolution movie is streamed on the IVI system (data is bundled with curated content)
- Customer is billed for the movie

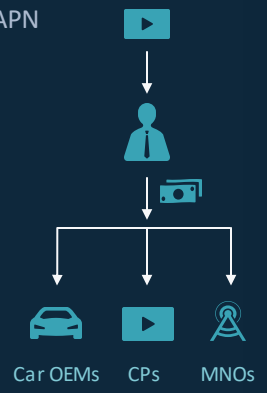
Business model

Monetization options

- Customer is charged for the movie (including airtime), where data is charged on a separate APN and removed from wireless subscriber bill)
- Service offered for high end customer for differentiation as part of convenience services
- Service offered to shared mobility fleet as a value add on

Revenue share

- Revenue share with content providers, MNOs, and car OEMs



How to enable

HW connectivity

MODEM Upgrade

- Upgrade to 5G for highest data rate on TCU
- Intelligently choose highest data rate

HW processing

AP Upgrade

- Enable Premium Graphics (2x 4K display) support
- Enable premium audio package

Connectivity plans

- Provide data for movie streaming
- Data consumed charged to separate APN and adjust billing

Curated content

- Movie sourced from selected content provider (e.g. Amazon, Sony Pictures, Disney, Netflix)

Evolution to autonomous driving

Qualcomm® Snapdragon Ride™ Platform



Level 1/2 → Level 2+ → Level 4+

Active safety

Forward collision warning, automatic emergency braking

Lane keep assist, departure warning

Blind-spot collision warning

Adaptive cruise control

Convenience

Adaptive cruise control with lane-keeping

Hands-off highway autopilot

Automated lane change

Autonomous parking

Self driving

Robotaxis, robo-logistics

Long-haul trucking

Parking lot to parking lot

Key solution requirements

Safe, robust, and efficient

Power and thermal efficiency

Scalable across multiple car classes

Qualcomm Snapdragon Ride is a product of Qualcomm Technologies, Inc. and/or its subsidiaries.

Qualcomm Snapdragon Ride platform

Powerful, scalable, thermally efficient safety solutions for ADAS and autonomous driving

2X more power efficient than latest competitive solutions in its class (passive or air cooled)

Designed for ASIL-D Systems

Open, customizable software stack

On the road in 2023

Hardware

Qualcomm Autonomous driving accelerator

Autonomous driving accelerator

Massive neural processor array
High-speed interconnects
Seamless integration with SoC

Qualcomm ADAS application processor

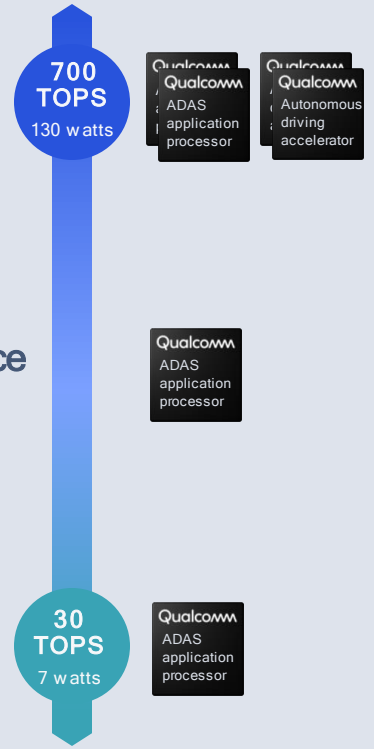
Family of ADAS SoCs

Qualcomm® Kryo™ CPU
Qualcomm® Adreno™ GPU
High-efficiency neural processors
Embedded vision accelerators

Software stack

Ride planner	Behavior prediction Planning stack
Ride localization	Qualcomm® Vision Enhanced Precise Positioning Map fusion
Ride perception	Camera | Radar Lidar | Lidar Sensor fusion | C-V2X
Ride framework	Automotive frameworks Diagnostics and tools
Ride core	Snapdragon SDKs for CV, AI OpenCL | OpenGL
Ride OS	Operating system Safety drivers

Scalable Performance



Partner ecosystem

arm · Elektrobit · Infineon · ON Semiconductor · QNX · Synopsys · TomTom · Xylon

Qualcomm Snapdragon Ride Autonomous driving accelerator, ADAS application processor, Qualcomm Kryo, Qualcomm Adreno, and Qualcomm Vision Enhanced Precise Positioning are products of Qualcomm Technologies, Inc. and/or its subsidiaries

Qualcomm

Thank you

Follow us on:

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2019-2020 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm is a trademark of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to "Qualcomm" may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm's licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc.,
a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm's engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.