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Valencia

Qualcomm

C-V2X Ignites Automotive Connected Revolution

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Precise positioning
Lane-level accuracy
anywhere, anytime



Wi-Fi
For in-car experiences
and car OEM services



Bluetooth
For high quality
voice and audio



4G/5G
For car OEM services



4G/5G
For driver
and passengers



C-V2X Direct
Communications
For car-to-infrastructure
communication



C-V2X Direct
Communications
For car-to-car
communication

Car connectivity
in the 5G era

Heterogeneous
connectivity

Secure, virtualized
wireless links

Advanced
Positioning

Multi-environment
implementation

4G/5G is referring to C-V2X network communications (i.e. V2N); C-V2X Direct Communications is referring to V2V, V2I, V2P



AI-based roadside unit

Smart RSU/Small cell

- 4G/5G small cell
- Integrated C-V2X support
- Infrastructure-to-vehicle (I2V)
- AI/perception and sensor fusion
- AI-based camera, radar, lidar
- Precise positioning and 3D HD mapping

Smart connected cars

- 4G/5G support
- Integrated C-V2X support
- Precise positioning
- AI/perception and sensor fusion



Smart transportation
infrastructure supported by
our foundational technologies



Artificial
intelligence



Mobile Edge
Compute



Sensor
fusion



Multimode
4G/5G



C-V2X Direct
Communications



Precise
positioning



Computer
vision



Power
management



Security

Qualcomm® Connected Car Reference Design, Gen 2



Qualcomm® Snapdragon™ Automotive 4G/5G platforms



Application Processor

With telematics SDK



Wi-Fi 6
BT5.1

SDRs

PMIC

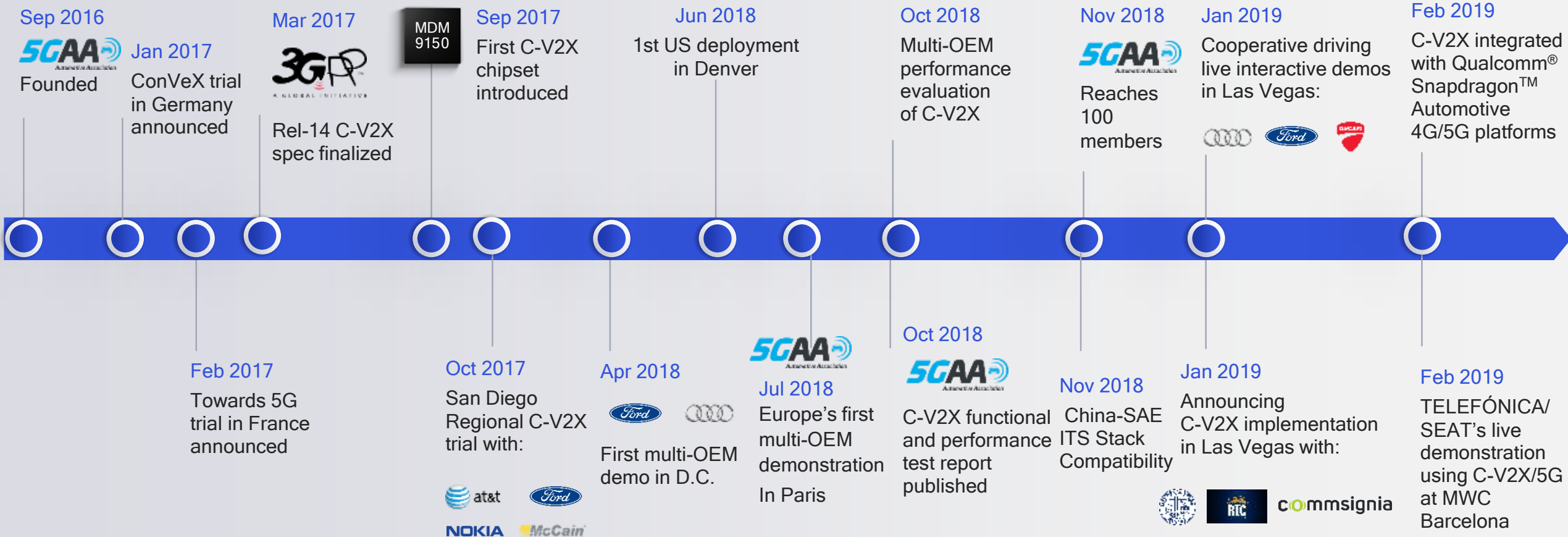
HSM

RF ICs +
antenna
modules

RF
front-end

Memory

Strong C-V2X momentum globally



Helping bring a comprehensive ecosystem together

Working across industries to forge sustainable relationships, unlocking new value



Software companies



Test equipment vendors

Automotive



Vehicle OEMs



Tier 1 suppliers

Transportation



Road operators



Traffic industry suppliers

Telecom



Mobile operators



Telecom suppliers

Internet/cloud



Cloud service providers



Map providers

Standards



Standards development organizations



Telecom and auto industry organizations



ITS organizations

Robust Global C-V2X Ecosystem is Ready

9150 Modules

- WNC
- Quectel
- ZTE
- LG
- LG Innotek
- SIMCom

Commercial ready
module in 2018

RSU vendors

- **US** : Commsignia, Savari, Kapsch, Danlaw
- **EU** : Swarco, Lacroix, Aximum, Marben
- **China** : Nebulalink, Genevict, Neusoft
- **RoW**: Cohda, Cybercom, Oki

12+ RSU products in the
pipeline. Commercial
ready in Q1 2019

Tier1s/OBU vendors

- Ficosa
- Cohda
- Valeo
- Savari
- Marben
- Continental
- LG Electronics
- Nebulalink
- Commsignia
- Genevict
- Danlaw

10+ OBU suppliers
the pipeline.
Commercial ready in
Q1 2019

System Integrators

- Sasken
 - Integration & support
- Thundersoft
 - Integration & support

Global foot print to
support system
Integration

C-V2X is ready for deployment now!

Commercially available Products

Ecosystem partner	Commercially available products (including web links)	
WNC	CV2X module & mPCIe card EVK - RR3 C-V2X platform	http://www.wnc.com.tw/index.php?action=pro_cate_third_close&top_id=106&scid=123&tid=145 http://www.wnc.com.tw/index.php?lang=en&action=pro_cate_third_close&top_id=106&scid=123&tid=145
Quectel	AG15 : C-V2X Module	https://www.quectel.com/product/ag15.htm
ZTE	ZM8350 : C-V2X Module	https://www.ztedevices.com/en/product/industry-user/automotive-module/zm8350
LG Innotek	LAM-V500 : C-V2X Module	http://www.lginnotek.co.kr/en/itk_product/v2x-communication-module/
Commsignia	C-V2X Roadside Unit	http://www.commsignia.com/wp-content/uploads/2019/04/Commsignia ITS RS4 ProductBrief.pdf
	C-V2X On Board Unit	http://www.commsignia.com/wp-content/uploads/2019/04/Commsignia ITS OB4 ProductBrief.pdf
	Software stack	http://www.commsignia.com/software/
Ficosa	CARCOM - OBU	https://www.ficosa.com/wp-content/uploads/2018/12/Ficosa On Board Unit C V2X.pdf
Kapsch	RIS 9260 : C-V2X Roadside Unit	https://connectedvehicles.kapsch.net/download/KapschRIS-9260datasheet.pdf
Nebulalink	V-Box : C-V2X Roadside Unit (C-SAE)	http://nebula-link.com/Product/view/id/5
Genvict	LB-RD10 : C-V2X Roadside Unit	http://www.genvict.com/en/project/Default.aspx?id=10000106
	LB-LD10 : C-V2X On Board Unit	http://www.genvict.com/en/project/Default.aspx?id=10000106
Savari	StreetWAVE 2000 OBU	http://savari.net/wp-content/uploads/2019/05/MW-2000_May2019-1.pdf
	StreetWave 2000 RSU	http://savari.net/wp-content/uploads/2019/05/SW-2000_May2019.pdf
	MobiWAVE C-V2X software stack	http://savari.net/technology-cv2x/
Neusoft	V2X Roadside Unit	http://www.reachauto.com/product/en/396.html
	V2X On Board Unit	
	Ve Talk C-V2X software stack	
Cohda Wireless	C-V2X Software development kit	https://cohdawireless.com/wp-content/uploads/2018/08/CW_Product-Brief-sheet-C-V2X-SDK.pdf
Danlaw	C-V2X Aftermarket OBU	https://www.danlawinc.com/wp-content/uploads/DS_Aftermarket_Safety_Device_V9.pdf
	C-V2X RSU	https://www.danlawinc.com/wp-content/uploads/DS_RSU_Datasheet_V9.pdf
Sasken	C-V2X system integration	https://www.sasken.com/C-V2X

5GAA Automotive Association

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Veniam • Verizon • Viavi • Vodafone • Volkswagen • ZF • ZTE

Key participants

driving global C-V2X activities with
Qualcomm Technologies

Ford	ZTE	Kapsch
PSA	Quectel	SWARCO
BMW	Lear	Genvict
Daimler	Valeo	Nebula
SAIC	WNC	R&S
China Domestic OEMs	CMCC	Datang
Continental	AT&T	Ficoso
Bosch	DoCoMo	And more ...
LG	CMRI	
	McCain	

Driving C-V2X global presence



Tremendous traction across regions and broad industry sectors
From standards completion to independent field testing to early commercialization

5G NR based C-V2X

5G NR : A unified connectivity fabric to expand into new industries

Mobilizing media
and entertainment



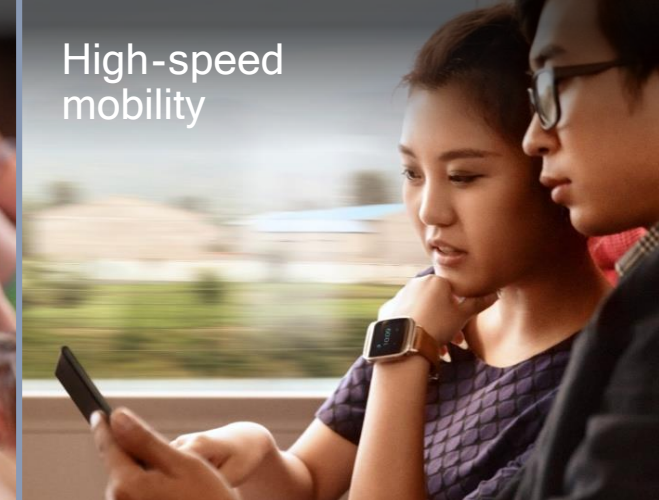
Rich user-generated
content



Congested
environments



High-speed
mobility



5G

5G is essential for next generation mobile experiences

- Fiber-like data speeds
- Low latency for real-time interactivity
- More consistent performance
- Massive capacity for unlimited data

Connected cloud
computing



Immersive
experiences



Connected
vehicle



Augmented
reality



5G NR based C-V2X for autonomous driving

Rel-14 C-V2X for automotive safety is gaining momentum and broad ecosystem support



5G NR provides a unified connectivity fabric to expand into new industries



C-V2X has a clear and forward compatible evolution path to 5G NR



5G NR C-V2X provides URLLC and high data rate to support higher level of predictability for autonomous driving



Evolving C-V2X Direct Communications towards 5G NR

While maintaining backward capabilities

Evolution to 5G NR, while being backward compatible
C-V2X Rel-14 is necessary and operates with Rel-16

Basic and enhanced safety

C-V2X Rel-14/Rel-15 with enhanced range and reliability

Basic safety

IEEE 802.11p



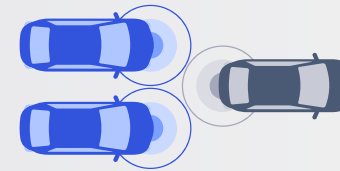
Autonomous driving use cases

5G NR C-V2X Rel-16

Backward compatible with Rel-14/Rel-15 enabled vehicles

Higher throughput
Higher reliability

Wideband carrier support
Lower latency



Advanced use cases for autonomous driving



High throughput sensor sharing

High throughput and reliability to enable the exchange of raw or processed data gathered



Intent/Trajectory sharing

High throughput and URLLC to enable planned trajectory sharing



Real-time local updates

High throughput to build local, dynamic maps based on camera and sensor data; and distribute them at street intersections



Coordinated driving

URLLC and high data rate to exchange path planning information in timely fashion

Wideband carrier support

High throughput

Ultra-low latency

Ultra-high reliability



Thank you

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