



# 20 Years of Cellular Standardization in China - *An Opportunity for Future Cooperation on Cellular Vehicle-to- Everything (C-V2X)*

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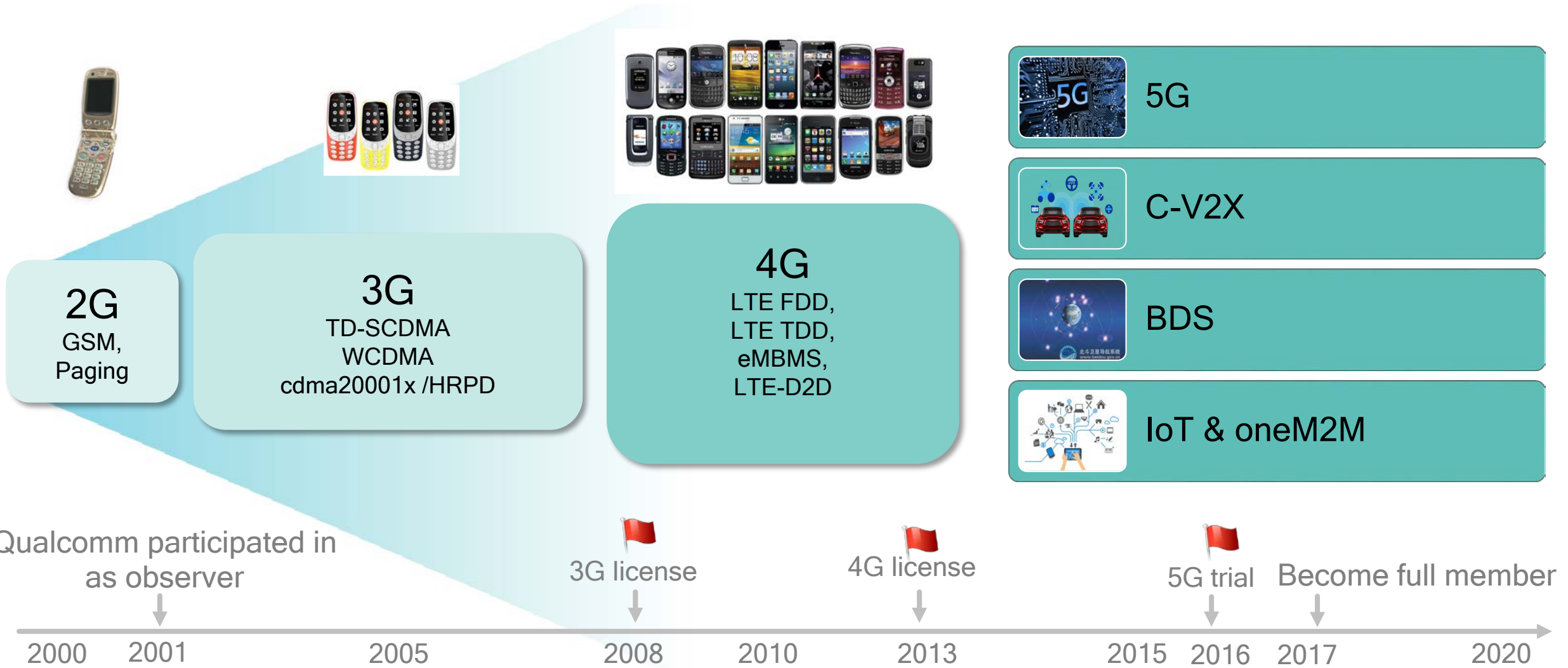
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June 9, 2017



# CCSA Leads China Telecom Industry to Success

Qualcomm China grows with CCSA in the ~20 year journey



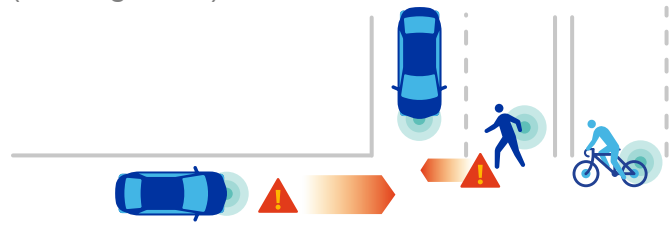
# V2X is a critical component for safer autonomous driving

Communicating intent and sensor data even in challenging real world conditions

## Non line-of-sight sensing

Provides 360° NLOS awareness

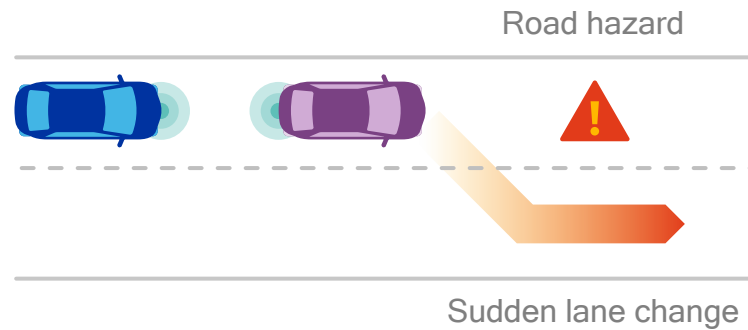
E.g. intersections/on-ramps,  
environmental conditions  
(rain/fog/snow)



Blind intersection/vulnerable  
road user (VRU) alerts

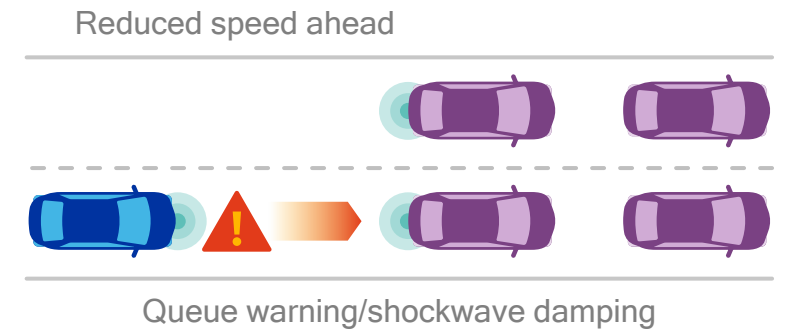
## Conveying intent

Communicates intent and  
share sensor data to provide  
higher level of predictability



## Situational awareness

Offers increased electronic horizon  
to enable soft safety alerts  
and reliable graduated warning



**Vehicle-to-vehicle (V2V)**  
e.g. collision avoidance  
safety systems



**Vehicle-to-pedestrian (V2P)**  
e.g. safety alerts  
to pedestrians, bicyclists



**Vehicle-to-infrastructure (V2I)**  
e.g. traffic light optimal  
speed advisory



**Vehicle-to-network (V2N)**  
e.g. real-time traffic / routing,  
cloud services

# Dedicated Short Range Communications (DSRC)

DSRC was designed for the US 5.9 GHz ITS Band

- 75 MHz Licensed under FCC Part 90 and 95
- 10 MHz channels
- FCC designates certain channels, e.g. V2V safety, control, public safety

## DSRC V2V Standards

- IEEE 802.11 (PHY/MAC)
- IEEE 1609.2-4 (message protocol and security services)
- SAE J2735 (data dictionary / message sets: Vehicle Safety Extension)
- SAE J2945/1 (on-board performance requirements)

Critical Safety of Life (Reserved) Ch172 5.860 GHz	Service Channel (SCH) Ch174 5.870 GHz	Service Channel (SCH) Ch176 5.880 GHz	Control Channel (CCH) Ch178 5.890 GHz	Service Channel (SCH) Ch180 5.900 GHz	Service Channel (SCH) Ch182 5.910 GHz	High-Power Public Safety (Reserved) Ch184 5.920 GHz
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DSRC V2V Use Cases (USDOT, OEMs) - These were tested at the Ann Arbor Safety Pilot

- Emergency Electronic Brake Lights (EEBL): Brake “on” from several cars ahead sent to subject vehicle
- Forward Collision Warning (FCW): Alert to elicit hard braking to prevent rear-end crash
- Blind Spot Warning/Lane Change Warning (BSW/LCW): Alerts of fast-approaching cars from behind (and in adjoining lanes)
- ~~Do Not Pass Warning (DNPW): Alerts for head-on crashes during passing maneuver~~
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Control Loss Warning (CLW)



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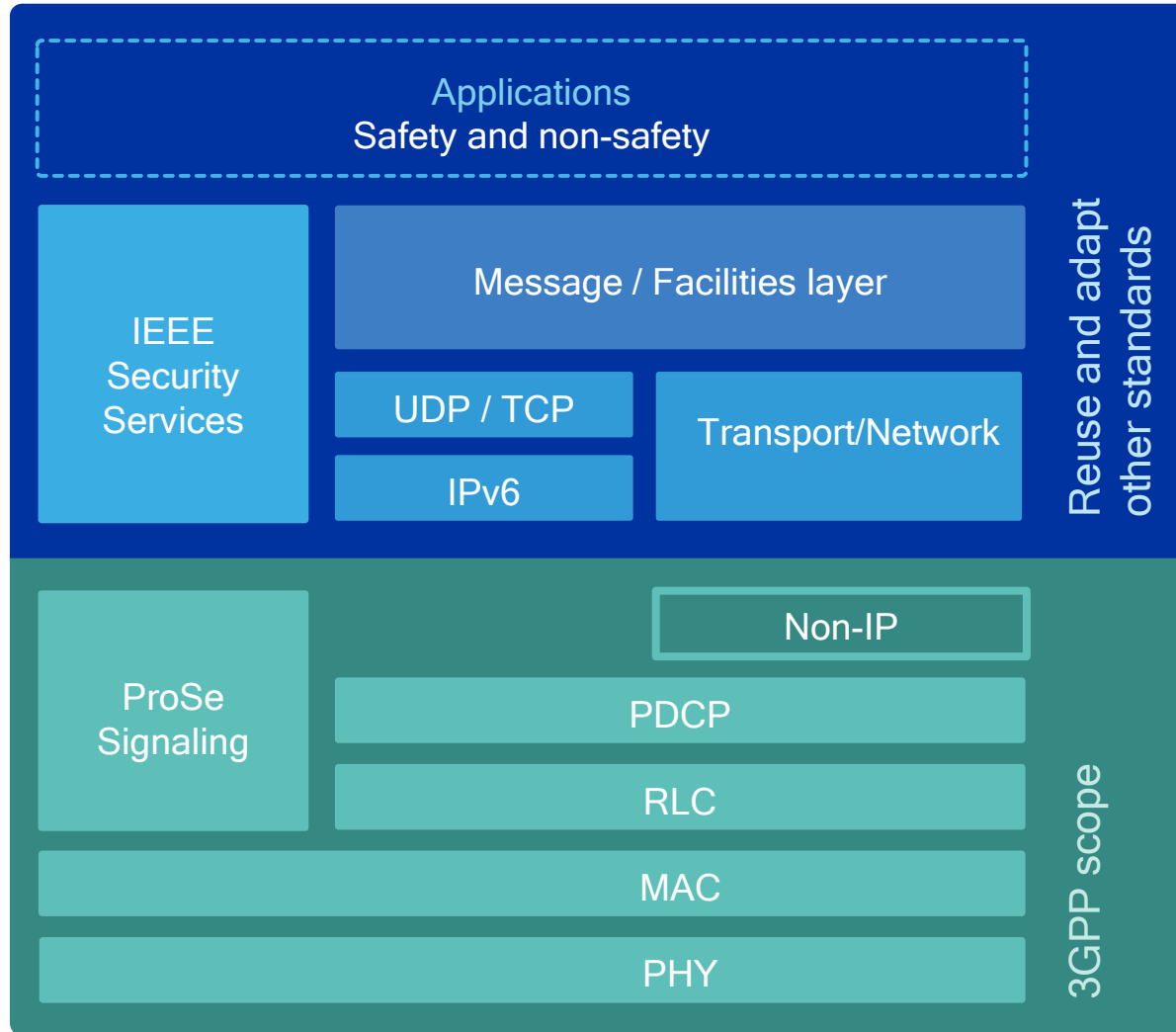
# 3GPP Based C-V2X

- 3GPP Release 14 includes support for V2V
- C-V2V portion completed in 2016
- Provides higher performance (greater reliability, longer range, better performance in dense situations) than 802.11p
- Will reuse the IEEE 1609 and SAE layers (with minor modifications)
- Most automobiles are already supporting (or are expected to support) a 3GPP based radio for infotainment or C-V2N communications
- 3GPP Release 16 is expected to have a 5G radio with significantly lower delay to support additional use cases



# Possible Areas of Cooperation

US and China may have similar goals



- Create “adaptation” between 3GPP-defined radio access and existing application protocols
  - US SAE data dictionary and emerging C-SAE work are compatible
  - Transport and network protocols can be harmonized
- Benefit: more unified adaptation could lead to harmonized applications. Such harmonization could be positive for both the US and China markets.



# Thank you

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