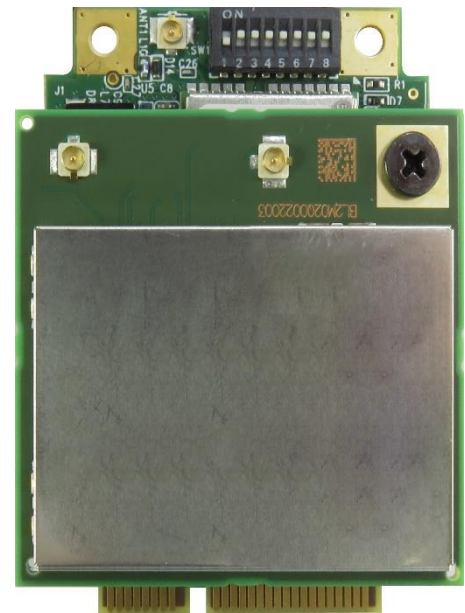




# SOM-351U

## Information Sheet

C-V2X mPCIe System-On-Module,  
PC5 US stack, V2Xcast®



## Overview:

Unex's SOM-351U is an innovative 3GPP C-V2X (LTE-V2X) PC5 System-On-Module that is designed to meet the rising market demand for easy-to-use V2X units in connected vehicles, intelligent transportation system (ITS), smart cities, smart farming, mining and port industry and to facilitate the development of mass-market solutions. Integrated with automotive-grade multi-core processor, RF, eHSM, RAM, flash, GNSS, PC5 US stack and V2Xcast® service, SOM-351U acts as a self-contained V2X system-on-module that enables V2X ecosystem on various platforms. Featuring V2Xcast® - a highly integrated and modular communication framework, SOM-351U supports rapid scalability on application host without sacrificing quality, making it an ideal V2X module of devices such as On-Board Unit (OBU), Roadside Unit (RSU), Telematics Box (T-Box) or Network Access Device (NAD).

## Feature

- ❖ Pre-integrated firmware contains IEEE WAVE stack, Security and POTI.
- ❖ A rich SDK containing SAE J2735 messages, APIs and example codes accelerates development of innovative V2X applications.
- ❖ mPCIe design and V2Xcast® software support easy migration between DSRC and LTE-V2X PC5 without any hardware change on the application host.
- ❖ Integrated and modular V2X subsystem allows expandable applications for sensor fusions and AI applications with ease.
- ❖ External Molex connector provides all I/O pins for direct deployment on the existing host.

## Specifications:

Chipset	<ul style="list-style-type: none"> <li>❖ Autotalks® CRATON2 V2X communication processor</li> <li>❖ Autotalks® PLUTON2 V2X RF Transceiver</li> <li>❖ Embedded Hardware Secure Module (eHSM)</li> <li>❖ Telit® SL869-V3 GNSS module (SL869-ADR optional)</li> </ul>
Operation System	Linux Yocto
Form Factor	PCI Express Mini Card (Mini PCIe)
Host Interface	USB 2.0
Preloaded Firmware	LTE-V2X PC5 US stack including IEEE WAVE stack and SCMS client
Development Tool	<p>V2Xcast® SDK*, including APIs and SAE J2735 facility layer messages</p> <p>*. Currently V2Xcast SDK supports X86 64-bit, ARMv7-A and ARMv8-A(64bits) Linux 4.x OS platforms, others by project based</p>
Hardware Security	<ul style="list-style-type: none"> <li>❖ Dedicated ROM containing certified secure V2X signing firmware</li> <li>❖ Secure encrypted off-chip storage of private keys</li> <li>❖ Private material is inaccessible outside HSM</li> <li>❖ Capable of &gt;110 signatures / second, with &lt;9ms signing latency for ECDSA NIST P256 or ECDSA Brainpool P256R1</li> <li>❖ Line-rate ECDSA verification engine (&gt;2500 ECDSA NIST P256 verifications / second)</li> </ul>

- ❖ FIPS 140-2 Level 3 certification
- ❖ Tamper detection\*  
(\* . Support by project)

**C-V2X (LTE-V2X)**

- ❖ Frequency band: 5.895 ~ 5.925 GHz
- ❖ Radio mode: 3GPP LTE-V2X Rel. 14 PC5 sidelink
- ❖ Channel bandwidth: 10/20 MHz
- ❖ RF transmit power: max. +20dBm on antenna port, Class C RF spectrum mask compliant with margins
- ❖ RF receive power: typ. < -92dBm

**GNSS**

- ❖ Update rate: 10Hz
- ❖ Sensitivity:
  - ◆ Acquisition: -146dBm
  - ◆ Navigation: -158dBm
  - ◆ Tracking: -162dBm
- ❖ NMEA Standard: NMEA 0183
- ❖ Accuracy: 1.5m (CEP50 with SBAS)
- ❖ Telit® SL869-V3 GNSS receiver supports GPS/Glonass/Galileo/QZSS constellations\*. SBAS like EGNOS (EU), WAAS (US), and MSAS (JP) are also supported.

(\* . GPS and Glonass are supported by default)

**Operation Power**

5V: I<sub>max</sub>=2A (during RF transmission, usually less than 2ms), I<sub>typ</sub>=0.7A  
 3.3V: I<sub>max</sub>=110mA, I<sub>typ</sub>=105mA  
 (preliminary data)

**On-board Interface**
**RF interfaces:**

- ❖ two MHF I RF connectors (LTE-V2X)
- ❖ one MHF I RF connector (GNSS)

**Industrial Standard mini PCIe interfaces:**

- ❖ one USB port
- ❖ one UART (console or external GNSS)
- ❖ one 1PPS input

- ❖ one Reset input
- ❖ 3.3V mini PCIe power input
- ❖ 5V power input (proprietary)

Cable interfaces:

- ❖ one UART (console or external GNSS)
- ❖ one 1PPS input
- ❖ one Reset input
- ❖ 5V power input (proprietary)

- Antenna
- ❖ LTE-V2X: two MHF I connectors (U.FL compatible), diversity support
  - ❖ GNSS: one MHF I connector (U.FL compatible)

ESD design                      ESD protects all ports in ESD events. (IEC 61000- 4-2 Level 4, Contact ±8kV, Air ±15kV)

Operation    Temperature  
Range                      ambient: -40°C ~ +85°C

Storage        Temperature  
Range                      -45°C ~ +90°C

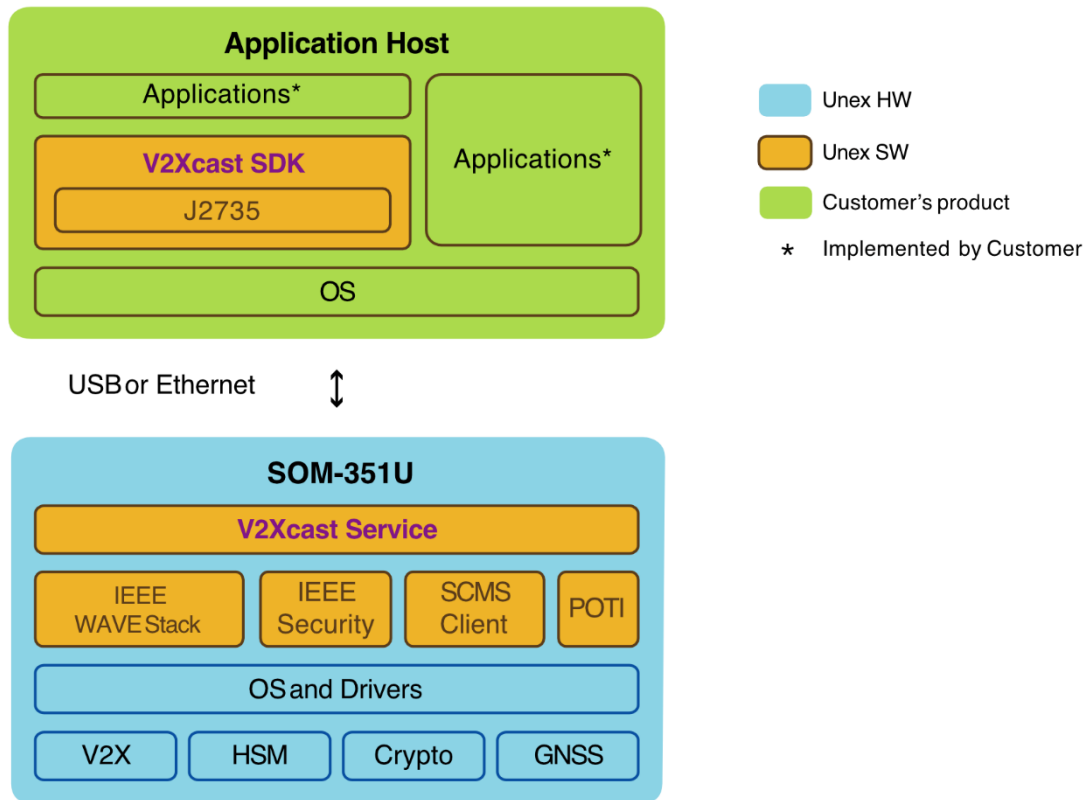
Operating Humidity                      10% - 95%, non-condensing

Storage Humidity                      max. 95%, non-condensing

Dimension                      50.95 mm(L) x 38.5 mm(W) x 11.7 mm (H)  
  
(preliminary data)

Environment-Friendly  
Compliance                      REACH and RoHS

## Software:



Unex SOM-351U enables ease of V2X software development through its V2Xcast® technology. V2Xcast is a highly integrated and developer friendly software development kit for V2X communication. The solution provides ready-to-use V2X communication services for V2X applications, users can significantly cut time-to-market with less development and testing cost.

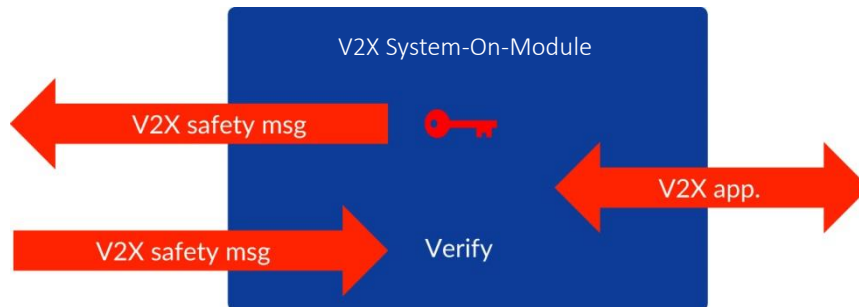
It includes two parts – V2Xcast Service and V2Xcast SDK.

**V2Xcast SDK:** Deploy V2Xcast SDK in your application host, it includes APIs to get the services from V2Xcast Service and the main functions of facility layer(J2735), such as message encoder/decoder and example code.

**V2Xcast Service:** V2Xcast Service image resides in SOM-351U, it combines IEEE WAVE stack, SCMS client and POTI. V2X communication protocols will be easily enabled via configuration profile input without any programming.

## Security:

A self-contained and highly integrated V2X system-on-module capable of highly secure V2X applications.



Security functions provided by V2Xcast® are designed based on a highly secure HSM (Hardware Security Module).

The highly secure HSM with FIPS 140-2 Level 3 certification is embedded in SOM-351U.

Cryptographic processor eliminates bottlenecks, maximizes application performance and offload CPU's computation. To protect your sensitive cryptographic keys in a high-assurance key vault, the design provides leverage a keys-in-hardware solution. With the keys-in-hardware solution, all the cryptographic operations are inside HSM and those keys never leave the HSM.

# Input Output Interface

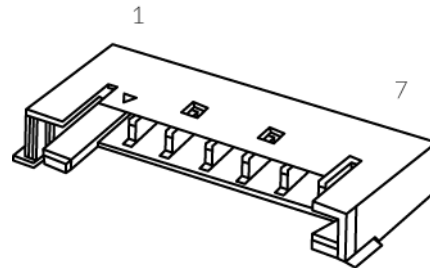
## mPCIe Pin Definition and Function

Row	Pin	Symbol	Type	Description	Status
0	1	WAKE#	O	Open drain active low signal. This signal is used to wake up the host.	NC
0	3	5V	P	5V/2A Power Input (originally reserved)	Proprietary
0	5	5V	P	5V/2A Power Input (originally reserved)	Proprietary
0	7	CLKREQ#	O	Reference clock request signal	NC
0	9	GND	G		
0	11	REFCLK-	I	PCI Express differential reference clock (100 MHz)	NC
0	13	REFCLK+	I	PCI Express differential reference clock (100 MHz)	NC
0	15	GND	G		
0	-	KEY	-	Mechanical Key	
0	17	UART_RX	I	UART receive data input (originally reserved)	Proprietary
0	19	UART_TX	O	UART transmit data output (originally reserved)	Proprietary
0	21	GND	G		
0	23	PERn0	I	PCI Express RX -	NC
0	25	PERp0	I	PCI Express RX +	NC
0	27	GND	G		
0	29	GND	G		
0	31	PETn0	O	PCI Express TX -	NC
0	33	PETp0	O	PCI Express TX +	NC
0	35	GND	G		
0	37	GND	G		
0	39	3.3 Vaux	P	Max 1100mA	
0	41	3.3 Vaux	P	Max 1100mA	
0	43	GND	G		
0	45	5V	P	5V/2A Power Input (originally reserved)	Proprietary
0	47	5V	P	5V/2A Power Input (originally reserved)	Proprietary
0	49	1PPS	I	GNSS 1 pulse per second input (GATEWORKS standard, originally reserved)	Proprietary
0	51	TAMPER#	I	0=Tampering, 1=Normal operation (PD)	Proprietary

Row	Pin	Symbol	Type	Description	Status
1	2	3.3 Vaux	P	Max 1100mA	
1	4	GND	G		
1	6	1.5 Volt	P	Max 500mA	NC
1	8	UIM PWR	O	SIM Card	NC
1	10	UIM_DATA	I/O	SIM Card	NC
1	12	UIM_CLK	O	SIM Card	NC
1	14	UIM_RESET	O	SIM Card	NC
1	16	UIM_VPP	O	SIM Card	NC
1	-	KEY	-	Mechanical Key	
1	18	GND	G		
1	20	W_DISABLE#	I	Disable wireless communications (Internally pulled up. Active LOW)	NC
1	22	PERST#	I	Module Reset (Internally pulled up. Active LOW, pulse)	
1	24	3.3Vaux	P	Max 1100mA	
1	26	GND	G		
1	28	1.5Volt	P	Max 500mA	NC
1	30	SMB CLK	I	SMBus clock signal compliant to the SMBus 2.0 specification	NC
1	32	SMB Data	I/O	SMBus data signal compliant to the SMBus 2.0 specification	NC
1	34	GND	G		
1	36	USB_D-	I/O	USB 2.0 differential data (-)	
1	38	USB_D+	I/O	USB 2.0 differential data (+)	
1	40	GND	G		
1	42	LED_WWAN#	O	Open drain, active low, max 9mA	NC
1	44	LED_WLAN#	O	Open drain, active low, max 9mA	NC
1	46	LED_WPAN#	O	Open drain, active low, max 9mA	NC
1	48	1.5Volt	P	Max 500mA	NC
1	50	GND	G		
1	52	3.3 Vaux	P	Max 1100mA	

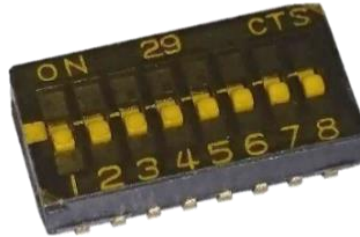


## I/O Cable Pin Definition



Function	Pin	Name	Type	Level	Description
Power	1	5V	P	5	5V power
UART	2	RXD	I	3.3	UART RXD
	3	TXD	O	3.3	UART TXD
Reset	4	EX_RSTn	I	3.3	System reset (active LOW) Min assertion time: 10ms
1PPS	5	1PPS	I	3.3	1PPS
Tamper	6	TAMPER#	I	3.3	Tamper switch signal (active LOW)
Ground	7	GND	G		Ground

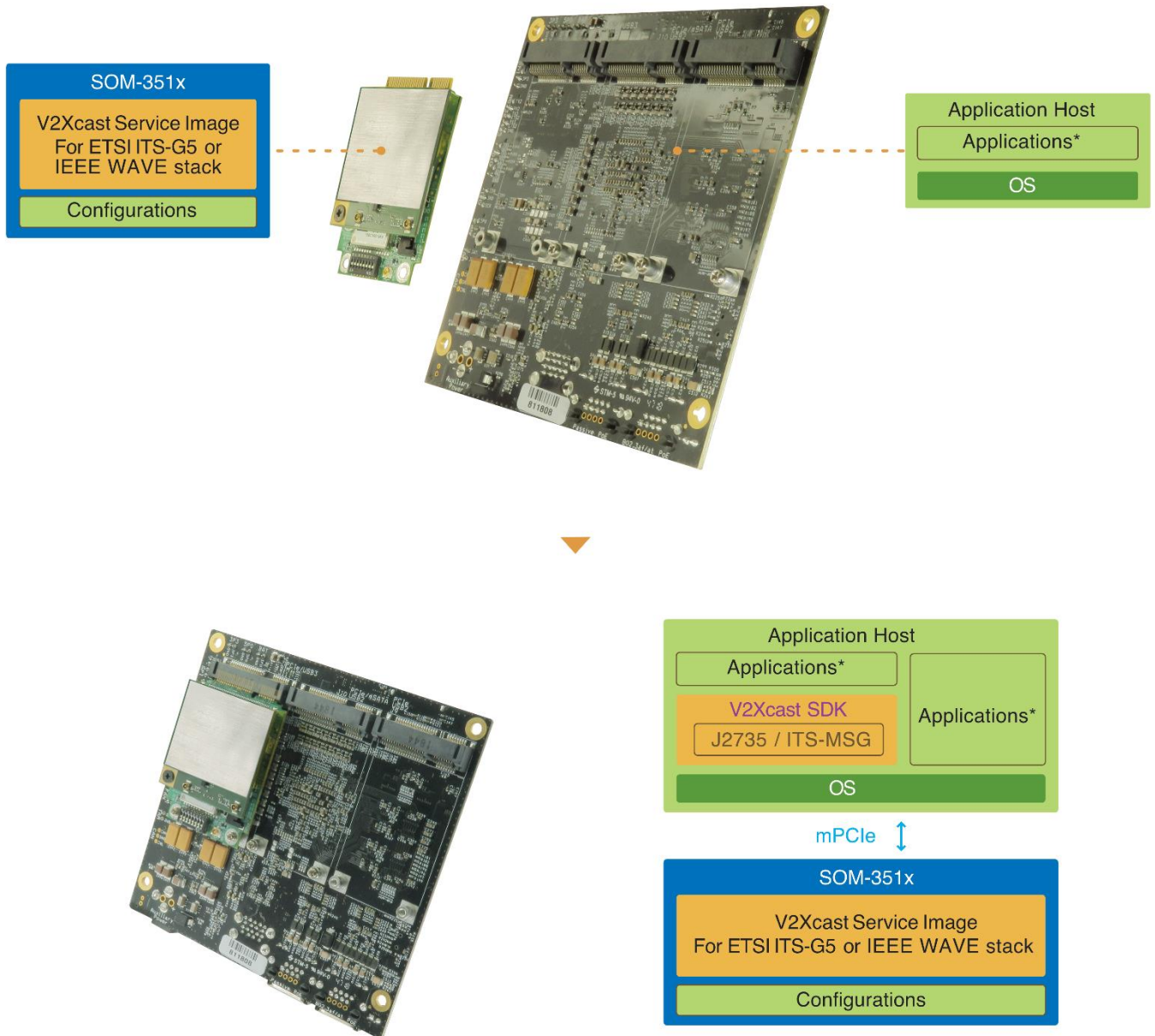
## DIP Switch

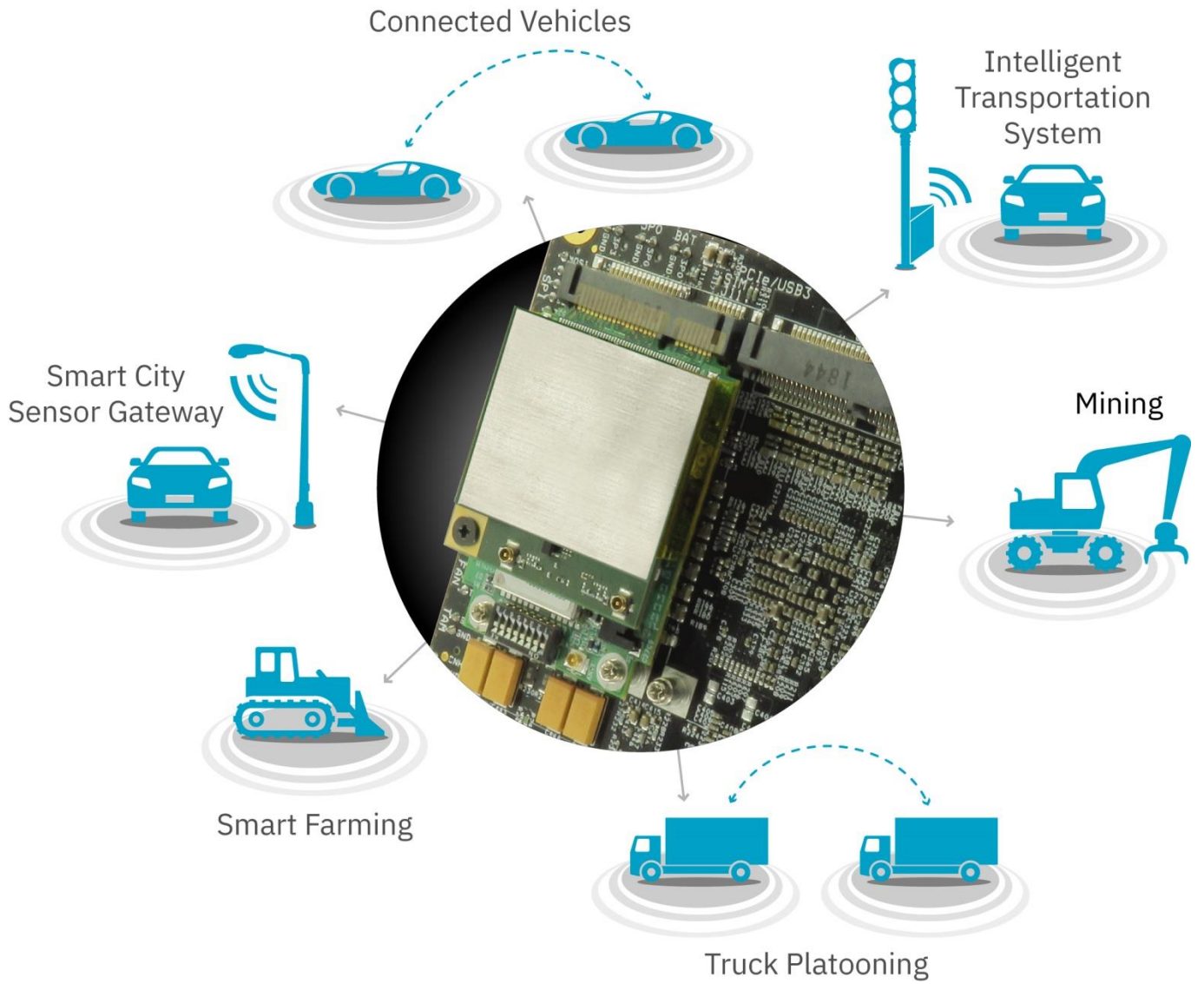


Function	Position	Name	Description
Power	1	5V_SW	Connect 3.3V to a NMOS gate which controls 5V power. ON: 5V power from mPCIe OFF: 5V power from cable
UART	2	RXD_SW	ON: UART RXD from mPCIe OFF: UART RXD from cable
	3	TXD_SW	ON: UART TXD from mPCIe OFF: UART TXD from cable
Reset	4	EX_RSTn_SW	ON: CR2 reset from mPCIe OFF: CR2 reset from cable
1PPS	5	1PPS_SW	ON: 1PPS from mPCIe OFF: 1PPS from cable
Tamper	6	TAMPER#_SW	ON:TAMPER# from mPCIe OFF: TAMPER# from cable
Trigger Mode	7	TRIGGER_SW	ON: Trigger when tamper SW close to GND (1K PU) OFF: Trigger when tamper SW open from 3V3 (30K PD)
Boot Strapping	8	BOOT_SW	ON: Boot from NAND (3K PD) OFF: Boot from USB0 (Open)

# Using Cases

Enable V2X on various platforms – from Low Power Devices to AI Applications





## Ordering Information:

SOM-351U

C-V2X mPCIe System-On-Module, PC5 US stack, V2Xcast®