

Quectel Automotive Module

Product Overview

February, 2020

Automotive Modules Roadmap

LTE Cat 4
AG35
MDM9628



- Automotive Grade
- Multi-mode LTE
- 150M DL/ 50M UL
- GNSS
- -CE/ -E/ -NA/ -LA/ -J
- LGA Form Factor

C-V2X
AG15
MDM9150



- Automotive Grade
- C-V2X PC5
- GNSS
- LGA Form Factor

LTE-A up to Cat 16
C-V2X (Optional)
AG520R
SA415M



- Automotive Grade
- Multi-mode LTE
- LTE-A up to Cat 16
- Integrate C-V2X ^{Optional}
- Multi-Frequency GNSS ^{Optional}
- -CN/ -NA*/ -EU* /-JP * /-LA*
- LGA Form Factor

5G
C-V2X (Optional)
AG550Q
SA515M



- Automotive Grade
- 5G NR Sub-6G
- 4G/3G/2G fallback
- DSDA ^{Optional}
- Integrate C-V2X ^{Optional}
- Multi-Frequency GNSS
- -CN*/ -NA*/ -EU* /-ROW*
- LGA Form Factor

C-V2X AP module
AG215S
SA2150P



- Automotive Grade
- Qualcomm SA2150P
- C-V2X SDK integrated
- C-V2X ITS integrated
- HSM integrated

Qx' xx

Estimated Engineering Sample Dates

2017

2018

2019

2020

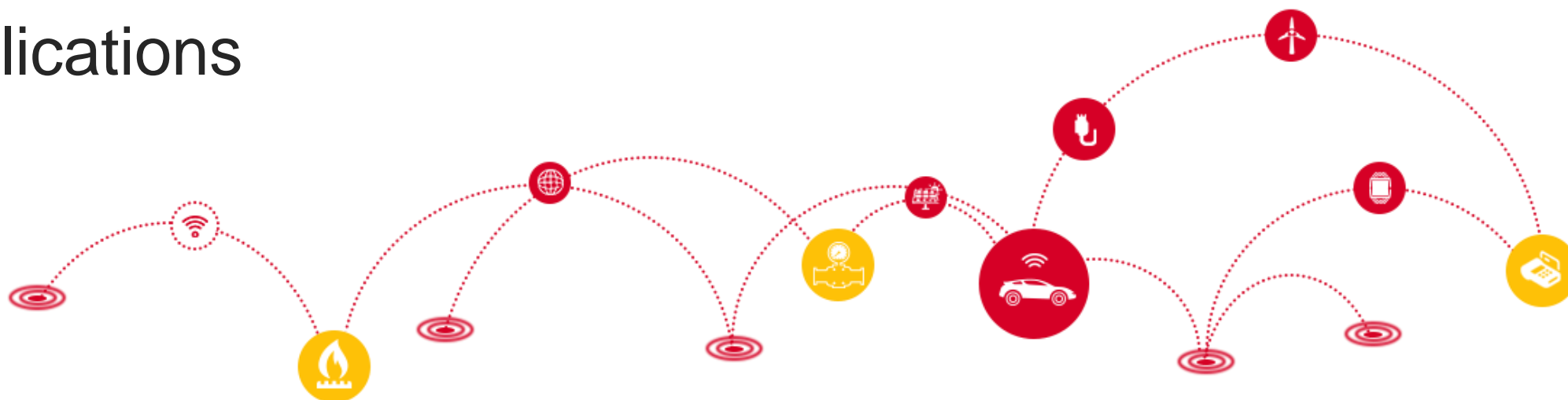
Roadmap

Product Overview

C-V2X Introduction

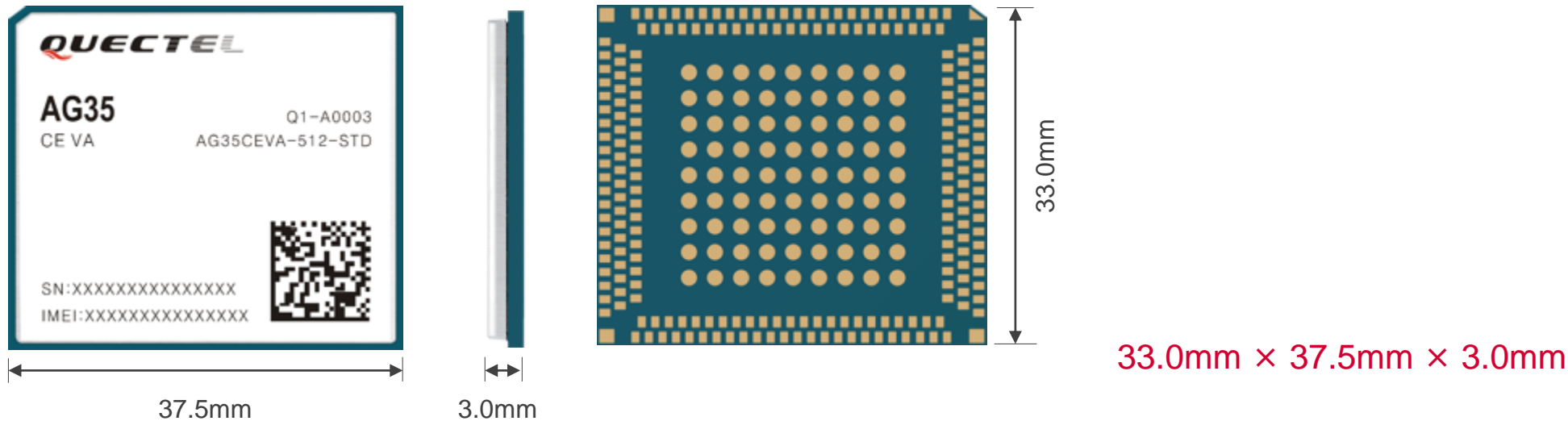
Enhanced Technologies

Applications



Automotive Module AG35 Highlights

Multi-Mode LTE Cat 4 Module (MDM9628)



- Qualcomm MDM9628 chipset solution dedicated for automotive applications
- Ideal for automotive applications with IATF 16949 requirement
- Wide operation temperature range (-40°C to +85°C) and support eCall under +95°C^{NOTE}
- Automotive quality processes (PPAP, 8D, DFMEA, PFMEA...)
- Excellent EMC/ESD protection ensures great robustness even in harsh environments
- Compact SMT form factor ideal for integration in slim and size-constrained automotive solutions
- Multi-constellation GNSS receiver available for applications requiring fast and accurate fixes in any environment

NOTE: +95°C eCall application is supported through proper customer system designs, and it may lead to module lifetime shortened.

AG35 Specifications



33.0mm × 37.5mm × 3.0mm
150M DL/ 50M UL

■ Multi-Mode LTE Cat 4 Module

Variant		AG35-CE	AG35-E	AG35-NA	AG35-LA	AG35-J
LTE	FDD-LTE	B1/B3/B5/B8	B1/B3/B5/B7/B8/B20/B28	B2/B4/B5/B7/B12(B17)/B13	B1/B2/B3/B4/B5/B7/B8/B28	B1/B3/B5/B8/B9/B19/B21/B28
	TDD-LTE	B34/B38/B39/B40/B41	B38/B40	\	\	B41
UMTS	WCDMA	B1/B8	B1/B5/B8	B2/B4/B5	B1/B2/B3/B4/B5/B8	B1/B3/B5/B6/B8/B19
	TD-SCDMA	B34/B39	\	\	\	\
EVDO/CDMA		BC0 ^①	\	\	\	\
GSM		900/1800MHz	900/1800MHz	850/1900MHz	850/900/1800/1900MHz	\
Embedded GNSS		Y	Y	Y	Y	Y
Dead Reckoning		Optional	Optional	Optional	Optional	Optional
PPE (RTK)		Optional	\	\	\	\
Wi-Fi/BT Interface		Y	Y	Y	Y	Y
Region		China	EMEA, Korea, Australia, India, Southeast Asia	North America	Latin America	Japan
Certification		Regulatory: SRRC/ NAL/ CCC	Carrier: KT*/ STK*/ LGU+* Regulatory: GCF/ CE/ FCC/ KC/ RCM	Carrier: AT&T/ Rogers/ Verizon*/ T-Mobile* Regulatory: GCF/ FCC/ PTCRB/ IC	Regulatory: CE/ FCC/ Anatel/ RCM	Carrier: NTT DOCOMO* Regulatory: JATE/ TELEC

“Y” means supported.

* means under development.

① means the band is optional.

AG35 Key Features

Item	Description
	Enhanced processes compliant with the key testing items required by AEC-Q100
Chipset	Application processor <ul style="list-style-type: none"> - ARM Cortex A7 up to 1.2 GHz with 256kB L2 cache - ARM Cortex A7 - primary boot processor Modem processor <ul style="list-style-type: none"> - QDSP6 processor at up to 691MHz (Turbo) RPM processor <ul style="list-style-type: none"> - ARM Cortex M3 up to 100 MHz
Memory	Embedded Nand+DDRAM <ul style="list-style-type: none"> - NAND: 512MB - DDRAM: 256MB Available for customers <ul style="list-style-type: none"> - NAND: > 120MB - DDRAM: > 100MB
Interfaces	USB 2.0, HSIC, UART, I2C, PCM, SGMII, SDIO, (U)SIM, ADC, SPI, GPIOs
Enhanced Features	Wi-Fi + BT* eCall, QuecOpen [®] (Open Linux), Multi-APN ERA-GLONASS* Secure Boot, TrustZone/TPM*, Code/user data backup for higher security Temperature management Embedded codec (<i>Optional</i>) ESD/ EMI protection through internal specific circuits and components
Data Speed	LTE: LTE-FDD: Max 150 Mbps (DL), Max 50 Mbps (UL) LTE-TDD: Max 130 Mbps (DL), Max 30 Mbps (UL)
	UMTS: DC-HSDPA: Max 42 Mbps HSUPA: Max 5.76 Mbps WCDMA: Max 384Kbps (DL/UL)
	TD-SCDMA: Max 4.2 Mbps (DL), Max 2.2 Mbps (UL)
	CDMA2000: EVDO: Max 3.1 Mbps (DL), Max 1.8 Mbps (UL) 1X Advanced: Max 307.2Kbps (DL/UL)
	GSM: EDGE: Max 296Kbps (DL), Max 236.8Kbps (UL) GPRS: Max 107Kbps (DL), Max 85.6Kbps (UL)

* means under development

AG35-CE Timeline



Project Stage

AG35-CE 

Regulatory Certifications

SRRC/ NAL/ CCC



AG35-E Timeline



2019						2020											
Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.

Project Stage

AG35-E 

Carrier Certification Schedule



Regulatory Certifications

GCF/ CE/ FCC/ KC/ RCM Completed

AG35-NA Timeline



2019												2020		
Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.

Project Stage

AG35-NA 

Carrier Certification Schedule



Regulatory Certifications

GCF/ FCC/ PTCRB/ IC Completed

AG35-LA Timeline

2018			2019												2020
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.

Project Stage

AG35-LA

SOP

Regulatory Certifications

CE/ FCC/ Anatel/ RCM



AG35-J Timeline



2019												2020				
Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May

Project Stage

AG35-J 

Carrier Certification Schedule

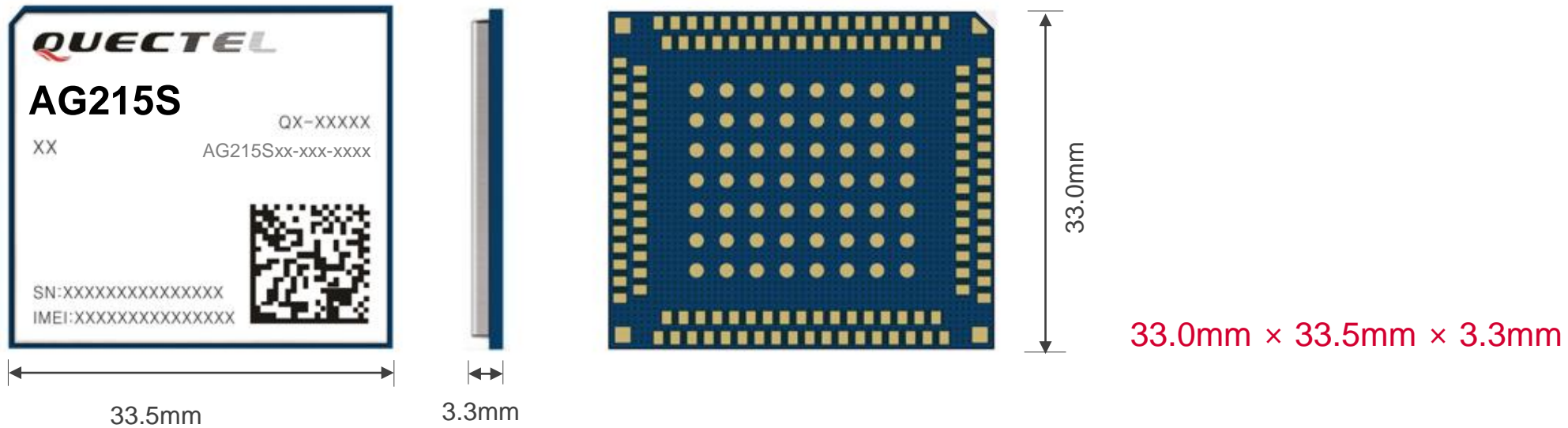


Regulatory Certifications

JATE/ TELEC Completed

Automotive EAP Module AG215S Highlights

AP Module Dedicated for C-V2X (SA2150P)



- Qualcomm SA2150P chipset dedicated for the C-V2X Application Processor
- Automotive quality processes (PPAP, 8D, DFMEA, PFMEA...)
- IATF 16949 compliant Application Processor to host ITS stack and applications
- Optimized communication performance with Quectel AG520R/AG550Q
- Hardware Crypto Engine embedded to fulfill powerful ECDSA verification capability
- Support global and China national security algorithms
- Additional HSM/SE integrated, and optional ITS stack integrated
- Wide operation temperature range (-40°C to +85°C)
- Extremely high reliability thanks to automotive grade testing standard

C-V2X AP Module AG215S Specifications



Automotive Grade C-V2X Application Processor Module

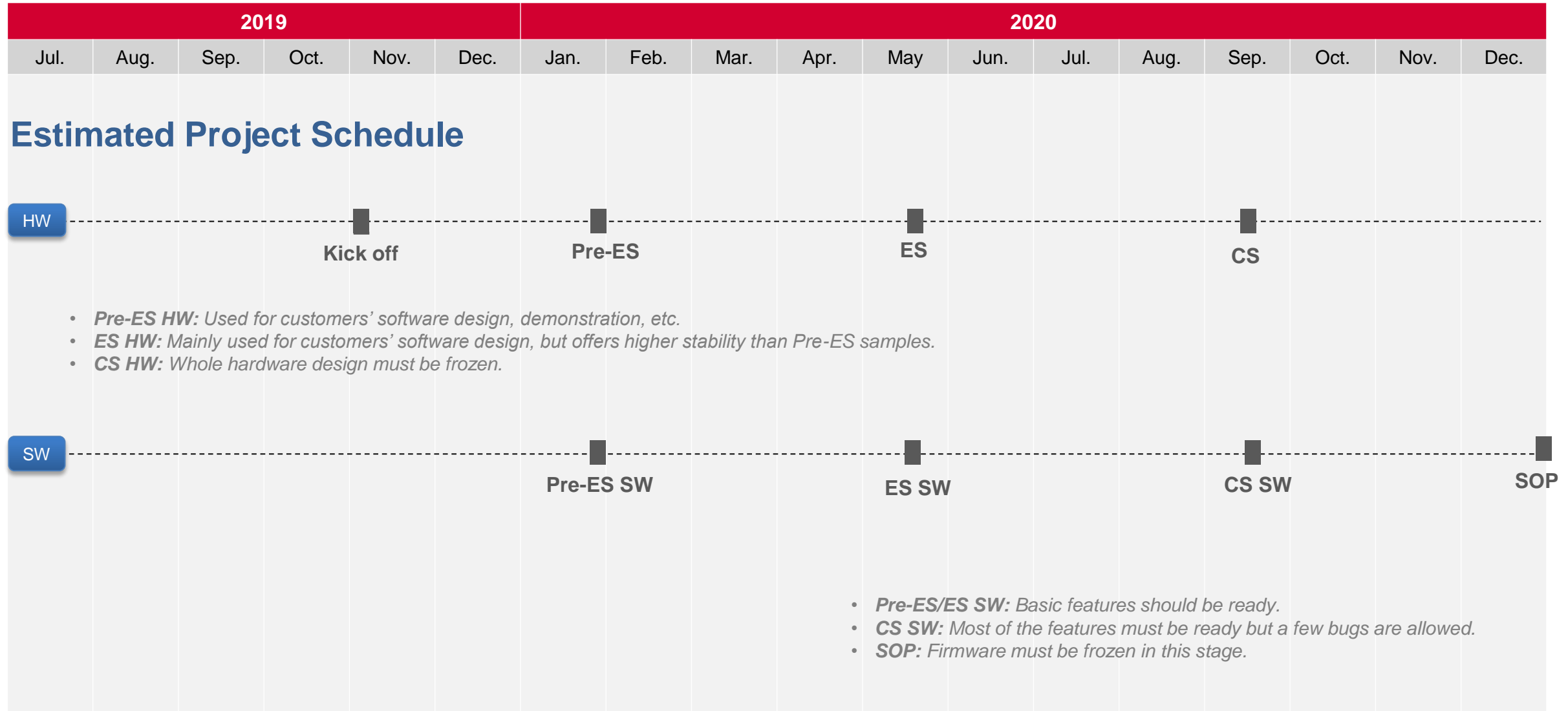


33.0mm × 33.5mm × 3.3mm

Features	AG215S
Processors	<ul style="list-style-type: none">64-bit ARM Cortex-A53 Microprocessor Cores1.4 GHz Dual-Core Processor (Quad-Core Processor Optional)
Interfaces	PCIe Gen2, USB 3.0/2.0, RGMII 1 Gbps, UART, SPI, I2C, 1PPS (Input), ADC
Embedded ECDSA Hardware Engine	Support NIST p-384, NIST p-256, Brainpool p-384, Brainpool p-256, SM2 256 bit Curves
Scalable ECDSA Capability	Up to 2500TPS through embedded engine and CPU (based on NIST p-256 and SM2)
Hardware Crypto Engine Embedded	<ul style="list-style-type: none">Secret key generation and storage, and digital signature and verificationAdditional 2000TPS ECSDA capability (based on NIST p-256 and SM2)
Region	Global
Certification	TBD

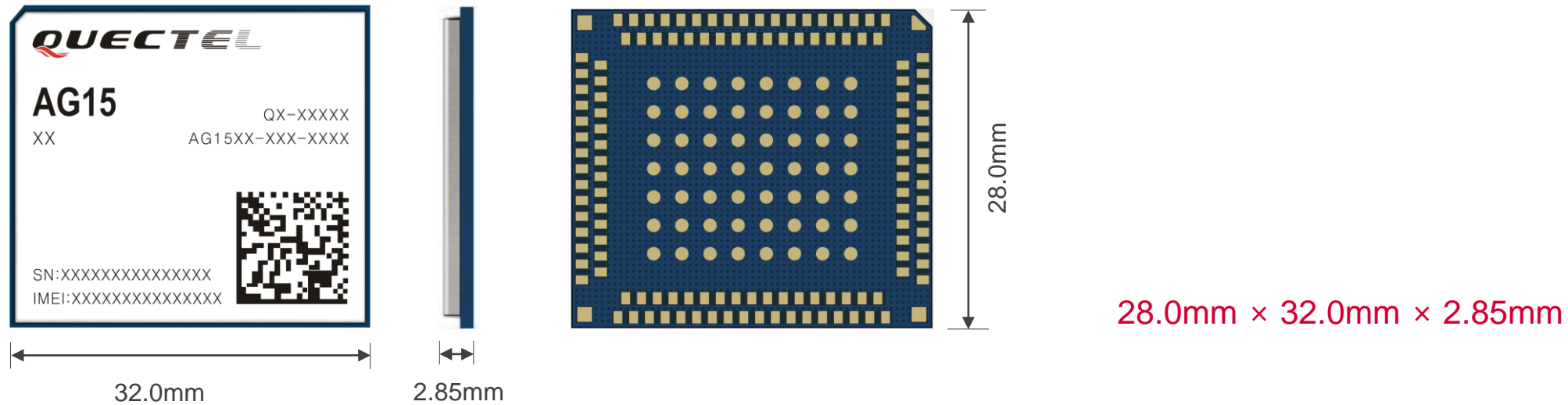
** means under development*

AG215S EAP Module Timeline (Estimated)



Automotive C-V2X Module AG15 Highlights

Support C-V2X PC5 Direct Communications (MDM9150)



- Qualcomm MDM9150 chipset solution dedicated for C-V2X (V2V, V2I, V2P) applications
- Designed to meet IATF 16949 requirements
- Wide operation temperature range (-40°C to +85°C)
- Automotive quality processes (PPAP, 8D, DFMEA, PFMEA...)
- Extremely high reliability thanks to automotive grade testing standard
- Excellent EMC/ESD protection ensures great robustness even in harsh environments
- Compact SMT form factor ideal for integration in slim and size-constrained automotive solutions
- Multi-constellation GNSS receiver available for applications requiring fast and accurate fixes in any environment

C-V2X Module AG15 Specifications



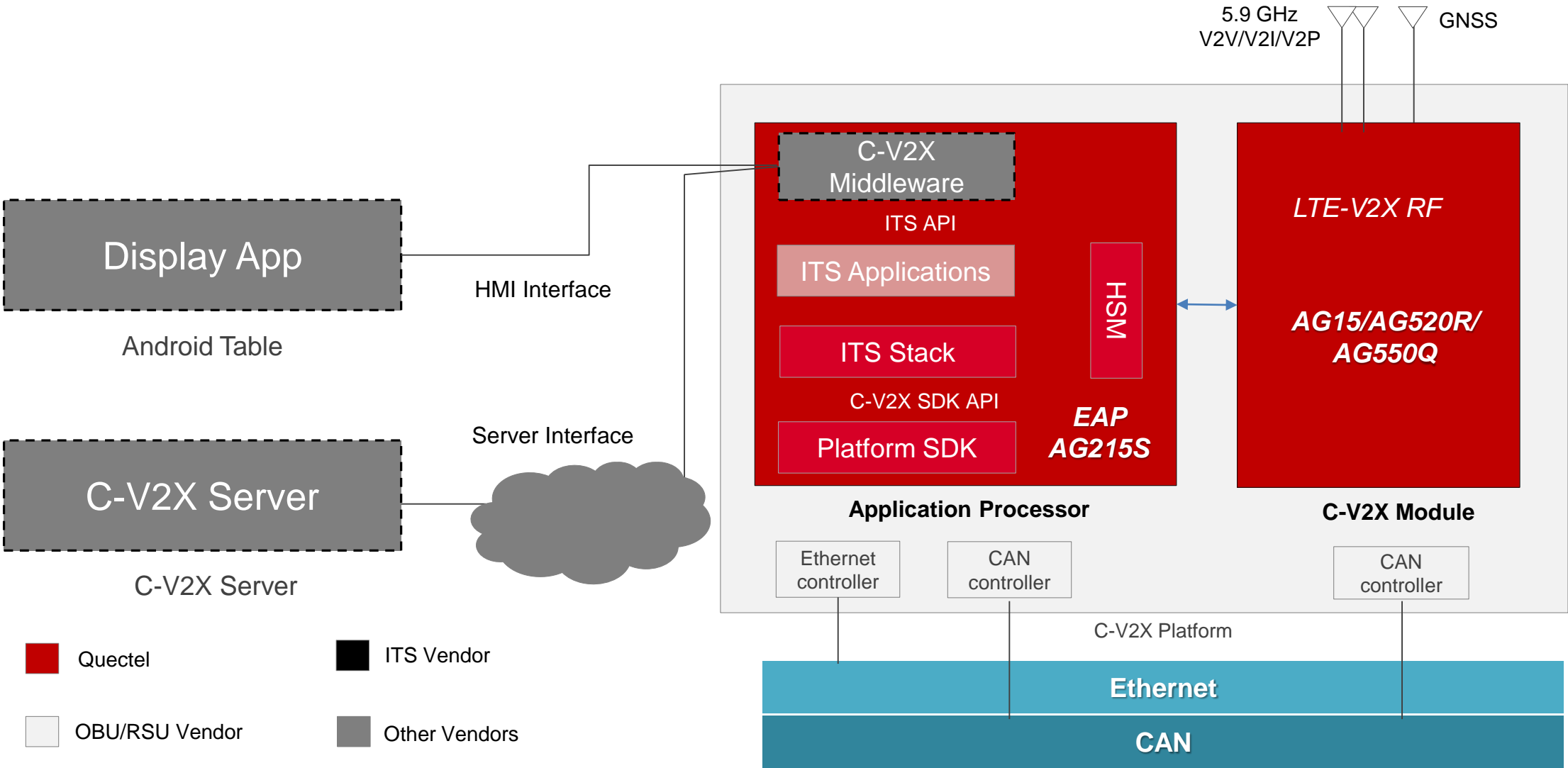
Qualcomm MDM9150 C-V2X Chipset solution
based on 3GPP Rel.14 for PC5-based
direct communications



28.0mm × 32.0mm × 2.85mm

Features	AG15
Frequency	5.8GHz & 5.9GHz
Embedded GNSS	GPS, GLONASS, BeiDou, Galileo, QZSS
Interfaces	PCIe, USB 3.0/2.0, SPI, I2C, UART, GPIO, ADC, DR_SYNC
Dead Reckoning	QDR3 (Share the same IMU with MDM9628)
Enhanced Features	PACE (Position Assisted Clock Estimator), TUNC (Time Uncertainty Constraint)
Region	Global
Certification	TBD

C-V2X System Architecture



QUECTEL®
Build a Smarter World

4G + C-V2X

USB debug

UART debug

AG215S (SA2150P)

IMU (QDR)

GPIO

1PPS

PCIe

AG15 (MDM9150)

UART

SPI

MCU (CAN)

CAN/LIN CVRs

ETH Switch

ETH PHY

ETH PHY

2-wire ETH to IVI or GW EAVB+DATA

I2C

IMU (QDR)

SGMII

AG35 (MDM9628)

GNSS

1×(U)SIM

UART

SPI

I2S PCM

FC20/AF20

ANT WLAN+BT

Audio Codec

MIC

SPK

BLE (low) power

BLE ANT

CAN/LIN to GW

C-V2X

GNSS

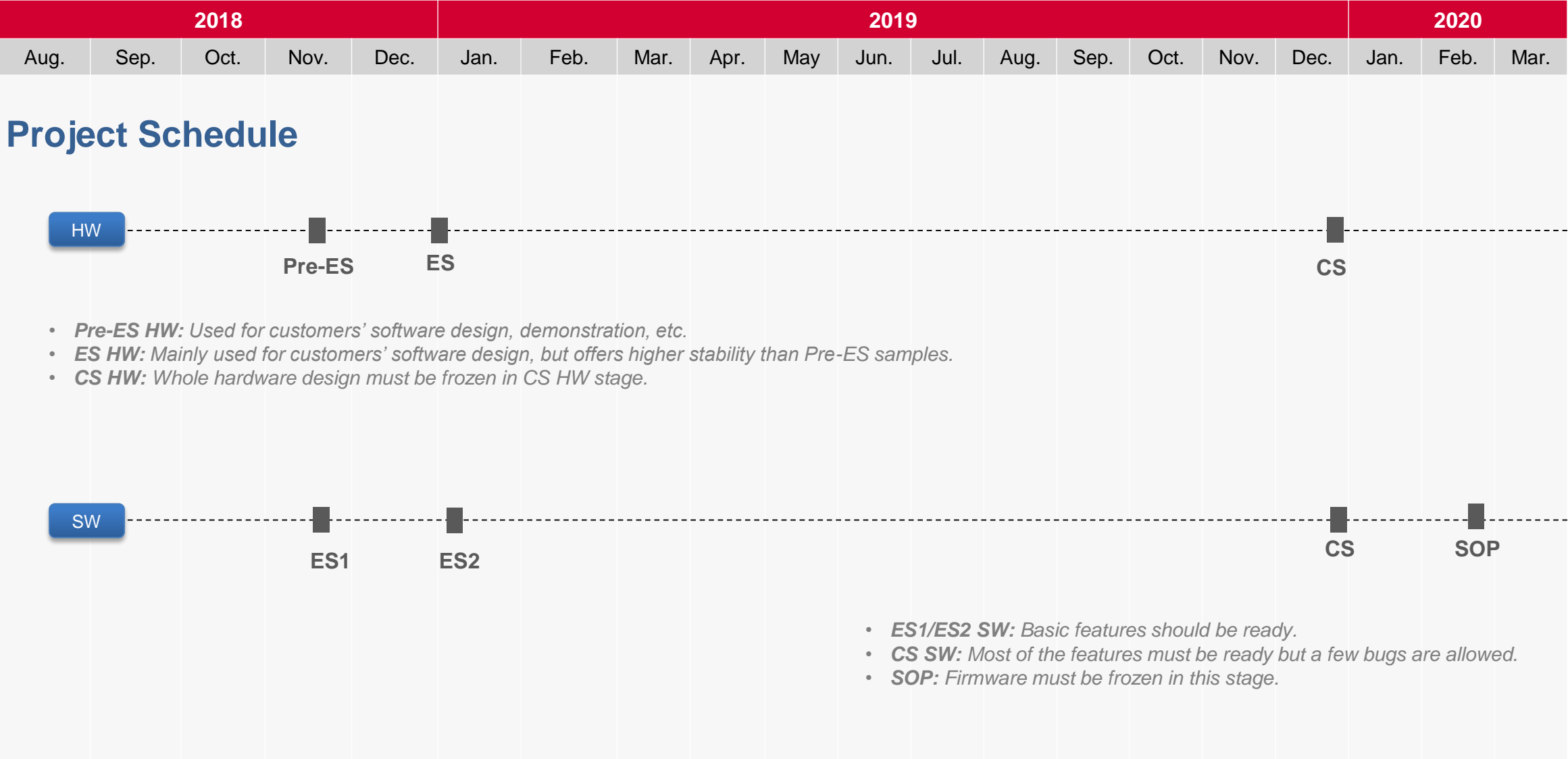
2×2 ANT (4G)

NOTES:

- AG15 can share the GNSS with AG35 through the 1PPS and GPIO.
- AG15 can share the CAN/LIN to GW with AG35 through the UART.

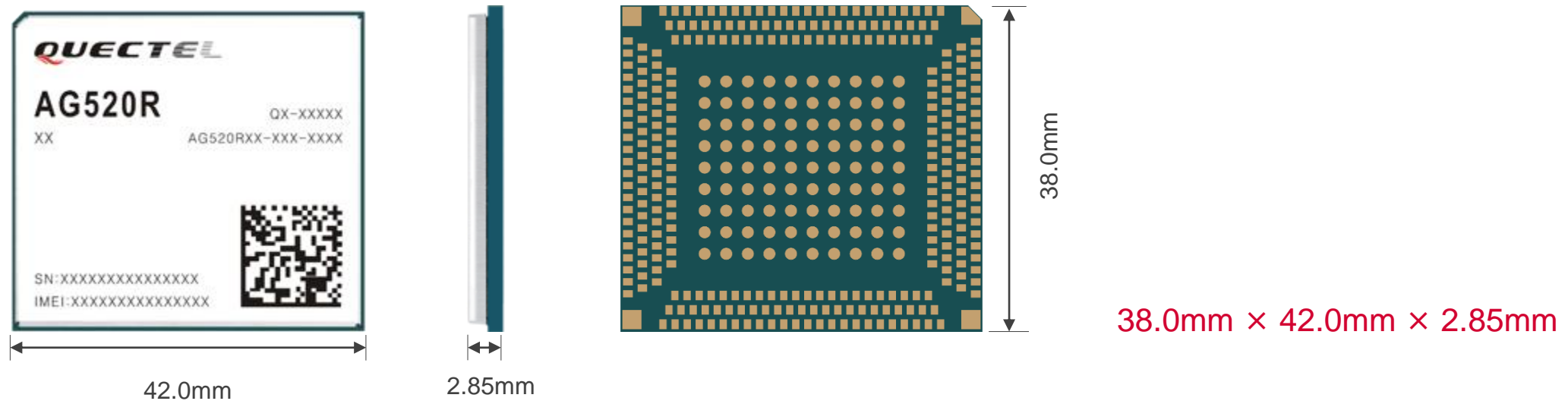
- NOTES:**
1. AG15 can share the GNSS antenna with AG35 through a power splitter.
 2. AG15 can share the IMU with AG35 through UART.

AG15 Timeline



Automotive Module AG520R Highlights

Multi-Mode Automotive Module up to LTE Cat 16 + Optional C-V2X (SA415M)



- AEC-Q100 qualified Qualcomm SA415M chipset solution dedicated for automotive and optional C-V2X applications
- Ideal for automotive applications with IATF 16949 requirement
- Wide operation temperature range (-40°C to +85°C) and support eCall under +95°C
- Automotive quality processes (PPAP, 8D, DFMEA, PFMEA...)
- Excellent EMC/ESD protection ensures great robustness even in harsh environments
- Compact SMT form factor ideal for integration in slim and size-constrained automotive solutions
- Multi-frequency GNSS receiver available for applications requiring fast and accurate fixes in any environment

AG520R Specifications



■ Multi-Mode LTE up to Cat 16 + Optional C-V2X

Variant		AG520R-CN	AG520R-EU*	AG520R-NA*	AG520R-JP*	AG520R-LA*
LTE	FDD-LTE	B1/B3/B5/B7/B8	B1/B3/B5/B7/B8/B20/B28/B32	B2/B4/B5/B7/B12/B13/B14/B17/ B25/B26/B29/B30/B66/B71	B1/B3/B5/B8/B9/B11/B18/ B19/B21/B28	B1/B2/B3/B4/B5/B7/B8/ B20/B28
	TDD-LTE	B34/B38/B39/B40/B41	B38/B40/B41	\	B41	B38/B40/B41
UMTS	WCDMA	B1/B8	B1/B3/B5/B8	B2/B4/B5	B1/B3/B5/B8/B9/B19	B1/B2/B3/B5/B8
	TD-SCDMA	\	\	\	\	\
GSM		900/1800MHz	900/1800MHz	\	\	850/900/1800/1900MHz
C-V2X ^{Optional}		B47	B47	B47	TBD	B47
MF-GNSS ^{Optional}		L1+L5	L1+L5	L1+L5	L1+L5	L1+L5
Dead Reckoning ^{Optional}		QDR 3.0	QDR 3.0	QDR 3.0	QDR 3.0	QDR 3.0
PPE (RTK)		Optional	Planning	Planning	TBD	\
Ethernet ^{Optional}		RGMII	RGMII	RGMII	RGMII	RGMII
Wi-Fi/BT Interface		Y	Y	Y	Y	Y
Region		China	EMEA, Korea, Brazil, India, Australia	North America	Japan	Latin America
Certification		TBD	TBD	TBD	TBD	TBD

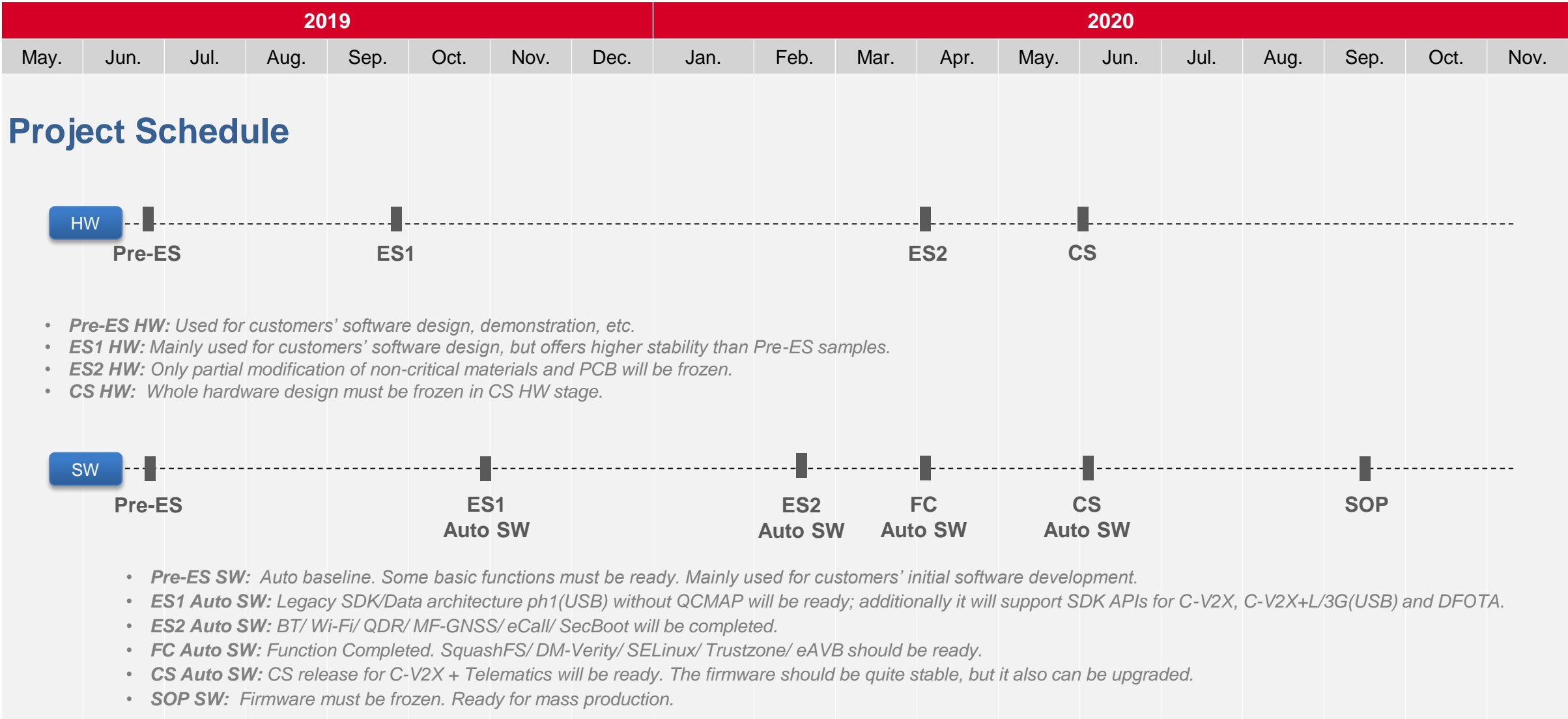
"Y" means supported.

* means under development.

AG520R Key Features

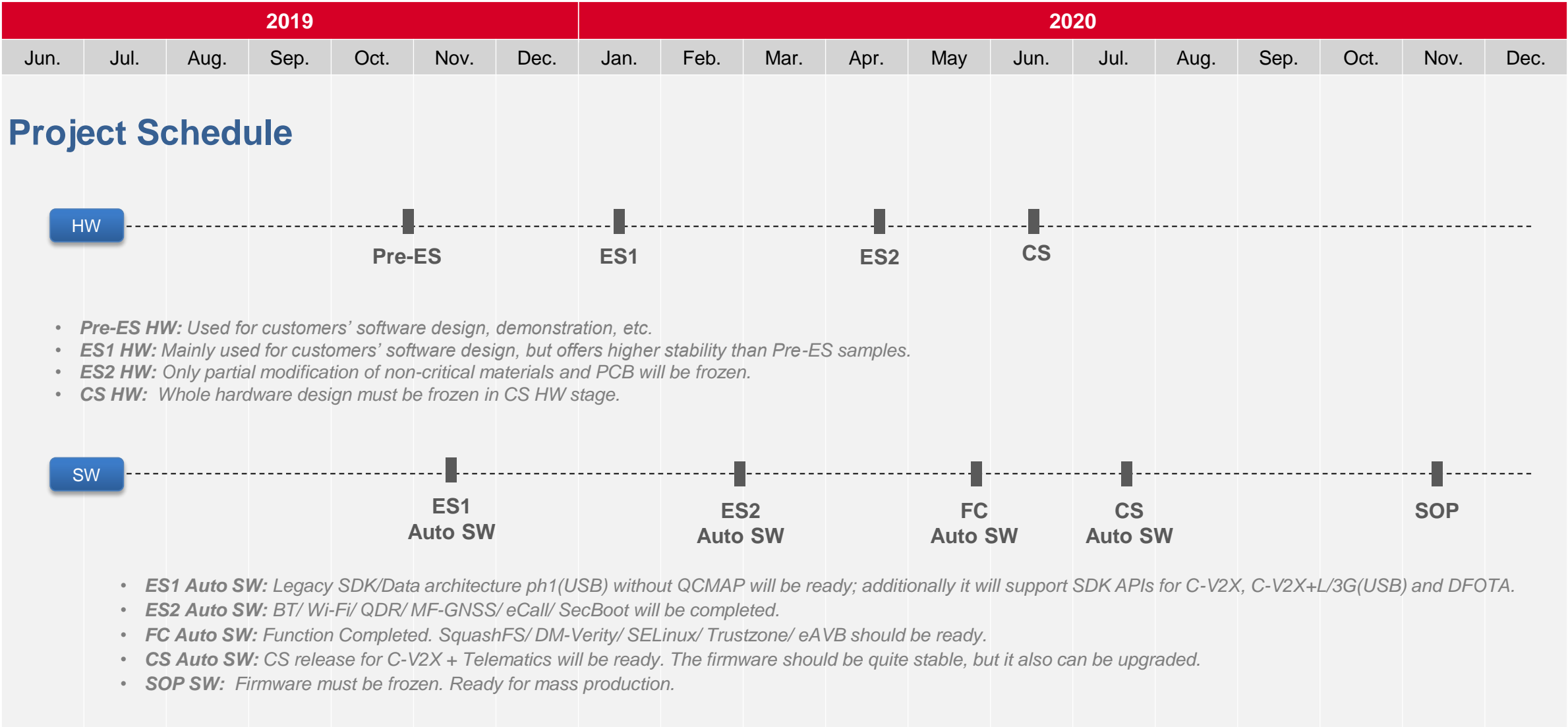
Item	Description
4G Category	Max up to Cat 16
Apps Processor	ARM Cortex A7 at 1.5GHz; 256 KB L2
C-V2X <small>Optional</small>	PC5 Mode 4 (direct communication), uu mode
Embedded GNSS	GPS/ GLONASS/ BeiDou/ Galileo Enhanced Automotive MF-GNSS (L1+L5) <small>Optional</small>
QDR <small>Optional</small>	QDR3 (external IMU is required)
Interface	PCIe, USB 2.0/3.0, RGMII, SDIO, SPI, I2C, I2S, PCM, UARTs, GPIOs, 1PPS, Wi-Fi interface, BT interface
Antenna Interfaces	<ul style="list-style-type: none"> • 4 × main antenna interfaces for LTE Cat 16 (4 × 4 MIMO) • 2 × C-V2X antenna interfaces • 1 × GNSS antenna interface
Data Speed	LTE: LTE-FDD: Max 1 Gbps (DL), Max 75 Mbps (UL) LTE-TDD: Max 880 Mbps (DL), Max 45 Mbps (UL)
	UMTS: DC-HSDPA: Max 42 Mbps HSUPA: Max 5.76 Mbps WCDMA: Max 384Kbps (DL/UL)
	GSM: EDGE: Max 296Kbps (DL), Max 236.8Kbps (UL) GPRS: Max 107Kbps (DL), Max 85.6Kbps (UL)
	C-V2X: Tx: Max 30 Mbps, Rx Max 30 Mbps

AG520R-CN Timeline



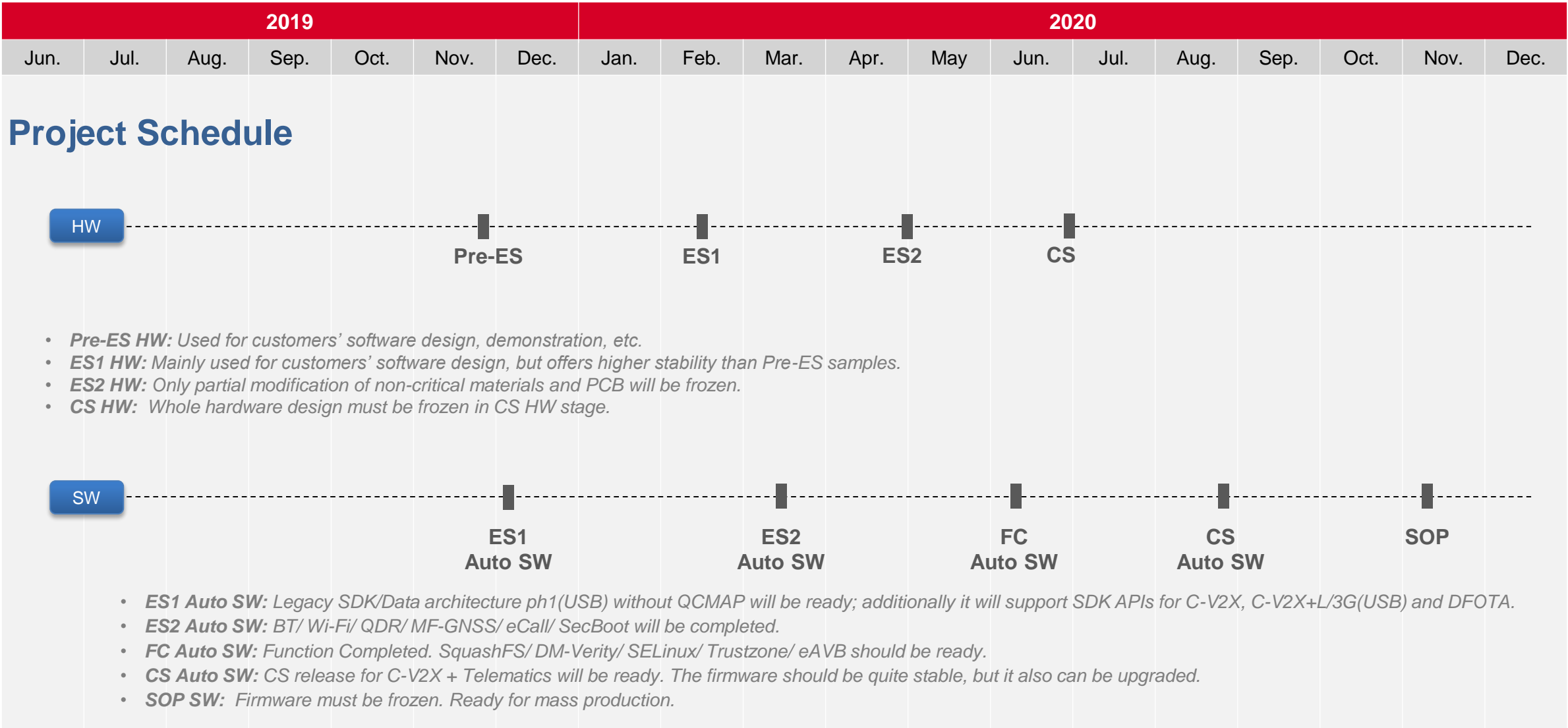
The timeline is estimated based on Qualcomm release schedule.

AG520R-EU Timeline



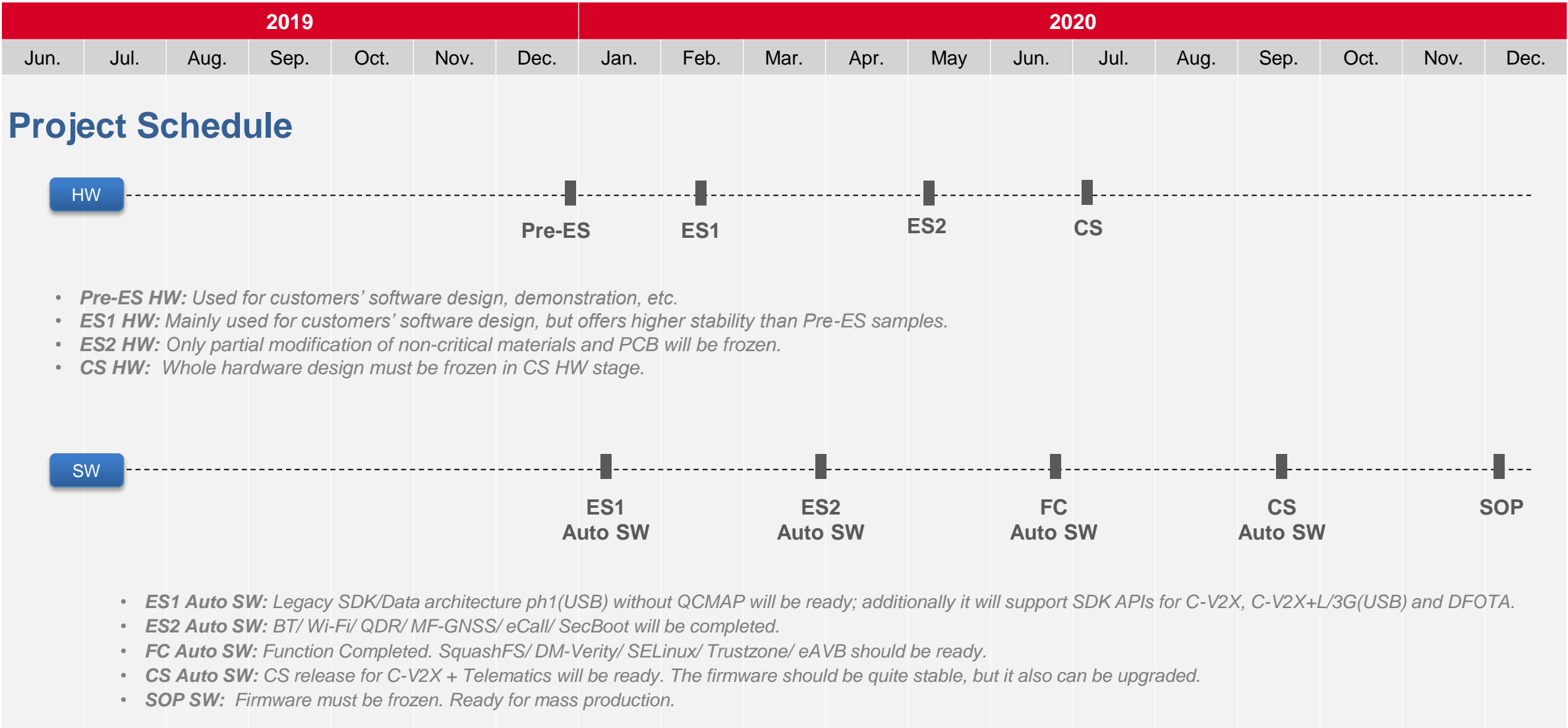
The timeline is estimated based on Qualcomm release schedule.

AG520R-NA Timeline



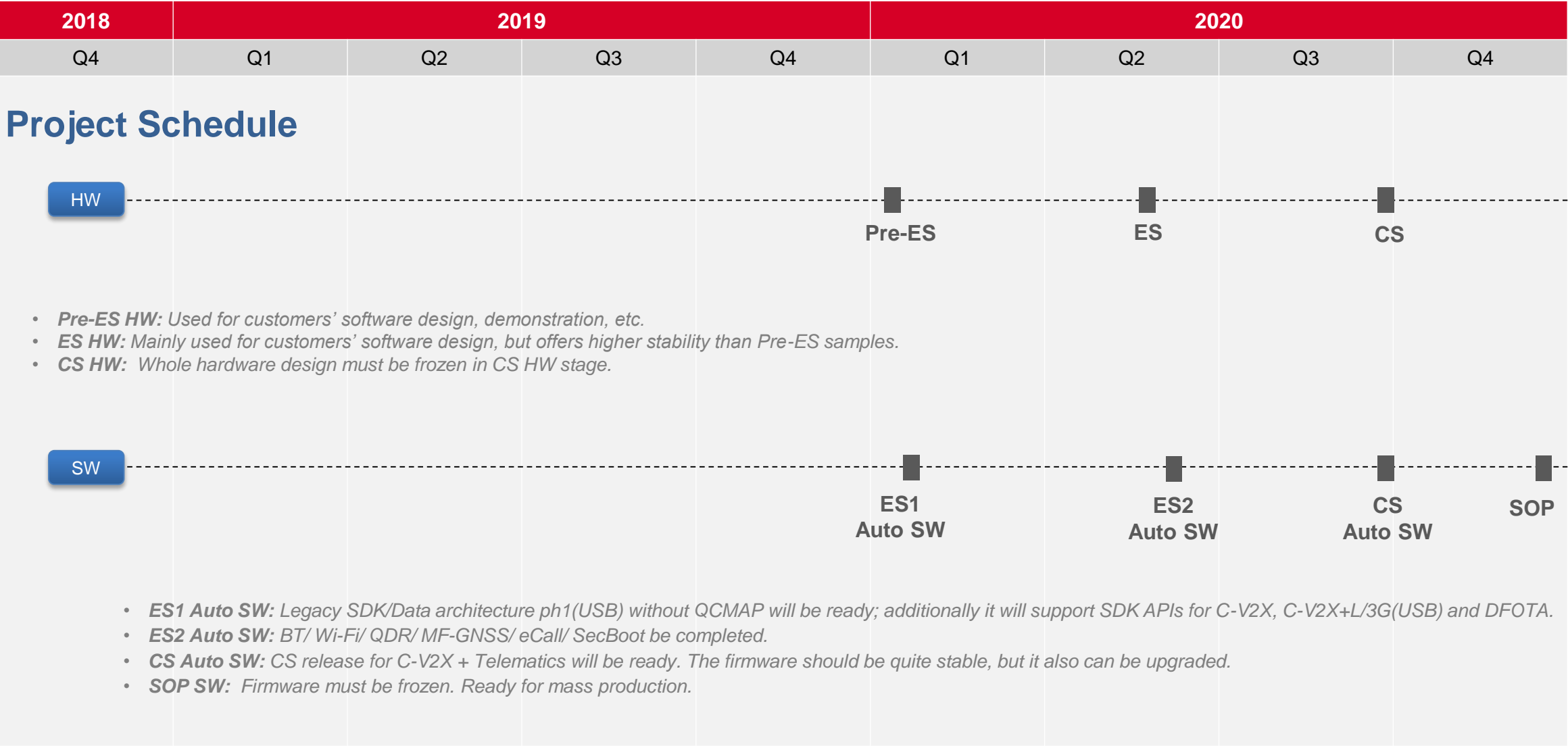
The timeline is estimated based on Qualcomm release schedule.

AG520R-JP Timeline



The timeline is estimated based on Qualcomm release schedule.

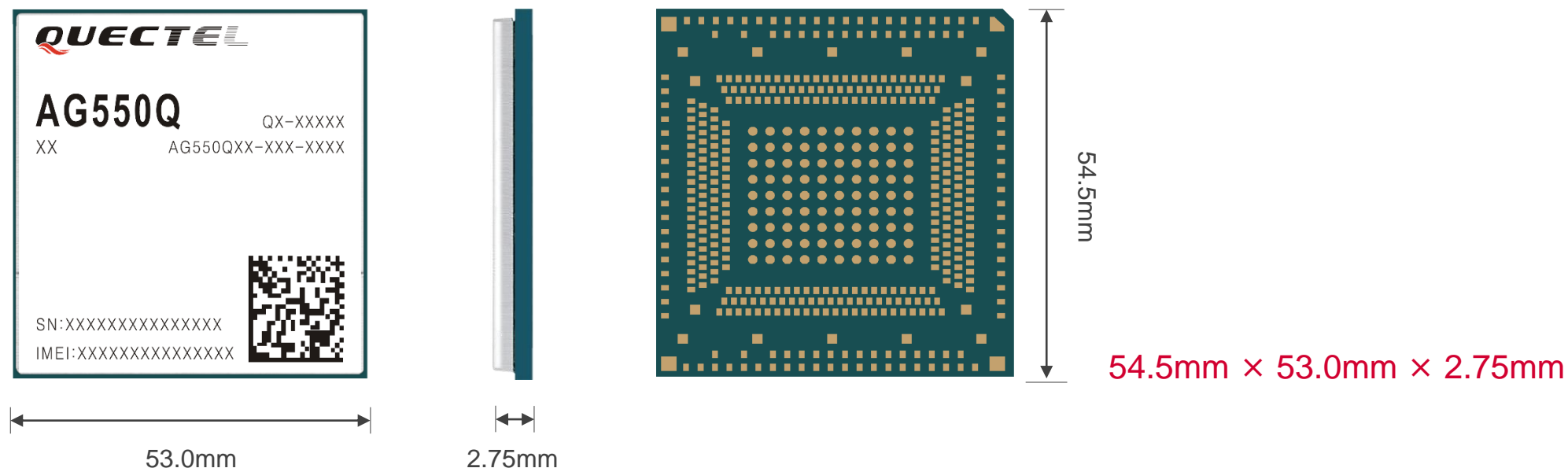
AG520R-LA Timeline (Preliminary)



The timeline is estimated based on Qualcomm release schedule.

Automotive Module AG550Q Highlights

Automotive Grade 5G Module + Optional C-V2X/ DSDA (SA515M)



- AEC-Q100 qualified Qualcomm SA515M chipset solution dedicated for automotive 5G NR and optional C-V2X applications
- Ideal for automotive applications with IATF 16949 requirement
- Wide operation temperature range (-40°C to +85°C) and support eCall under +95°C
- Automotive quality processes (PPAP, 8D, DFMEA, PFMEA...)
- Excellent EMC/ESD protection ensures great robustness even in harsh environments
- Compact SMT form factor ideal for integration in slim and size-constrained automotive solutions
- Multi-frequency GNSS receiver available for applications requiring fast and accurate fixes in any environment

AG550Q Specifications



■ Automotive Grade 5G Module + Optional C-V2X

54.5mm × 53.0mm × 2.75mm

Variant		AG550Q-CN*	AG550Q-EU*	AG550Q-NA*	AG550Q-ROW (Planning)
5G NR	5G FDD	\	n1/n3/n8/n20/n28	n2/n5/n66/n71	\
	5G TDD	n41/n78/n79	n78	n41/n78	n77/n78/n79
LTE	FDD-LTE	B1/B3/B5/B7/B8	B1/B3/B5/B7/B8/B20/B28/B32 ^①	B2/B4/B5/B7/B12/B13/B14/B17/B25/B26/B28/B29 ^① /B30/B66/B71	B1/B3/B5/B7/B8/B11/B18/B19/B20/B21/B26/B32 ^①
	TDD-LTE	B34/B38/B39/B40/B41	B38/B40/B41	B41	B38/B39/B40/B41
UMTS	WCDMA	B1/B8	B1/B3/B5/B8	B2/B4/B5	B1/B2/B3/B4/B5/B8
	TD-SCDMA	\	\	\	\
GSM		900/1800MHz	900/1800MHz	\	900/1800/MHz
C-V2X ^{Optional}		B47	B47	B47	B47
DSDA ^{Optional}		LTE	LTE	LTE	LTE
MF-GNSS ^{Optional}		L1+L2+L5	L1+L2+L5	L1+L2+L5	L1+L2+L5
Dead Reckoning ^{Optional}		QDR 3.0	QDR 3.0	QDR 3.0	QDR 3.0
PPE (RTK)		Optional	Planning	Planning	TBD
Ethernet ^{Optional}		RGMII	RGMII	RGMII	RGMII
Wi-Fi/BT Interface		Y	Y	Y	Y
Region		China	EMEA, Korea, Australia, India, Southeast Asia	North America	Latin America, Japan
Certification		TBD	TBD	TBD	TBD

^① LTE-FDD B29/B32 supports Rx Only

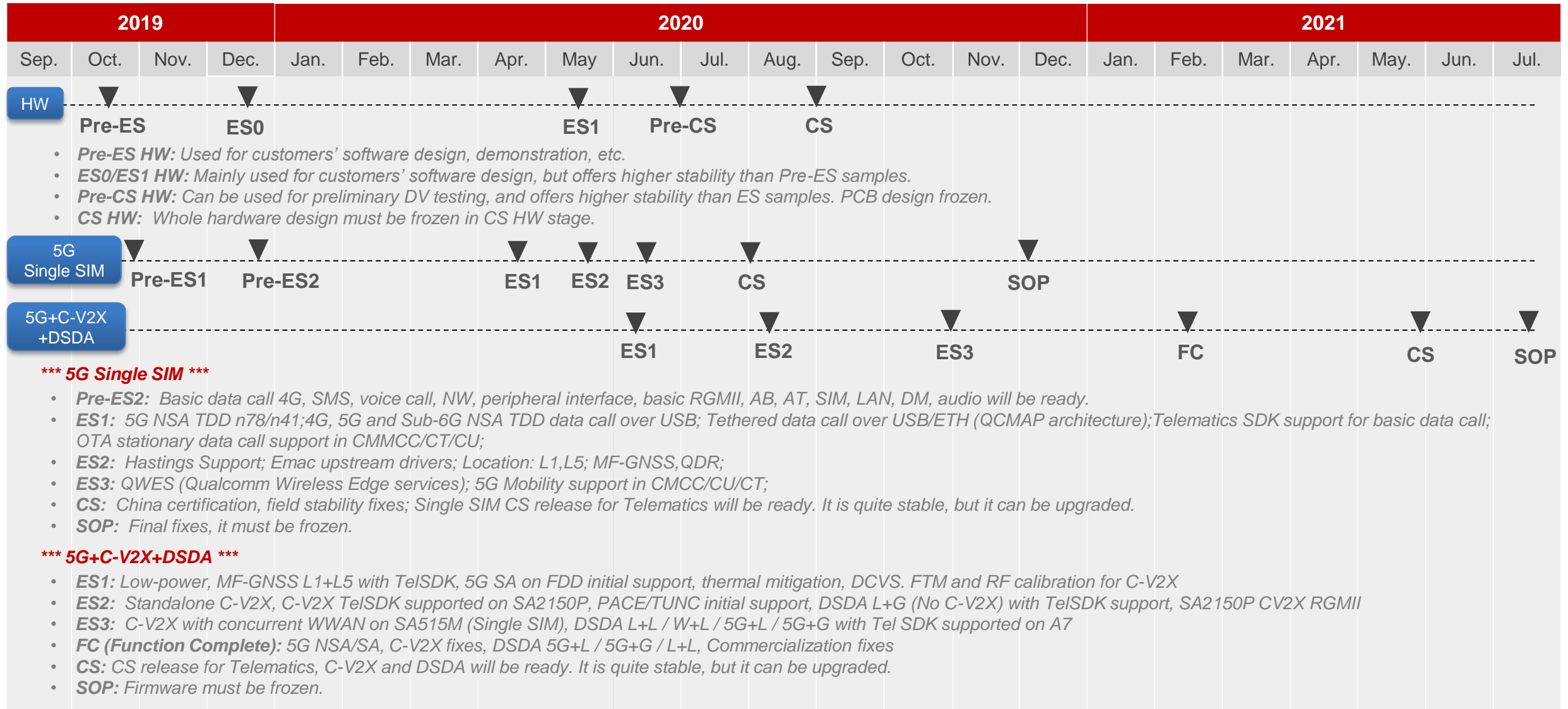
"Y" means supported.

* means under development.

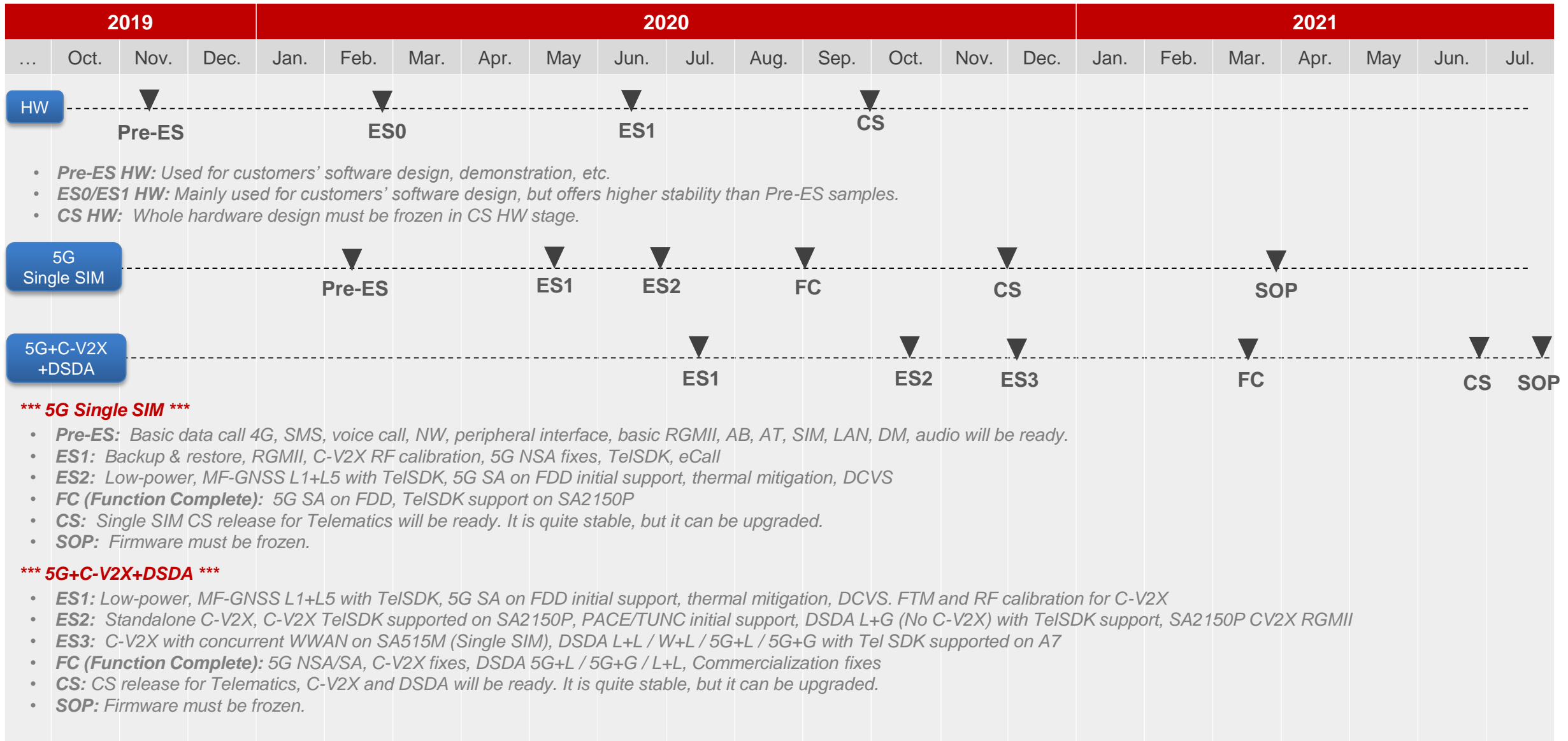
AG550Q Key Features

Features	AG550Q
5G NR	3GPP Release 15 NSA/SA operation, Sub-6G
4G Category	LTE Cat 19, 3G/2G fallback
Apps Processor	Cortex A7 at 1.5GHz; 256 KB L2
C-V2X <small>Optional</small>	PC5 Mode 4 (direct communication), uu mode
DSDA <small>Optional</small>	Dual SIM Dual Activation
Embedded GNSS	GPS/ GLONASS/ BeiDou/ Galileo Enhanced Automotive MF-GNSS (L1/L2/L5) <small>Optional</small>
QDR <small>Optional</small>	QDR3 (external IMU required)
Interface	PCIe 3.0, USB 2.0/3.1, RGMII, SDIO, SPI, I2C, I2S, UART, PCM, ADC, (U)SIM, 1PPS, GPIOs
Antenna Interfaces	<ul style="list-style-type: none"> • 4 × 5G/4G antenna interfaces (4 × 4 MIMO) • 2 × antenna interfaces for DSDA (2 × 2 MIMO) • 2 × C-V2X antenna interfaces (2 × 2 MIMO) • 1 × GNSS antenna interface
Data Speed	5G NR: Max 1.77 Gbps (DL), Max 490 Mbps (UL)
	LTE: LTE-FDD: Max 1.6 Gbps (DL), Max 150 Mbps (UL) LTE-TDD: Max 1.16 Gbps (DL), Max 45 Mbps (UL)
	UMTS: DC-HSDPA: Max 42 Mbps HSUPA: Max 5.76 Mbps WCDMA: Max 384Kbps (DL/UL)
	TD-SCDMA: Max 4.2 Mbps (DL), Max 2.2 Mbps (UL)
	GSM: EDGE: Max 296Kbps (DL), Max 236.8Kbps (UL) GPRS: Max 107Kbps (DL), Max 85.6Kbps (UL)
	C-V2X: Tx: Max 48 Mbps, Rx Max 48 Mbps

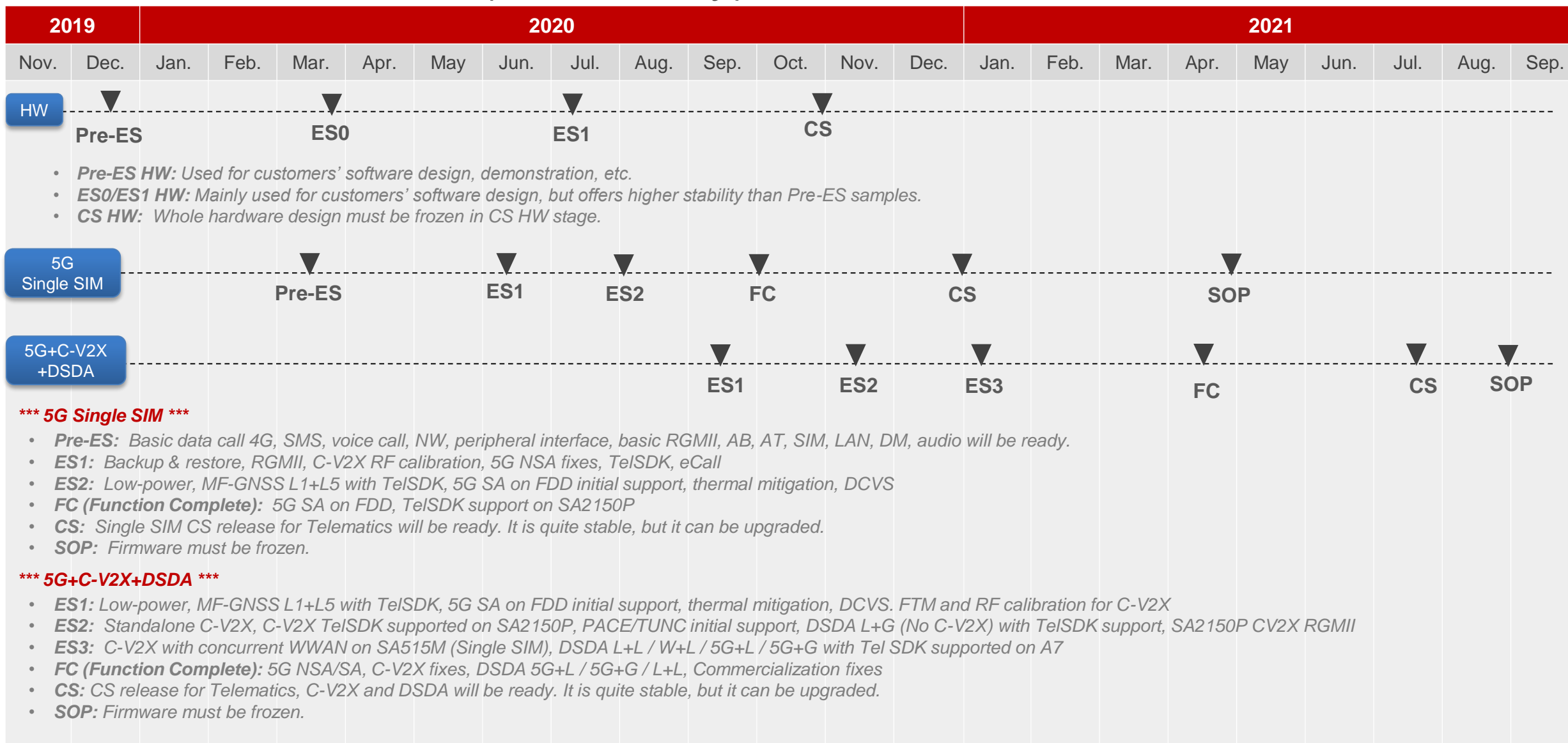
AG550Q-CN Timeline



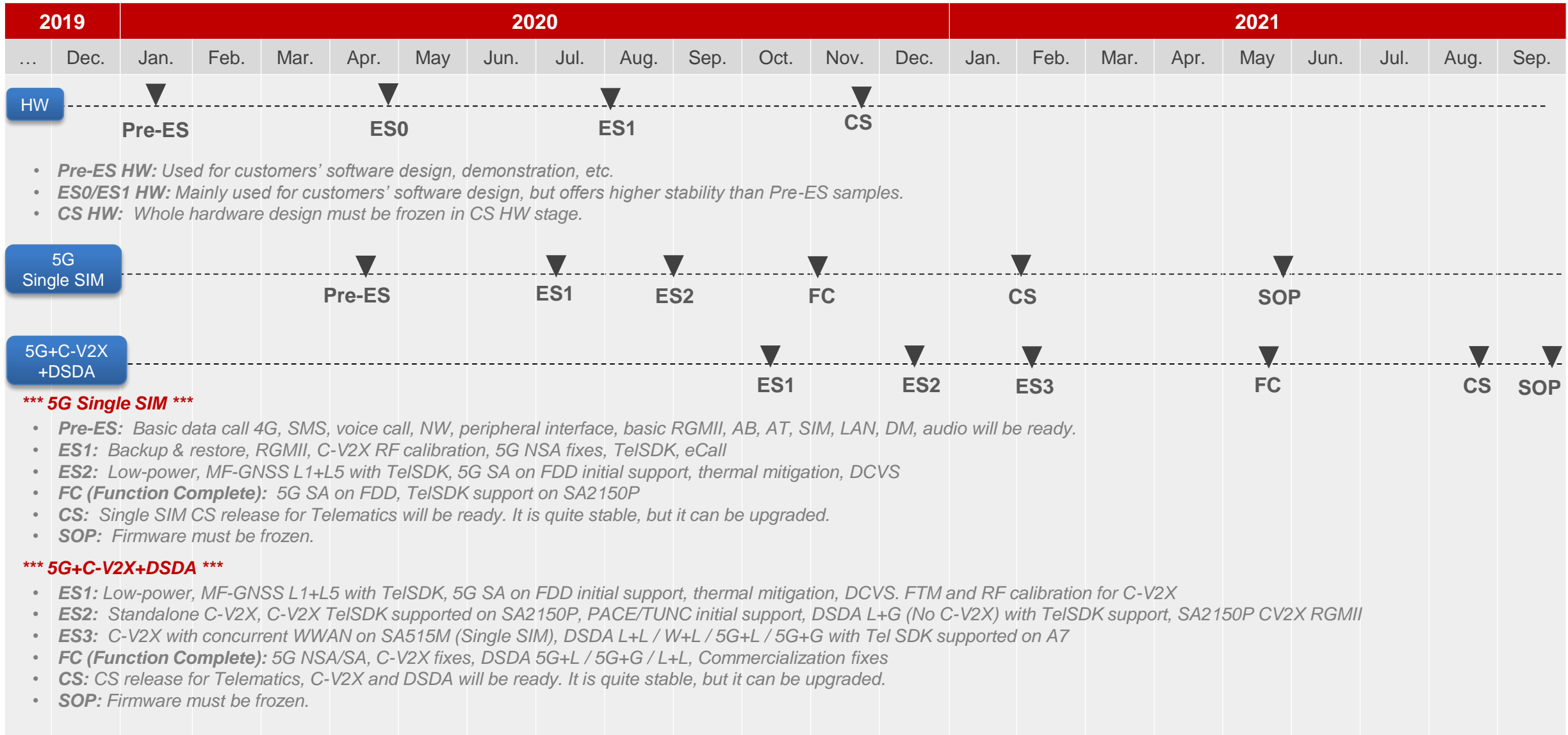
AG550Q-EU Timeline (Preliminary)



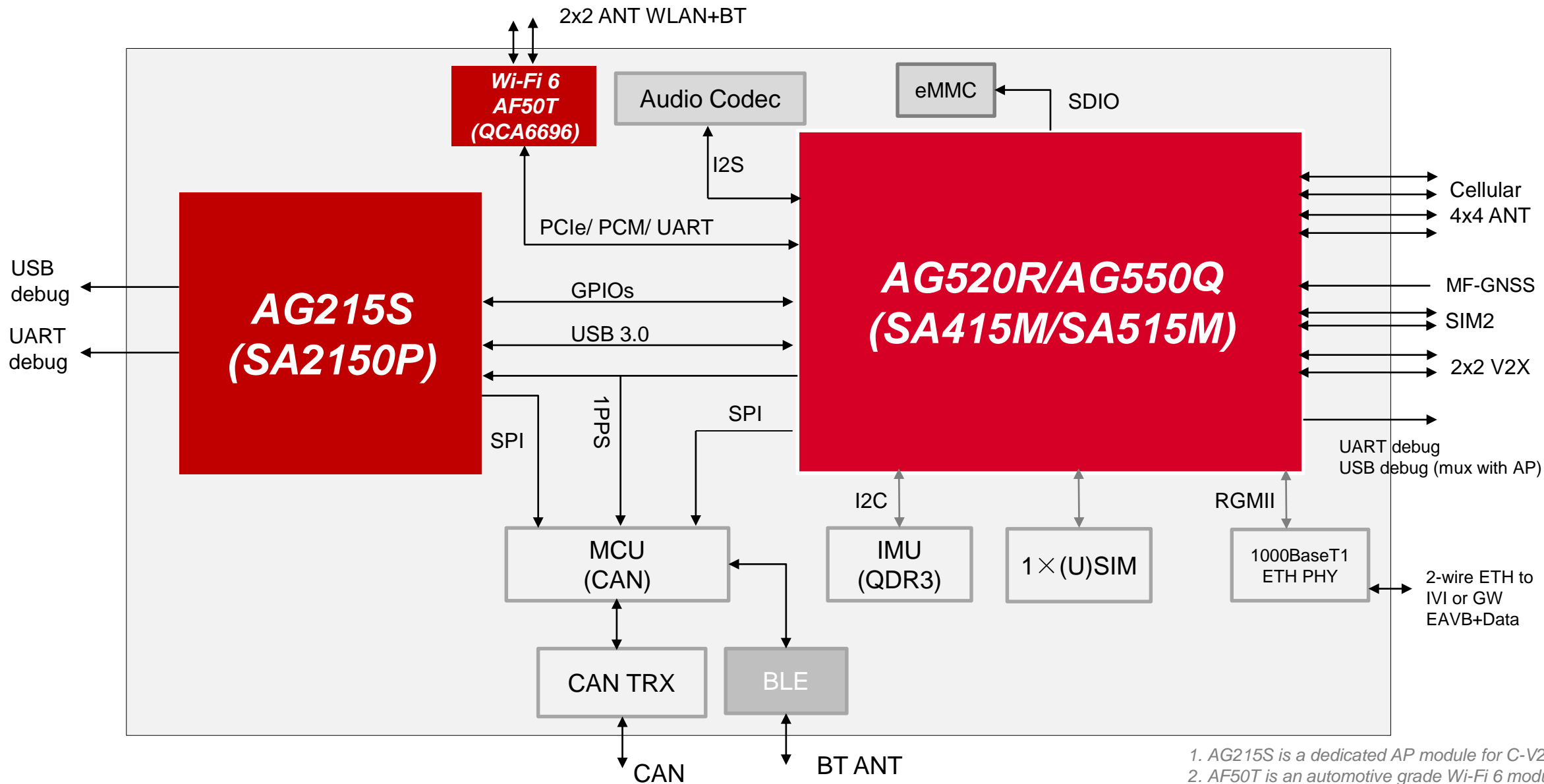
AG550Q-NA Timeline (Preliminary)



AG550Q-ROW Timeline (Preliminary)

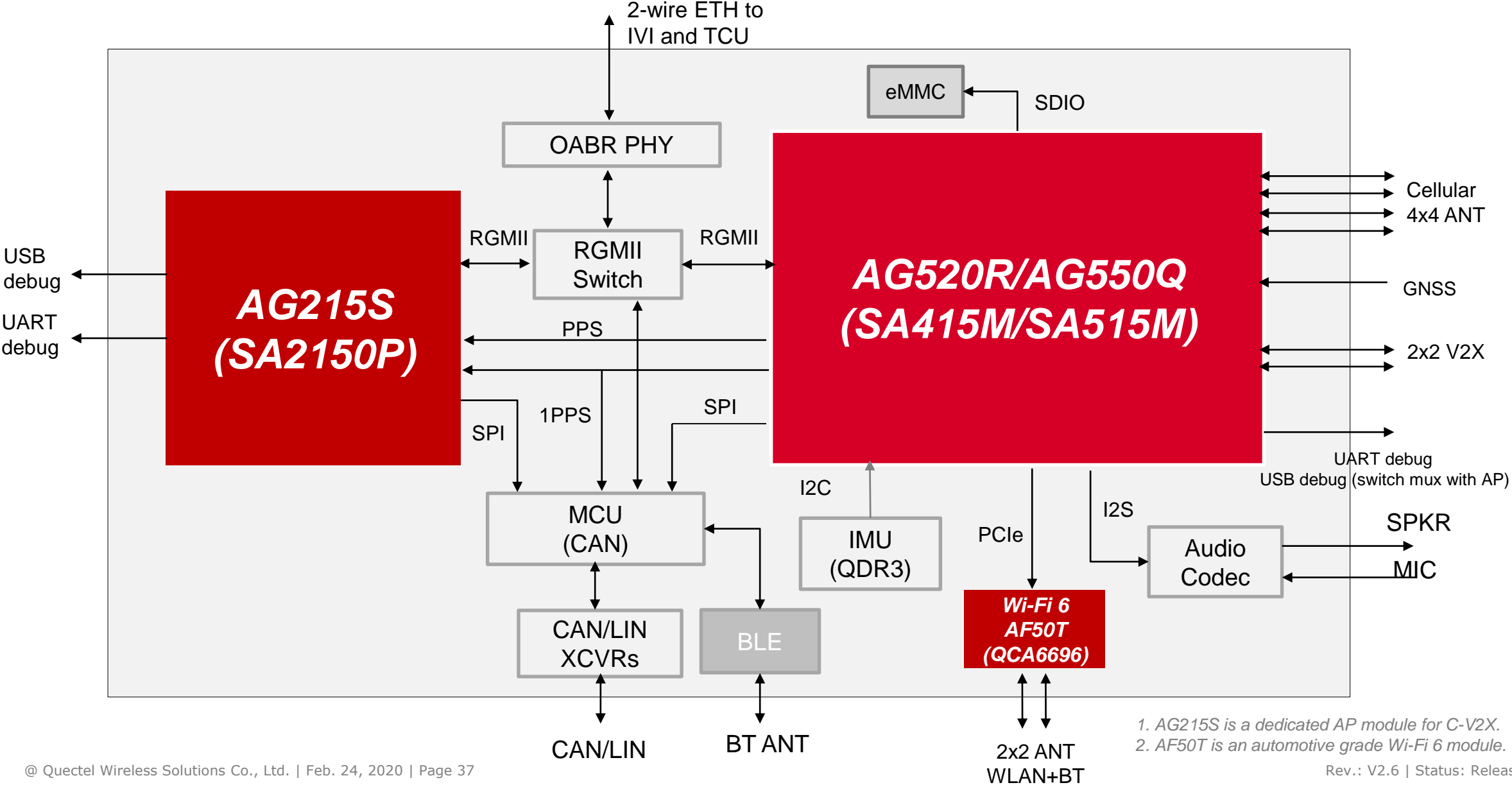


AG520R/AG550Q Application Architecture (1)



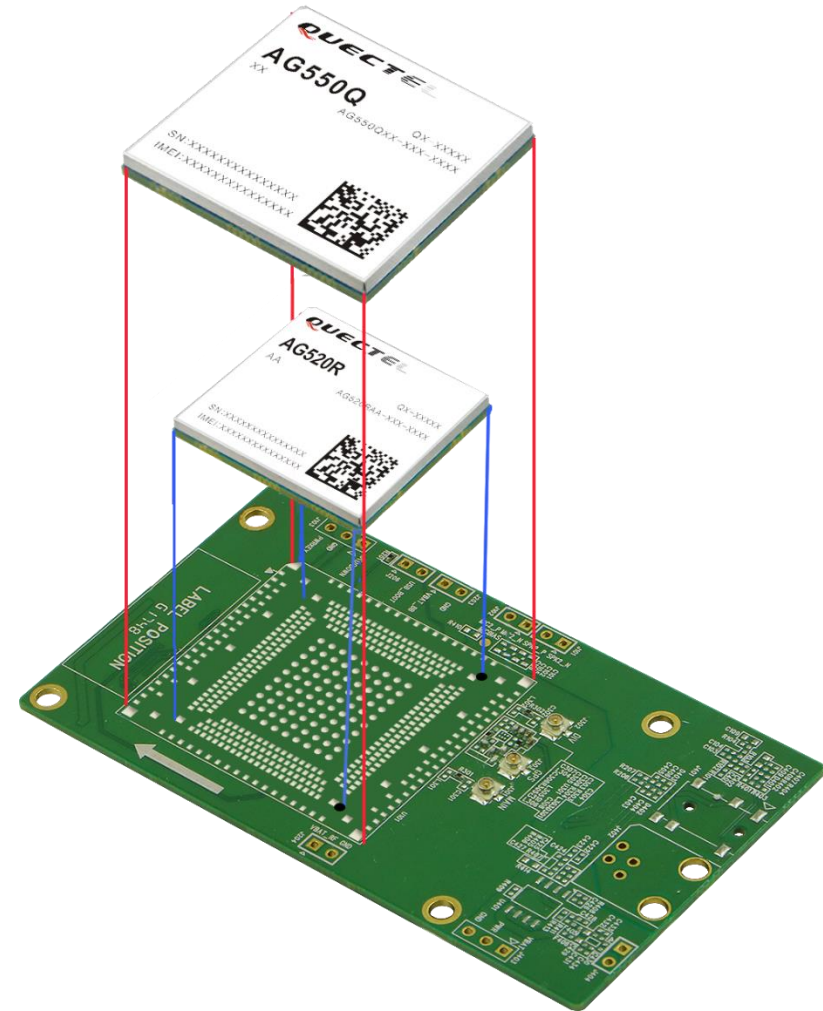
1. AG215S is a dedicated AP module for C-V2X.
2. AF50T is an automotive grade Wi-Fi 6 module.

AG520R/AG550Q Application Architecture (1)



AG550Q & AG520R Layout Compatibility

Compatible design accommodates
AG550Q and **AG520R** modules on the
same PCB footprint.



*The compatibility diagram shown above is for illustration purpose only.
The actual label design may be different.*

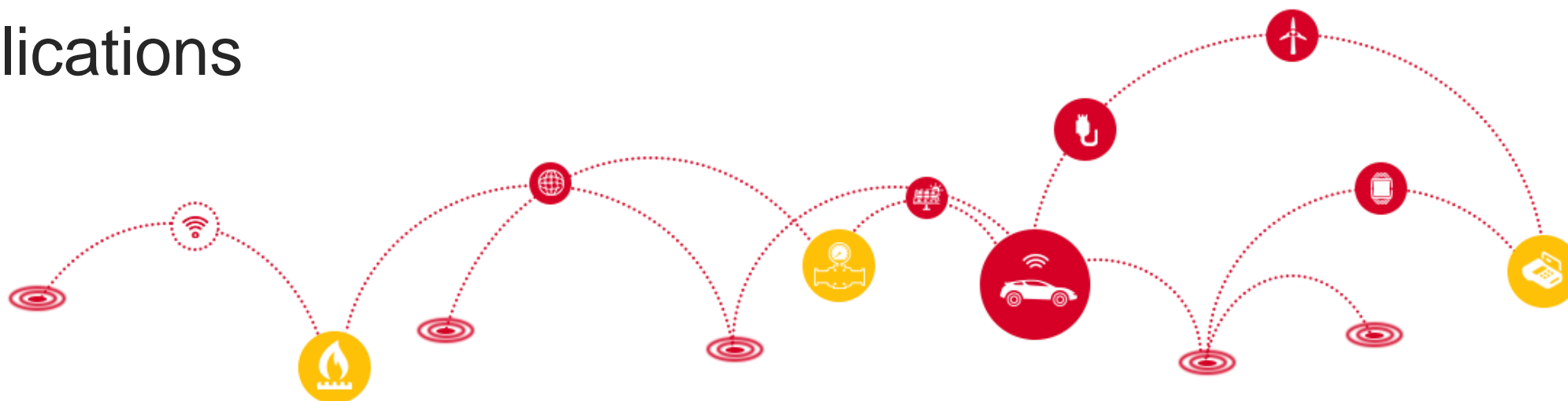
Roadmap

Product Overview

C-V2X Introduction

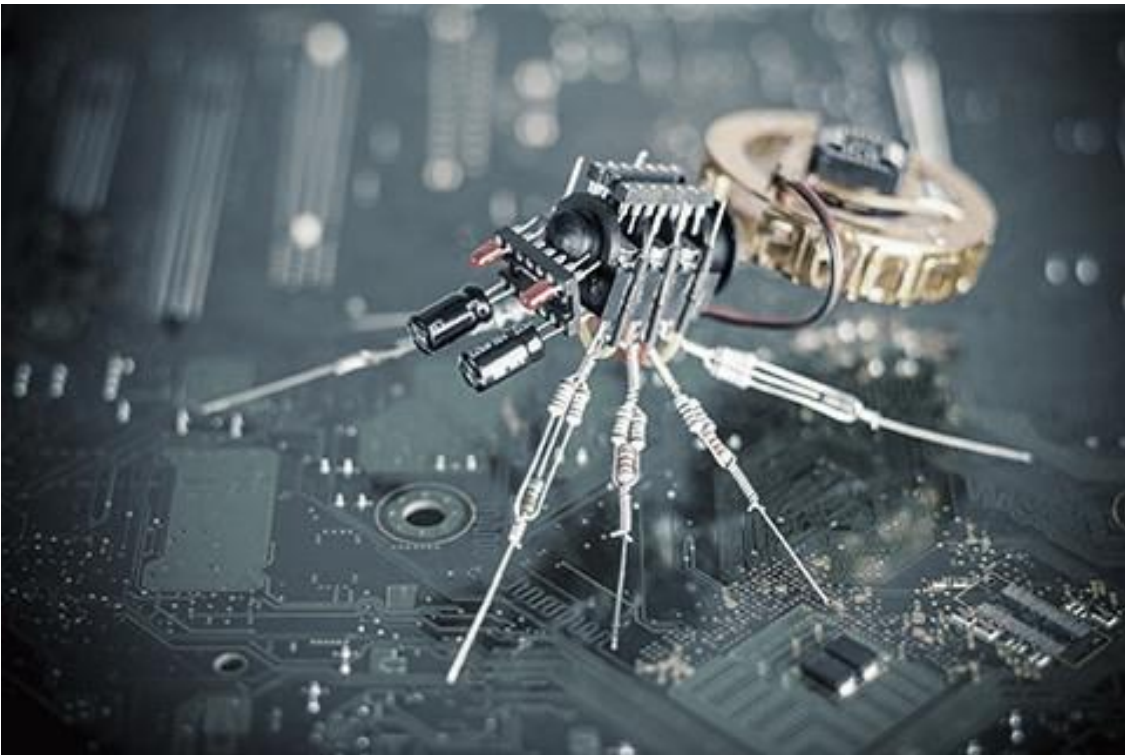
Enhanced Technologies

Applications



New Technology - LTE-V2X

LTE-V2X for Future Autonomous Driving



Continuous V2X Technology Evolution

- Careful spectrum planning to support continuous V2X technology evolution shown as below
- Evolution to 5G, while maintaining good backward compatibility

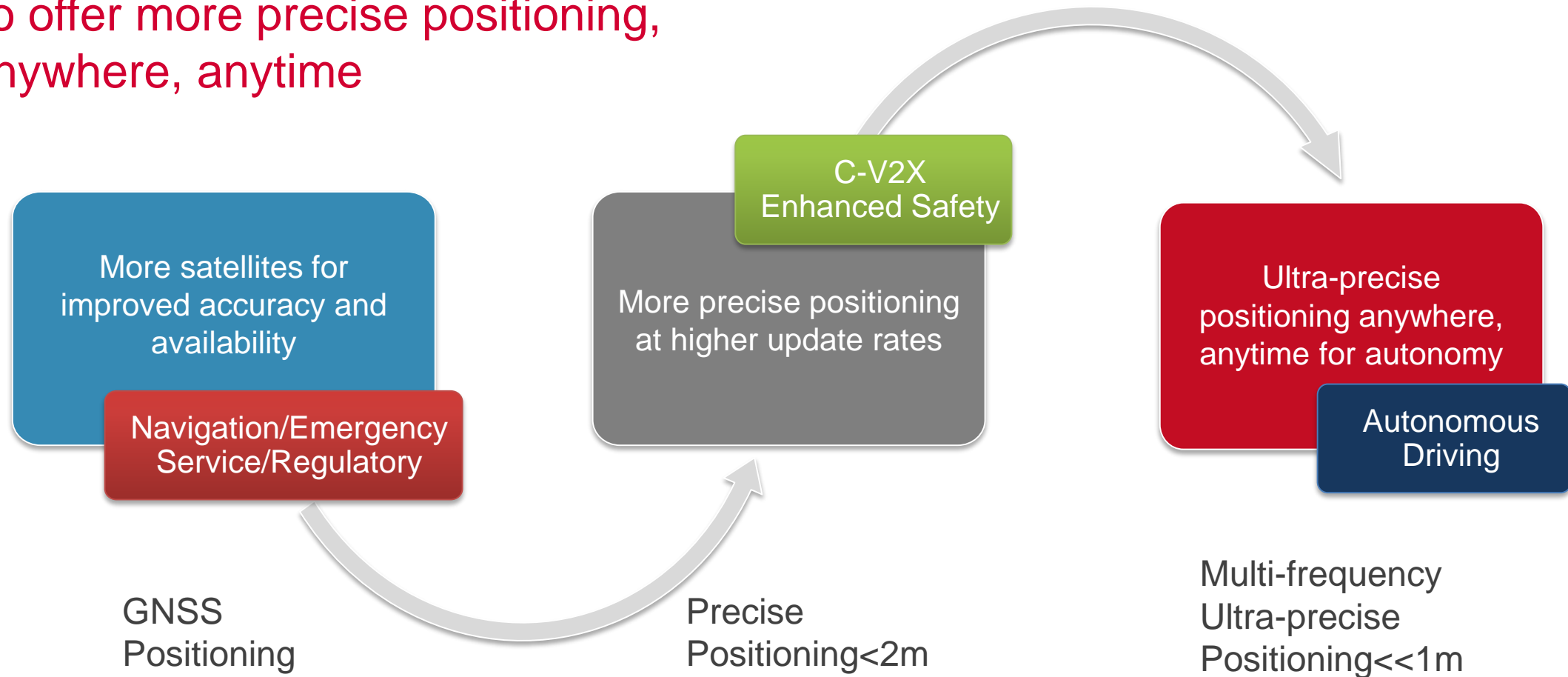


C-V2X is a critical component for safer autonomous driving, communicating intent and sensor data even in challenging real world conditions.

- Non line-of-sight sensing
- Conveying intent
- Situational awareness

Evolving Positioning Technologies for C-V2X

To offer more precise positioning,
anywhere, anytime



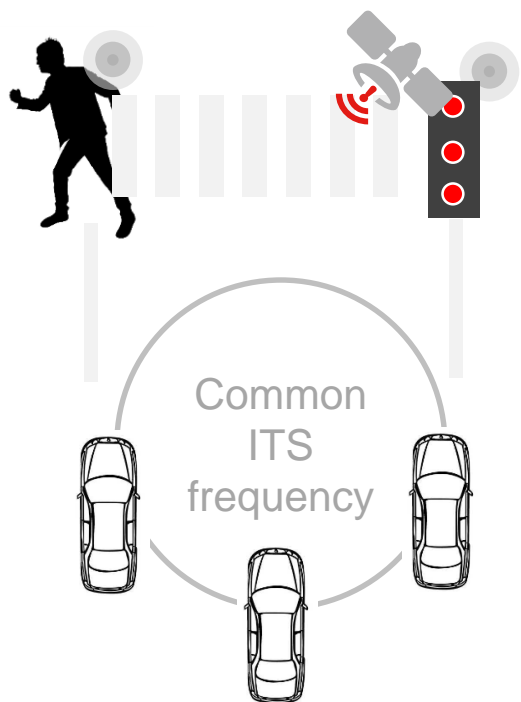
C-V2X's Key Advantages in Multiple Dimensions



C-V2X Supports Direct Communications

V2X/V2I/V2P direct communications can be self managed

PC5 Interface Mode 4: Self Managed (without cellular network assistance)

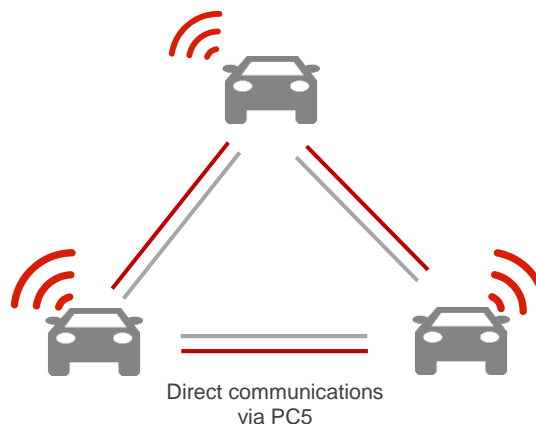


Direct communications
via PC5 interface on 5.9GHz

- USIM-less operation
- Autonomous resource selection
- GNSS time synchronization

PC5 Mode 4

Direct communications, no network assistance



Reduced Cost

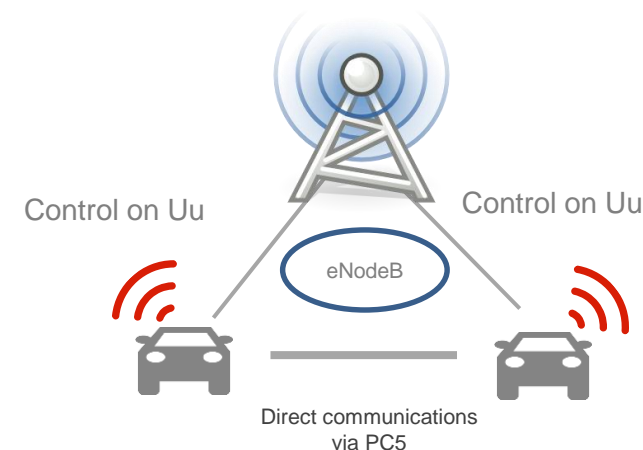
Does not use prime licensed spectrum for control, no additional network investment

Increased Reliability

Does not rely on network coverage , does not suffer from service interruption during handover

PC5 Mode 3

Network communications, network-assisted



Reduced Complexity

Does not rely on coordination between operators for resource assignment, does not require subscription

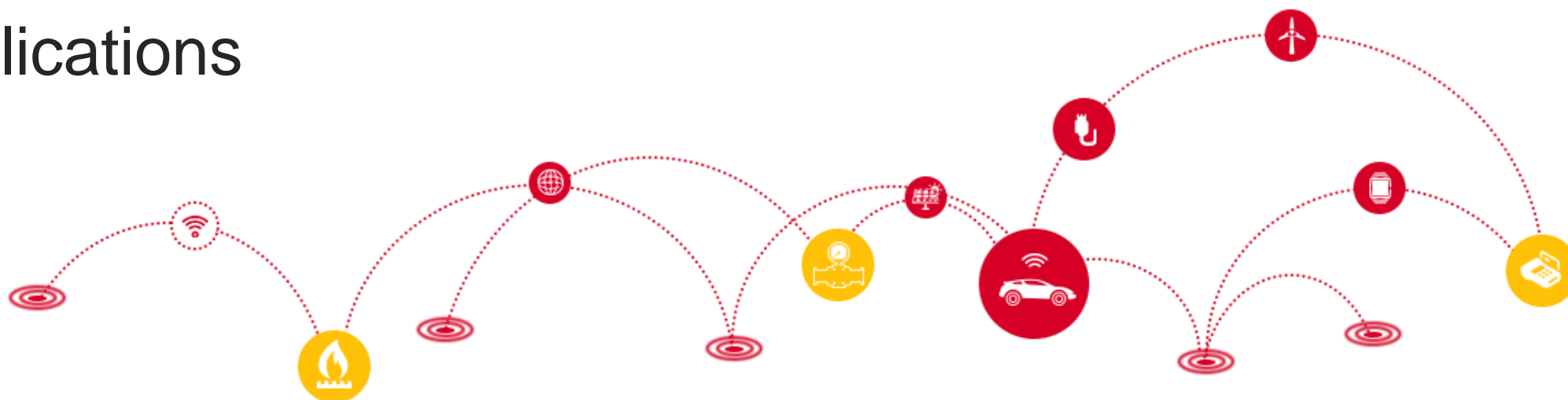
Roadmap

Product Overview

C-V2X Introduction

Enhanced Technologies

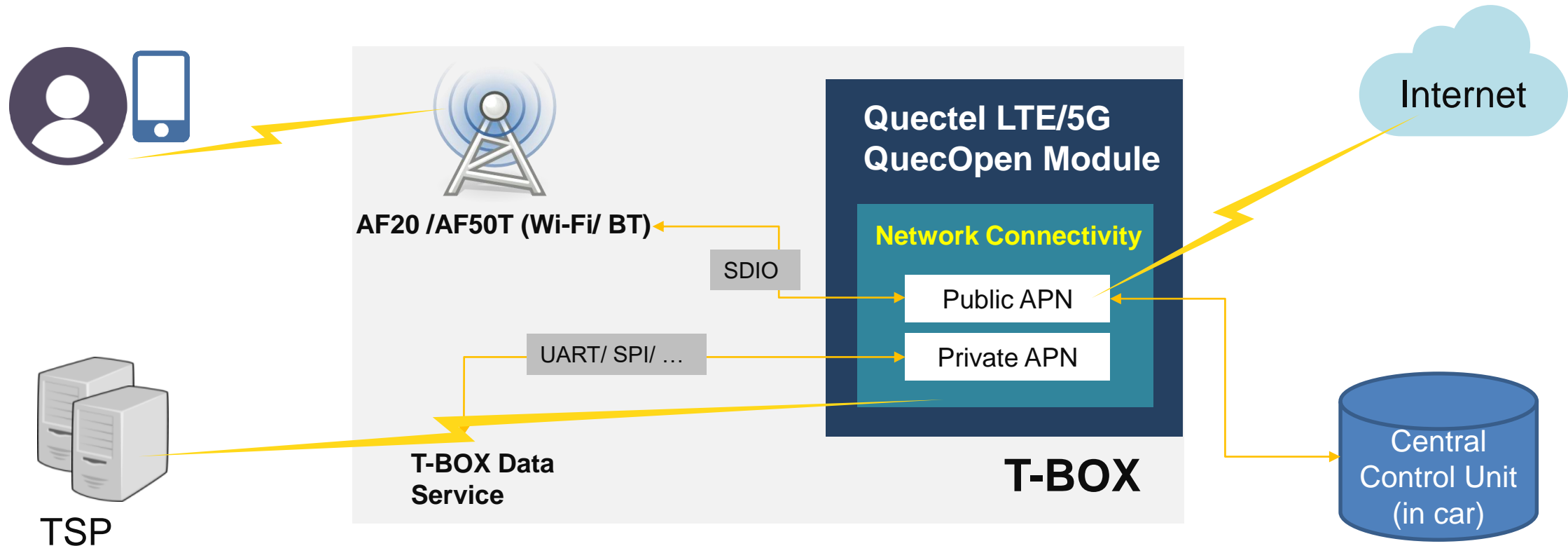
Applications



On-board Technical Characteristics



Multi-APN Solution



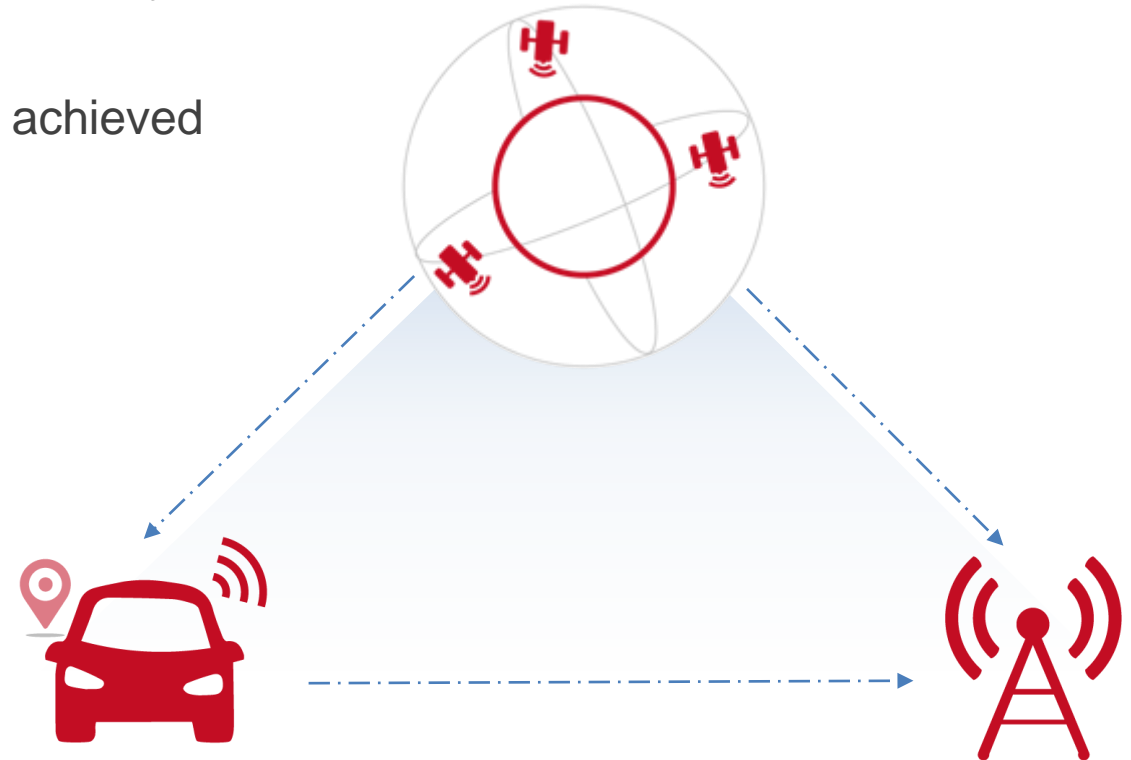
- Users can get in-car infotainment and Wi-Fi access via the public APN.
- TSP is able to communicate with vehicles via the private APN, which can ensure the data that car OEM gets safer and more reliable.
- Maximally 8 APNs are supported now.

Multi-Frequency GNSS

By simultaneously tracking all global navigation satellite systems (GNSS) and receiving **two frequencies** from each satellite system to meet car-level positioning accuracy.

Precise positioning and fast convergence time can be achieved globally.

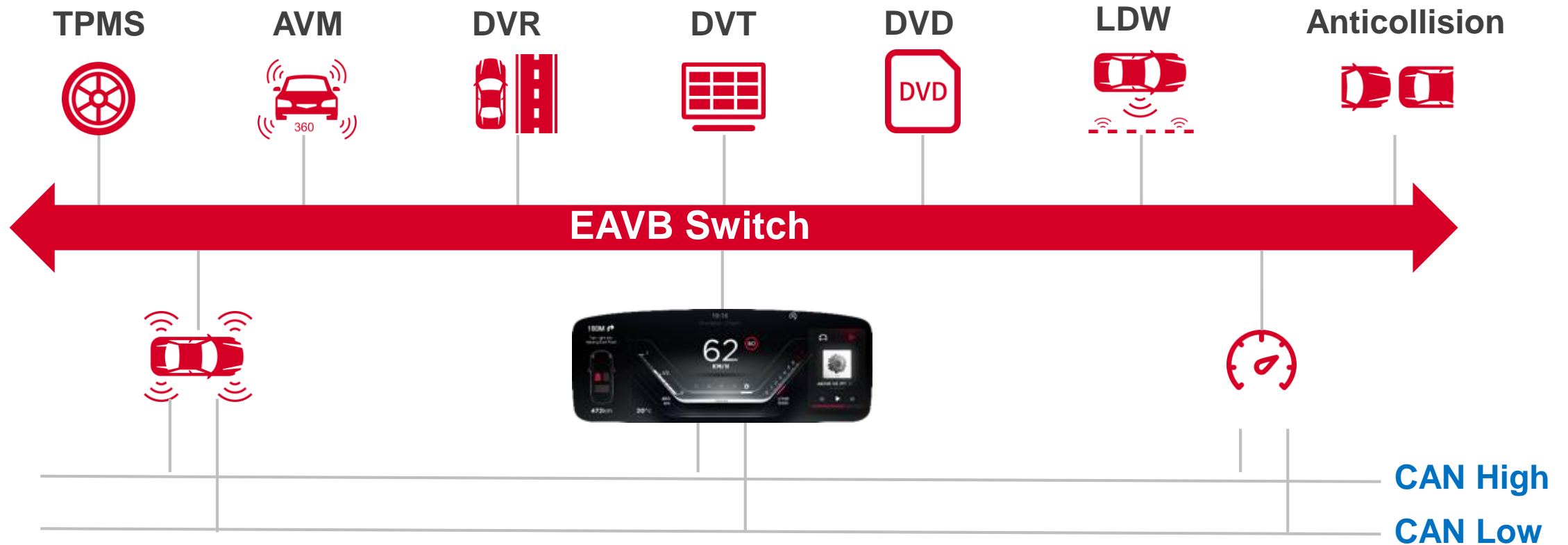
- Multipath signals L1/L5
- Higher chipping rate
- Direct measurement of the Ionospheric delay
- Increased robustness
- Integer resolution for PPP



Estimated Multi-GNSS Performance

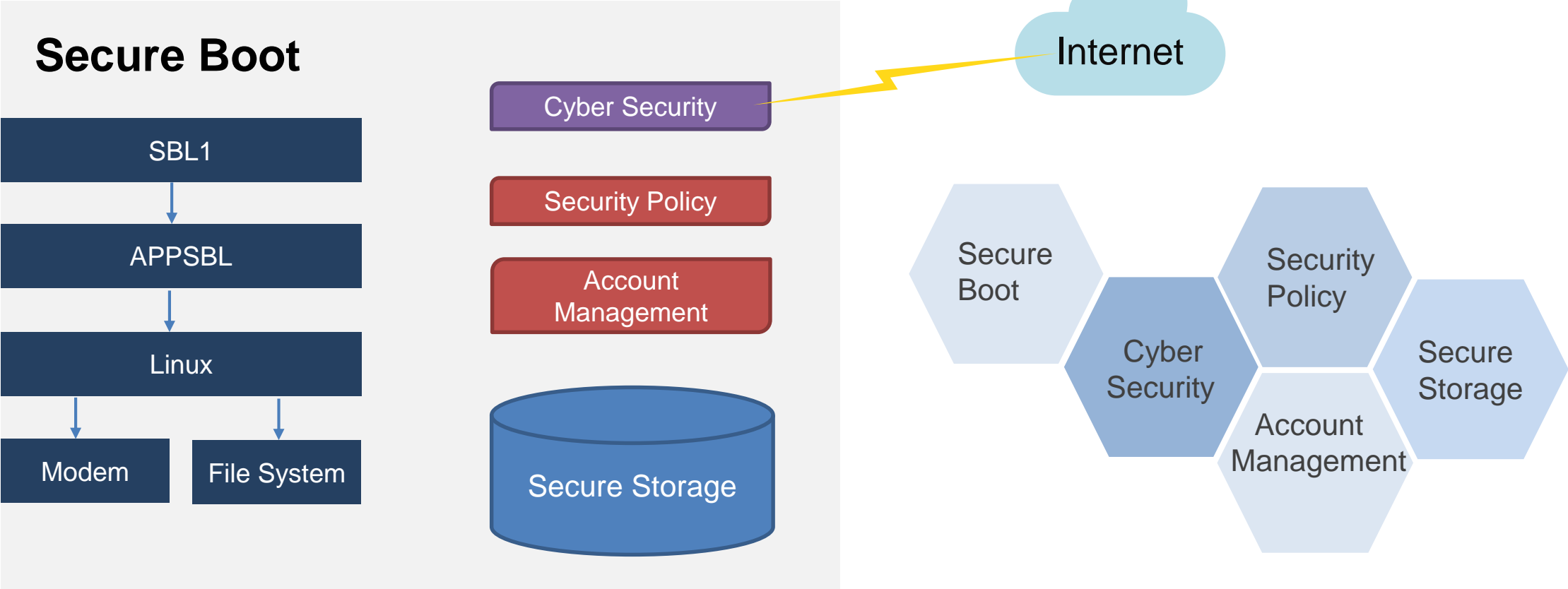
SN.	GNSS Performance Metric	L1 GNSS	L1+L5 GNSS	Remark
1	2D positioning error (50%, 68%, 95%)	<2m, <2.5m, <5m	<1.2m, <1.5m, <3m	Under open sky conditions, standalone
2	Altitude accuracy (50%, 68%, 95%)	<2.5m, <3m, <6m	<2m, <2.5m, <5m	
3	The 2D positioning error in meters (50%, 68%, 95%)	<1m, <1.5m, <3m	<0.9m, <1.1m, <2.2m	Under open sky conditions, standalone with SBAS
4	Altitude accuracy (50%, 68%, 95%)	<2m, <2.5m, <5m	<1.6m, <2m, <4m	Under open sky conditions, SBAS
5	Speed accuracy (68%, 95%)	0.15m/s, 0.3m/s	0.15m/s, 0.3m/s	Straight line driving at 30m/s
6	Heading accuracy (68%, 95%)	0.2deg, 0.5deg	0.2deg, 0.5deg	
7	Vertical speed accuracy (68%, 95%)	0.23m/s, 0.45m/s	0.23m/s, 0.45m/s	
8	RTK 2D positioning error in centimeters (50%, 68%, 95%)	<1cm, <1.2cm, <2.5cm	<1cm, <1.2cm, <2.5cm	Open sky, static environment. Based on Qualcomm GNSS receiver capabilities assuming <1 km short base line RTK, choke ring type precision navigation grade antenna in perfect no interference environment.
9	RTK altitude accuracy (50%, 68%, 95%)	<2cm, <2.5cm, <5cm	<2cm, <2.5cm, <5cm	
10	RTK Heading Accuracy(68%, 95%)	0.05deg, 0.1deg	0.05deg, 0.1deg	

Ethernet AVB (Audio Video Bridging)



Ethernet AVB (Ethernet Audio/Video Bridging), based on IEEE 802 standard, provides perfect quality of service through guaranteeing bandwidth, limiting latency and accurate time synchronization on the basis of traditional Ethernet network, so as to support various audio and video network multimedia applications.

Security Solution



QuecOpen® Software Architecture

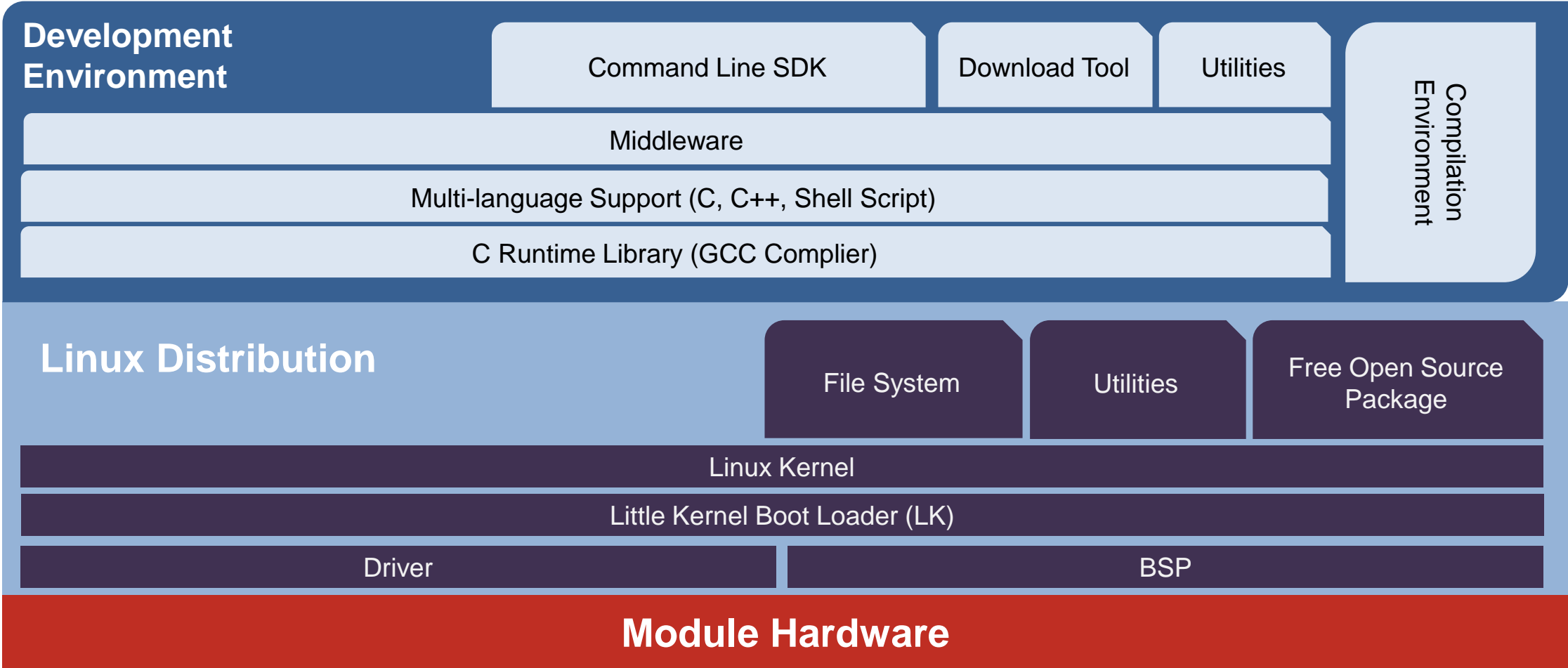
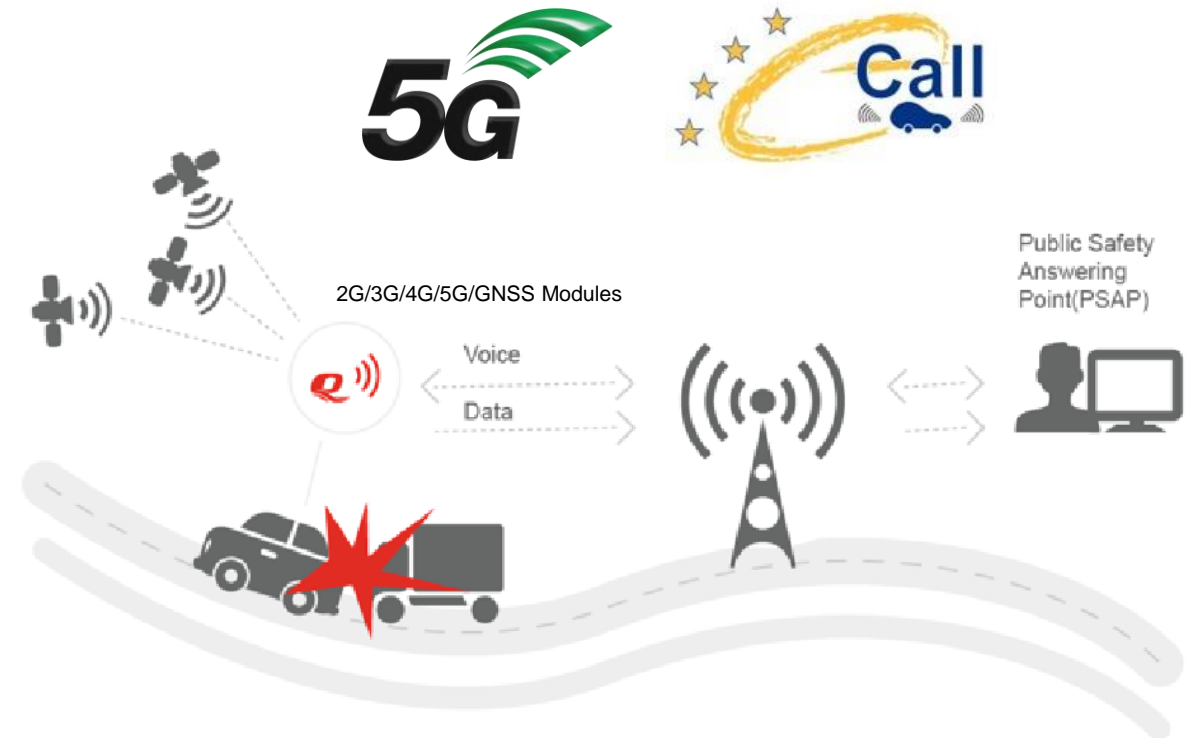


Figure: Framework of QuecOpen®

eCall

eCall Function

A car will have an electronic safety system automatically call emergency services in case of a serious accident. Even if the driver is unconscious, the system will inform rescue workers of the crash site's exact whereabouts, and the rescues will be on its way within minutes. The system is named as "**eCall**".



- Quectel supports eCall in 2G/3G/4G/5G/GNSS modules and has been working on eCall since late 2011.
- Quectel has enough development experience on eCall to support and assist customers with eCall application development.

DR Function

Quectel AG35 module supports Qualcomm DR Technology

Support Bosch 6-axis inertial MEMS sensor:

- Industrial sensor: BMI160
- Automotive sensor: SMI130

Support STMicroelectronics 6-axis gyroscope:

- Automotive sensor: ASM330

Support InvenSense 6-axis gyroscope:

- Automotive sensor: IAM-20680

Condition	2D DR Position Drift	
2D DR position drift (straight road tunnel, Minimum 1km length)	2D position error in distance (50%)	~0.6m @1km
	2D position error in distance (95%)	~1m @1km
	2D position error in distance as % of distance travelled (50%)	< 0.6%
	2D position error in distance as % of distance travelled (95%)	< 1%

 DR Positioning

 GNSS Positioning

Multi-level Building



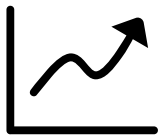
Underground Parking Lot



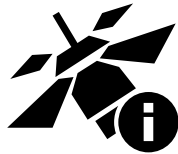
RTK Positioning Technology

Integrating Qualcomm DR technology and Qianxun RTK positioning technique,
Quectel AG35 module gets <1m positioning accuracy.

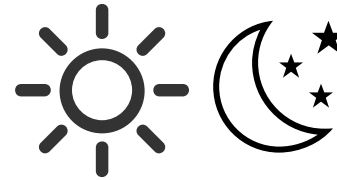
Qianxun RTK Advantages:



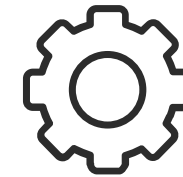
High efficiency



High positioning accuracy and no
error accumulation



All-day operation



Automation and high
integration level

Item	Accuracy	Definition
Fixed Solutions		
Horizontal Positioning Accuracy	< 10cm	2D position accuracy of ambiguity-fixed solutions (CEP95)
Float Solutions		
Horizontal Positioning Accuracy	< 100cm	2D position accuracy of ambiguity float solutions (CEP95)



RTK: Real-Time Kinematic

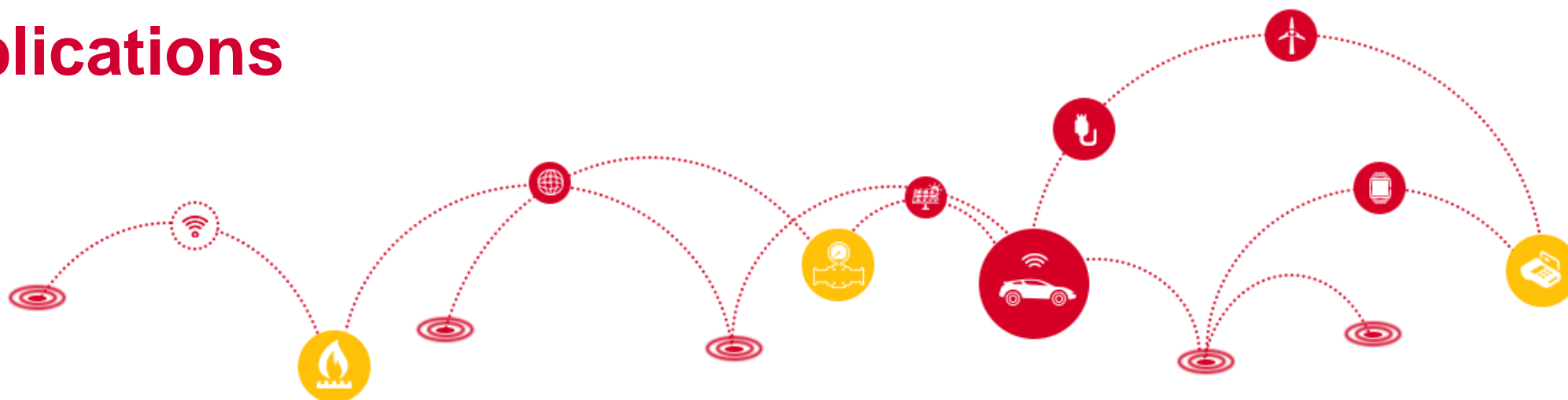
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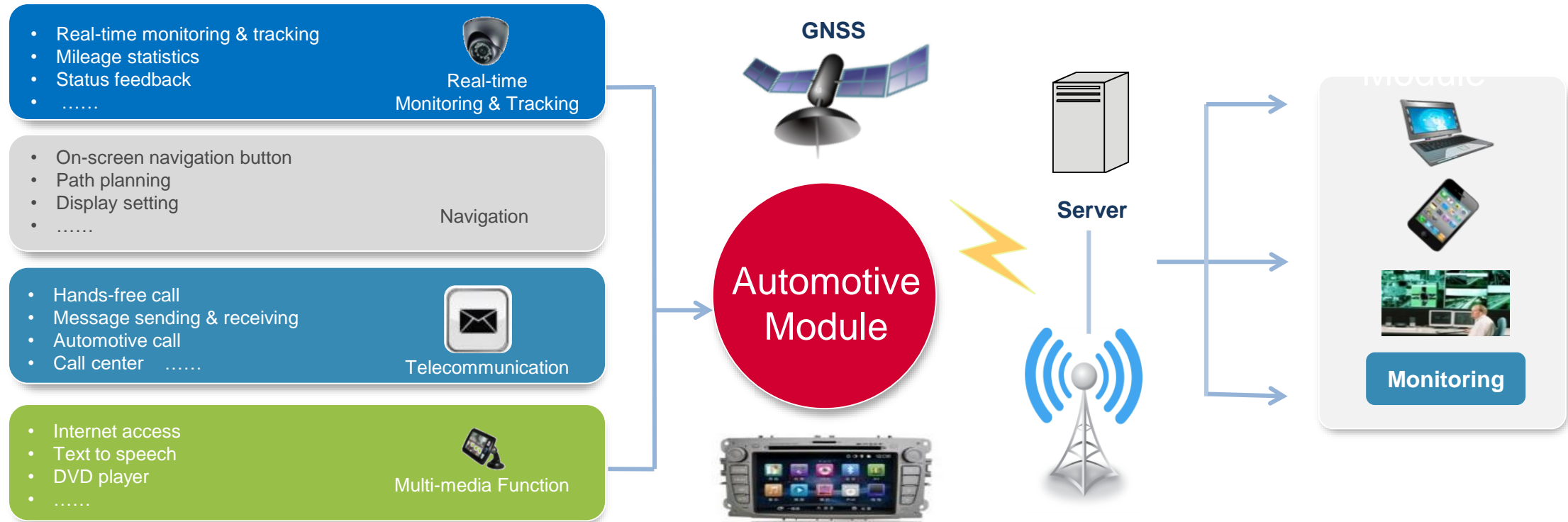
Enhanced Technologies

Applications



GNSS-based Autonomous Navigation System

- GNSS-based autonomous navigation system + monitoring center + wireless communication + Internet
- Based on M2M module, it combines geographical information system with automotive voice-assisted navigation technology to implement the perfect integration of the on-board wireless communication with autonomous navigation system.



T-BOX



T-Box is a standard terminal for the connected car, providing diversified online applications like vehicle remote monitoring, remote control, safety monitoring and alarming, and remote diagnosis by means of 4G/5G remote wireless communication, GNSS satellite positioning, acceleration sensing and CAN communication functions.

T-BOX transmits the vehicle information and position information to the TSP Center via the built-in module. The TSP Center can track the status of vehicles and provide relevant services accordingly.

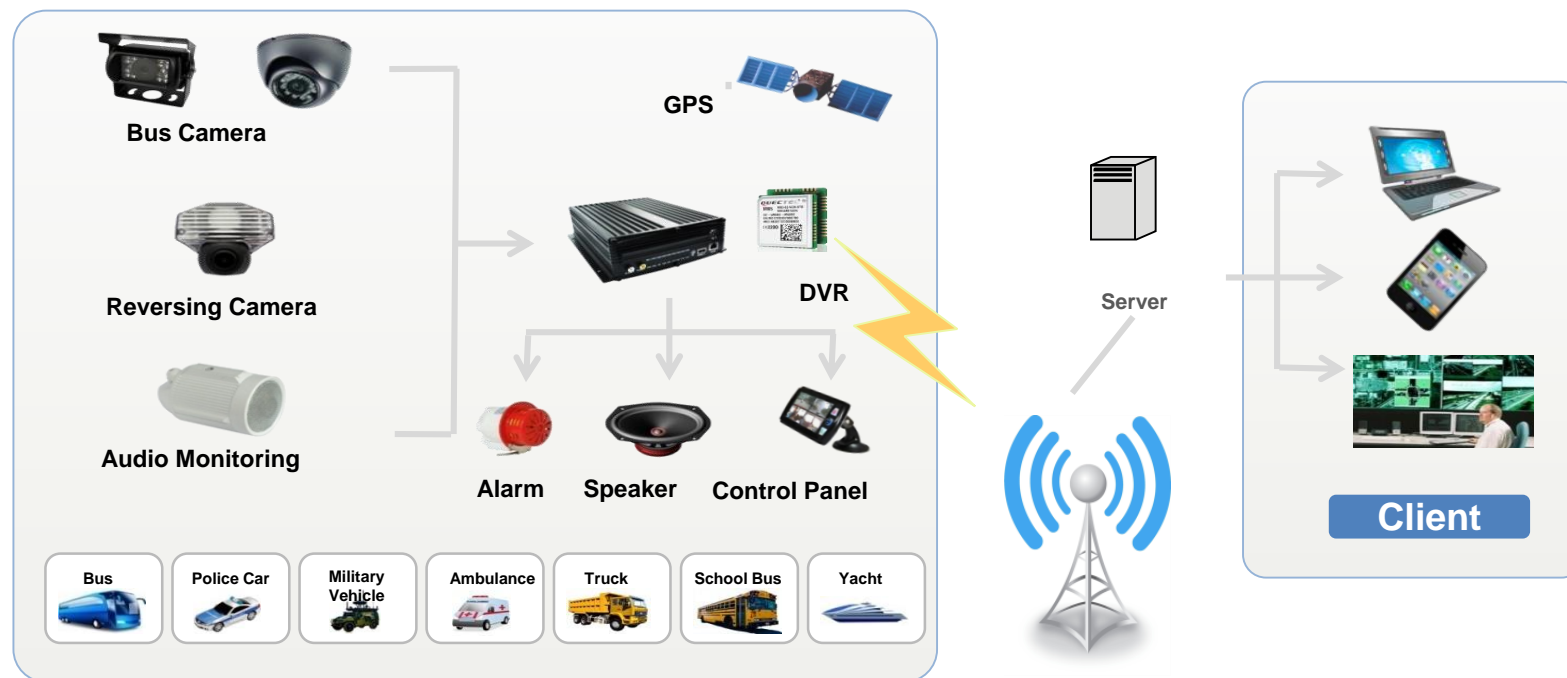
- Windows and air conditioner control
- Vehicle health alerts
- Unsafe driving alerts & reports
- Remote automatic vehicle diagnostic



4G DVR



- Real-time video and audio monitoring
- Track and record vehicle movement including speed, position, temperature, brake, reverse, turn, alarm, etc.
- Remote communication with driver by intercom, broadcasting, and text message
- Video playback
- Remote alarm



OBD



On-board diagnostics (OBD) refers to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle subsystems.

- Self-diagnostic and reporting features
- Integrated GSM/GPRS and/or Bluetooth, GPS+BeiDou.
- Supports CAN and OBD II protocols
- Data can be stored on remote servers
- Provides real-time data for drivers or maintenance technicians to rapidly identify and remedy malfunctions within vehicles



4G/5G In-car Wi-Fi



In-car Wi-Fi refers to Internet service provided in a car. Internet access can be provided by tethering a mobile phone, or with a mobile hotspot, whether portable or built into the car.

- Stay connected to everything while on the road
- Access your music, apps, social media – everything needed to keep in touch

Fast and
reliable
connection

Stream
movies and
TV on the go

4G/5G In-car Wi-Fi



Easy
access to
multi-media

Real-time
data
transmission



Intelligent BOX

Intelligent BOX not only provides the functionalities related with telematics, but also C-V2X functionalities including V2V/ V2I/ V2P.

Telematics functionalities:

- Windows and air conditioner control
- Obtain real-time traffic, road and pedestrian information
- Vehicle health alerts
- Unsafe driving alerts & reports
- Remote automatic vehicle diagnostic

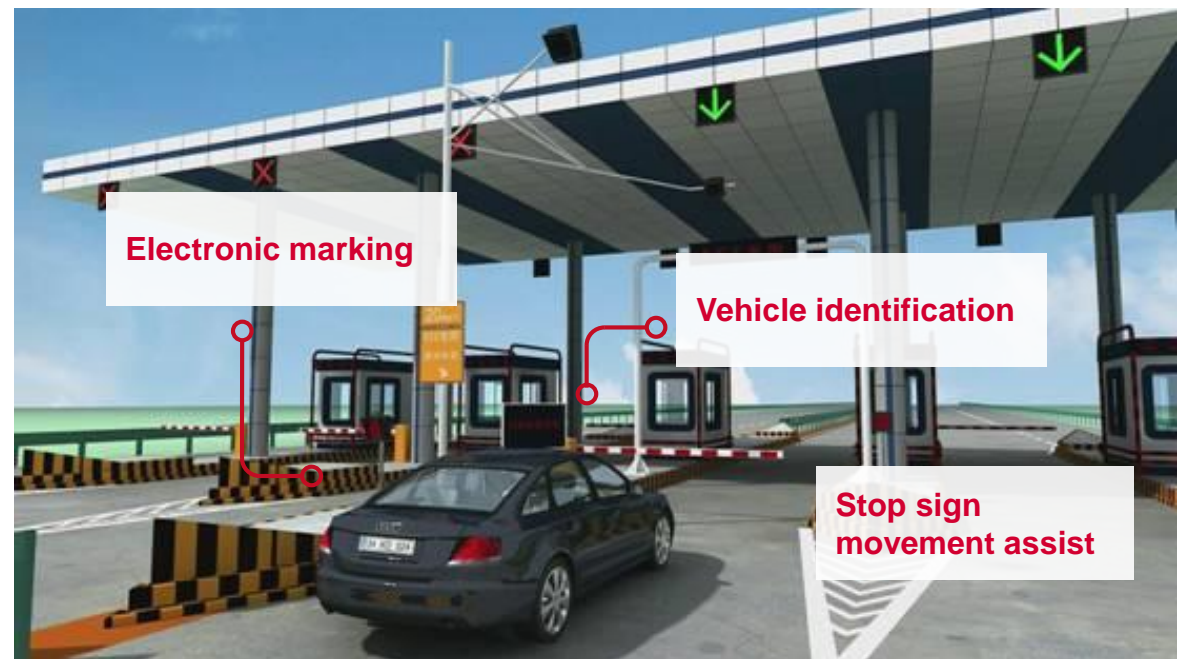
C-V2X functionalities:

- V2V/ V2I/ V2P



RSU

- RSU, which literally means Road Side Unit, is installed on the Road Side in traffic light system, ETC systems, etc. and it uses **C-V2X** technology to communicate with **OBU (On Board Unit)** inside vehicles.
- When an accident occurs, wireless technologies enable vehicles to share warning messages with other vehicles by using **vehicle to vehicle (V2V)** communications, and with the emergency services by using **vehicle to infrastructure (V2I)** communications. Regarding vehicle to infrastructure communications, RSU acts similarly to wireless LAN access points, and can provide communications with the infrastructure.



Thank you!

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