

Samsung ARTIK™ Overview

Secure end-to-end IoT platform

Sep 19, 2018
Wei Xiao



Agenda

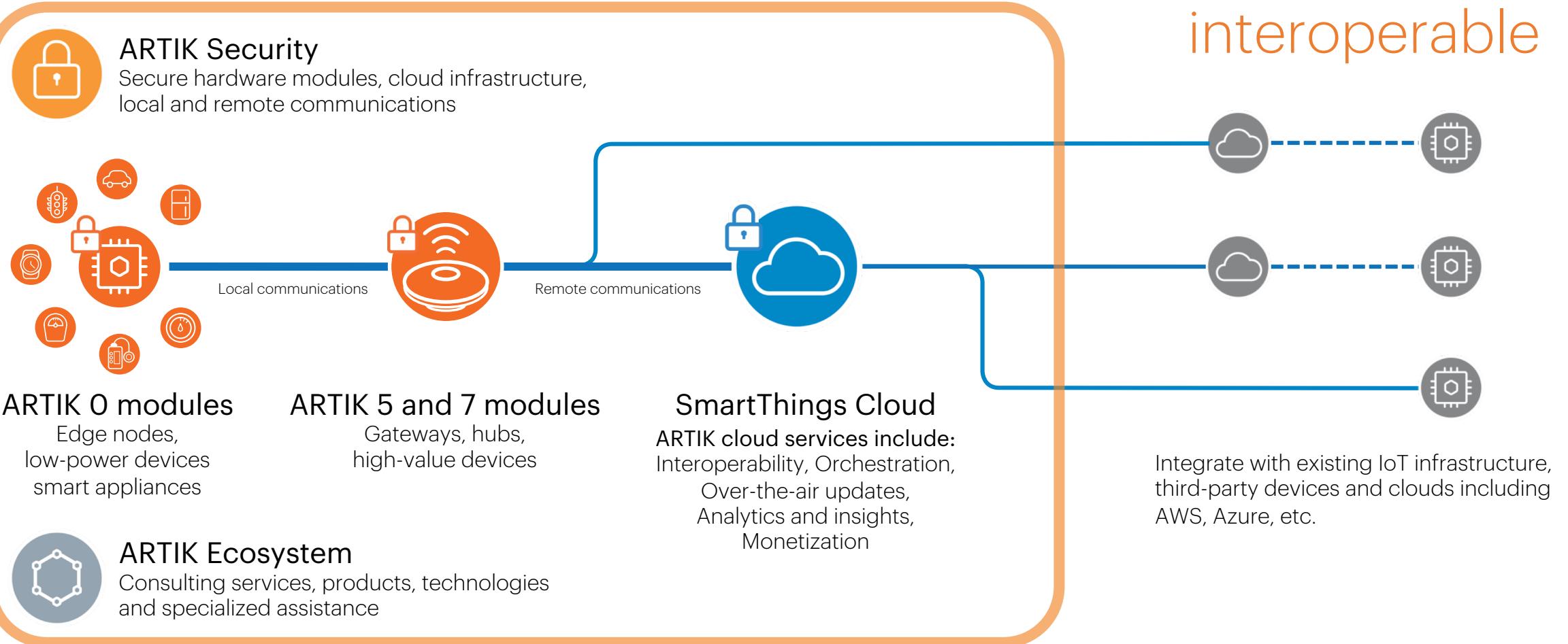
- ARTIK Overview
- ARTIK Module Overview
- ARTIK Cloud Services
- ARTIK Security
- Workshop Hands-On



Samsung ARTIK™ IoT Platform

End-to-end integration...

...Open and
interoperable



ARTIK Gateway Module Overview

Samsung ARTIK module product family

ARTIK 0 Modules

Edge nodes, battery-powered devices, intelligent appliances



Bluetooth, Z-Wave, WiFi

020

030

053

055s

053s



15 x 12.9 x 2



15 x 12.9 x 2



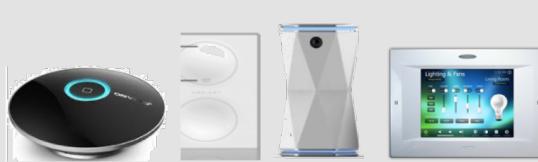
15 x 40 x 3.9
5-12 VDC



15 x 26 x 3.9
3.3 VDC

ARTIK 5, and 7 Modules

Hubs and gateways



Bluetooth, Z-Wave, WiFi

520

Bluetooth, Z-Wave, WiFi

530

Bluetooth, Z-Wave, WiFi

710

530s

530s_1G



30 x 25 x 3.4



36 x 49 x 3.4



36 x 49 x 3.4

- Single, dual Cortex-M, Cortex-R CPUs
- RTOS based OS

- Dual, quad, up to octa-core Cortex-A CPUs
- Linux based platforms

Samsung ARTIK™ 530/530s (512 MB, 1 GB) mid-range gateway

Secure, fully-integrated IoT solution



- Industrial and home gateways
- Voice-controlled speakers
- Building zone controllers
- Display-based healthcare monitors



Processor	CPU: 4x ARM® Cortex® A9 @ 1.2 GHz GPU: 3D graphics accelerator
Memory	DRAM: 512 MB/1 GB DDR3 Flash: 4 GB eMMC v4.5
Multimedia	Camera I/F: 4-lane MIPI CSI up to 5MP Display: 4-lane MIPI DSI, HDMI 1.4 a or LVDS (1280 x 720 @ 60 fps) Audio: 2x I2S audio input/output
Connectivity	WLAN (Wi-Fi): IEEE 802.11 b/g/n single-band SISO Bluetooth: 4.2+ Smart 802.15.4: Zigbee, Thread Ethernet: 10/100/1000 Base-T MAC (external PHY required)
Security	Secure element, EAL Level 5, unique device certificate and keys, PKI with mutual authentication to cloud, hardware crypto engine; secure boot*, KMS*, TEE*, <small>*S-modules</small>
I/O	GPIO, UART, I2C, SPI, USB Host, USB OTG, HSIC, ADC, PWM, I2S, JTAG
Temperature range	-25° to 85° (°C)
Size	36 mm W x 49 mm H x 3.4 mm D

Samsung ARTIK™ 710/710s high-end gateway

Secure, fully-integrated IoT solution

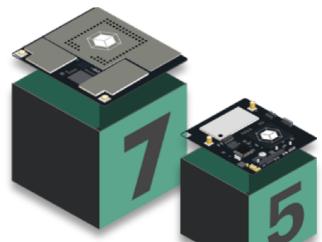
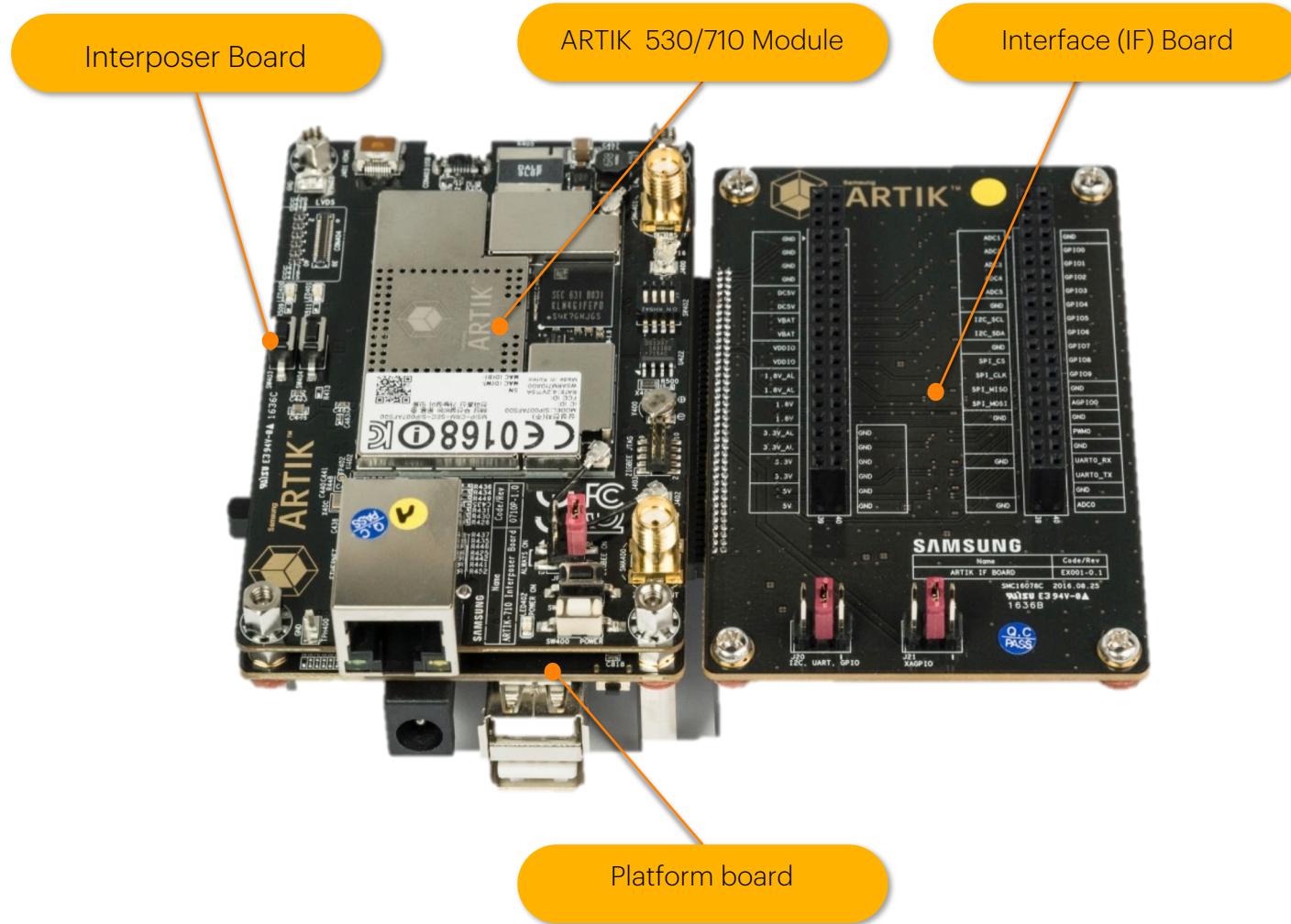


- High-end gateways
- Cameras
- Human-machine interface
- Machine learning

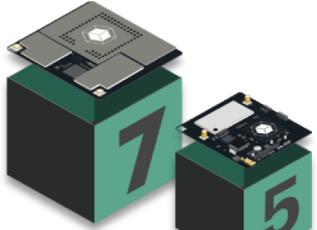
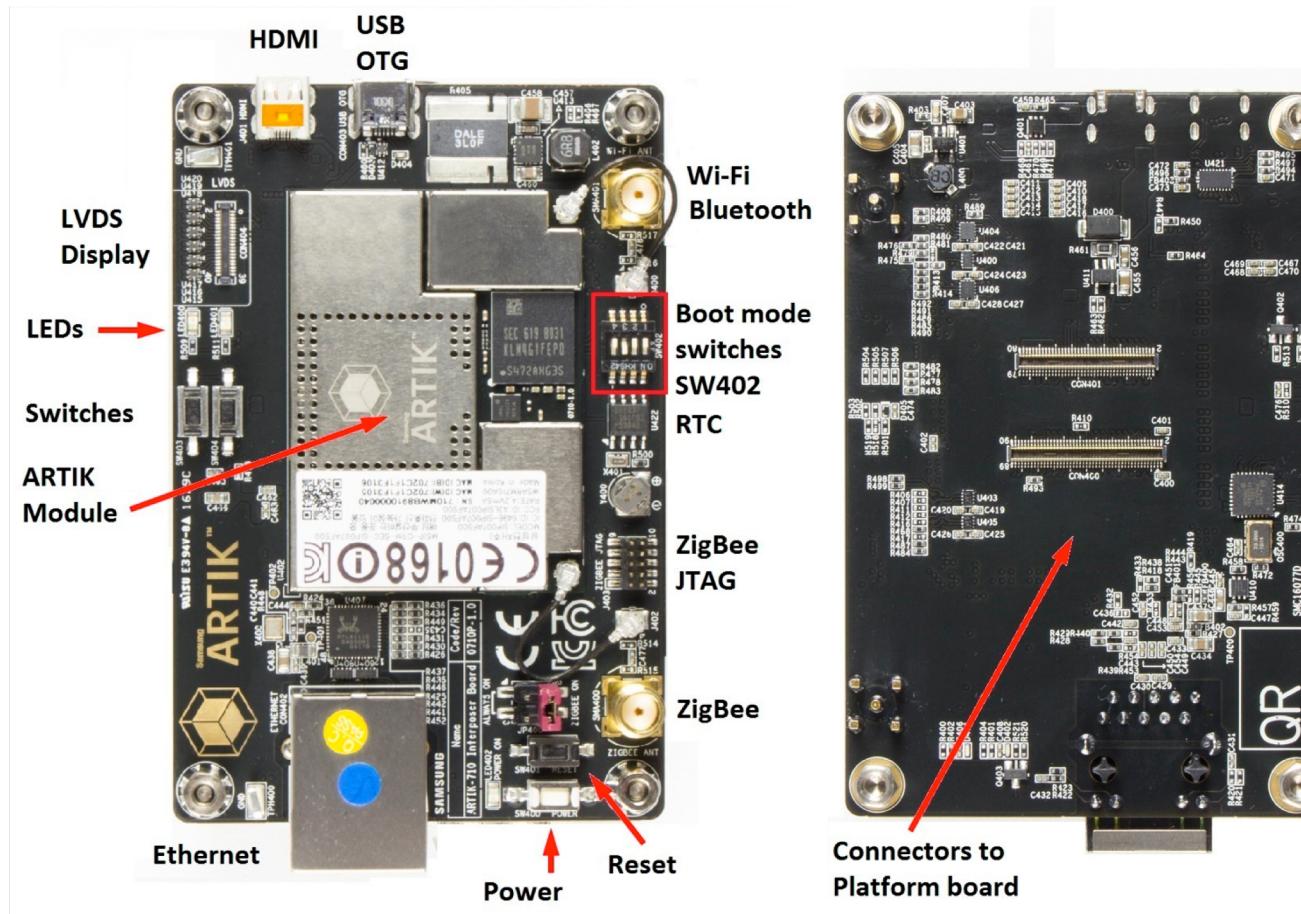


Processor	CPU: 8x ARM® Cortex® A53 @ 1.4 GHz GPU: 3D graphics accelerator
Memory	DRAM: 1 GB DDR3 @ 800 MHz Flash: 4 GB eMMC v4.5
Multimedia	Camera I/F: 4-lane MIPI CSI Display: 4-lane MIPI DSI up to FHD@24 bpp, LVDS, HDMI v1.4 Audio: I²S audio interface
Connectivity	WLAN (Wi-Fi): IEEE 802.11 b/g/n/ac Bluetooth: 4.1+ Smart 802.15.4: Zigbee, Thread Ethernet: 10/100/1000 Base-T MAC (external PHY required)
Security	Secure element, EAL Level 5, unique device certificate and keys, PKI with mutual authentication to cloud, hardware crypto engine; secure boot*, KMS*, TEE*, *S-modules
I/O	GPIO, I²C, I²S, SPI, UART, PWM, SDIO, USB 2.0, JTAG, analog input
Temperature range	0° to 70° (°C)
Size	36 mm W x 49 mm H x 3.4 mm D

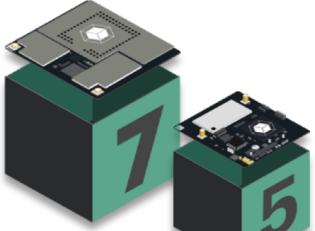
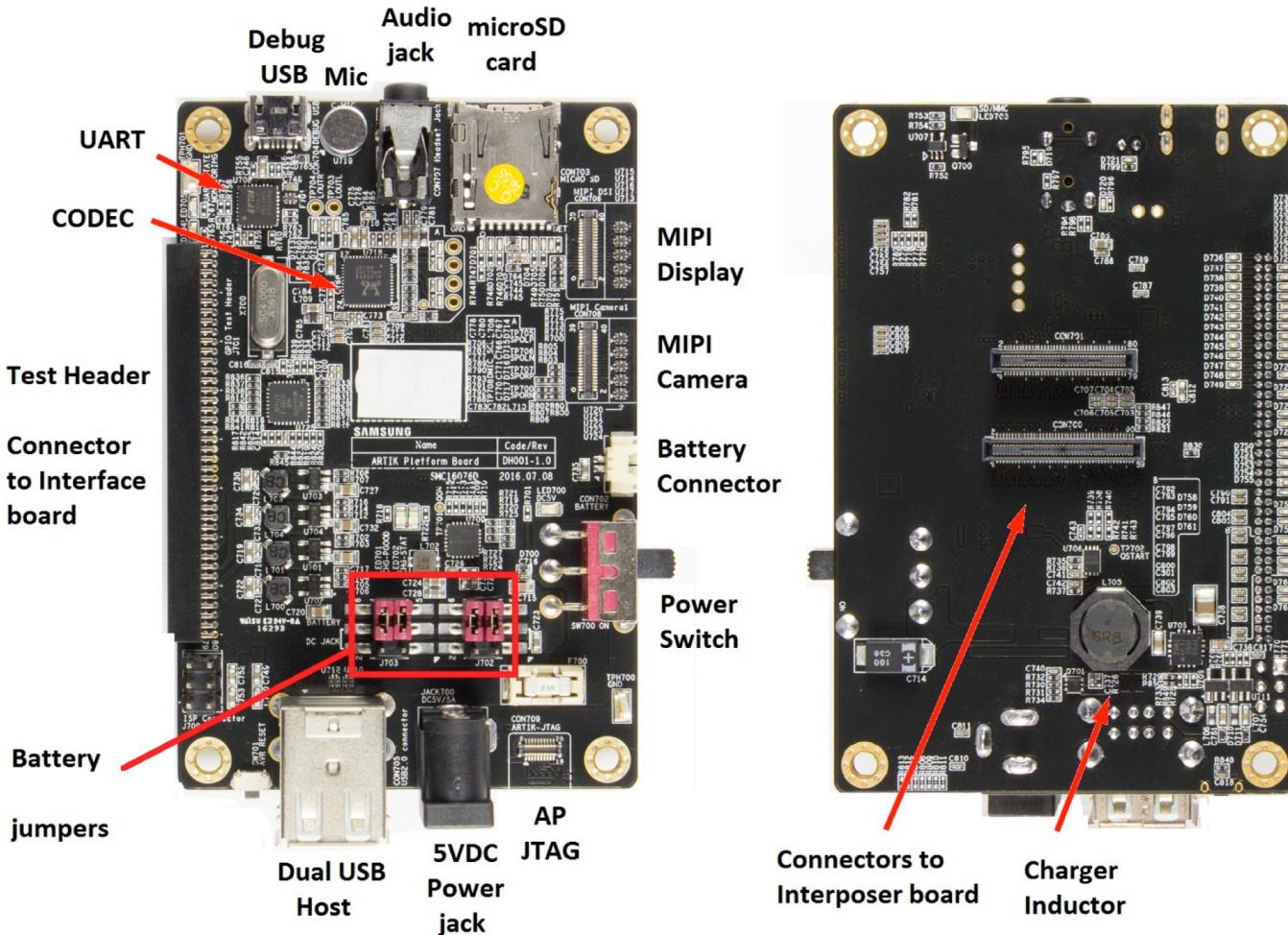
ARTIK High-end module development board



ARTIK High-End Module Interposer Board



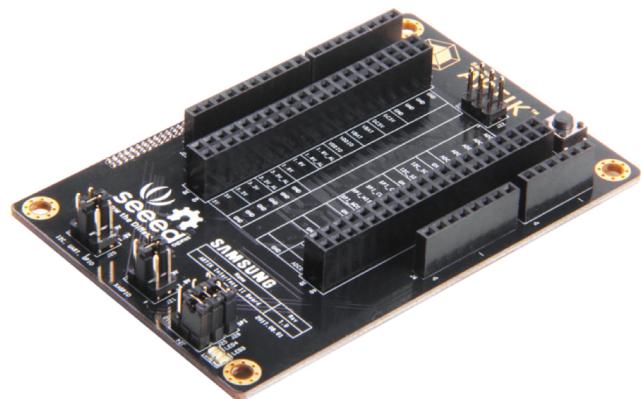
ARTIK Gateway Module Platform Board



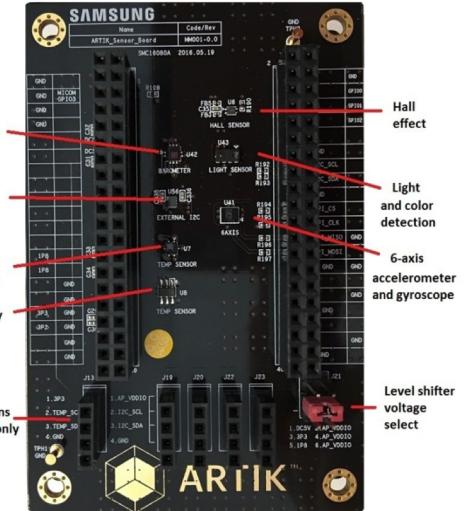
ARTIK Gateway Module Expansion Boards



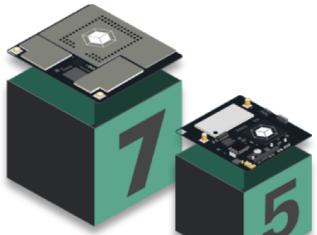
Interface Board



Interface Board II



Sensor Board



Radio Connectivity

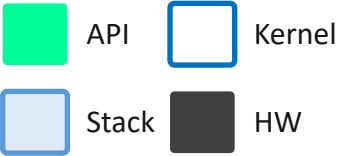
Radio	Range	Data Rate	520	530	710
BLE	50m	<1Mbps	✓	✓	✓
BT	30m	1-3Mbps	✓	✓	✓
ZigBee	10-100m	10-100Kbps	✓	✓	✓
Thread	N/A	10-100Kbps	✓	✓	✓
Wi-Fi	~50m	10-100Mbps	✓	✓	✓
Ethernet			✓	✓	✓

*Z-wave and Sigfox chip set is on 520 development boards

Peripheral Interfaces + Power MGT & Analog blocks

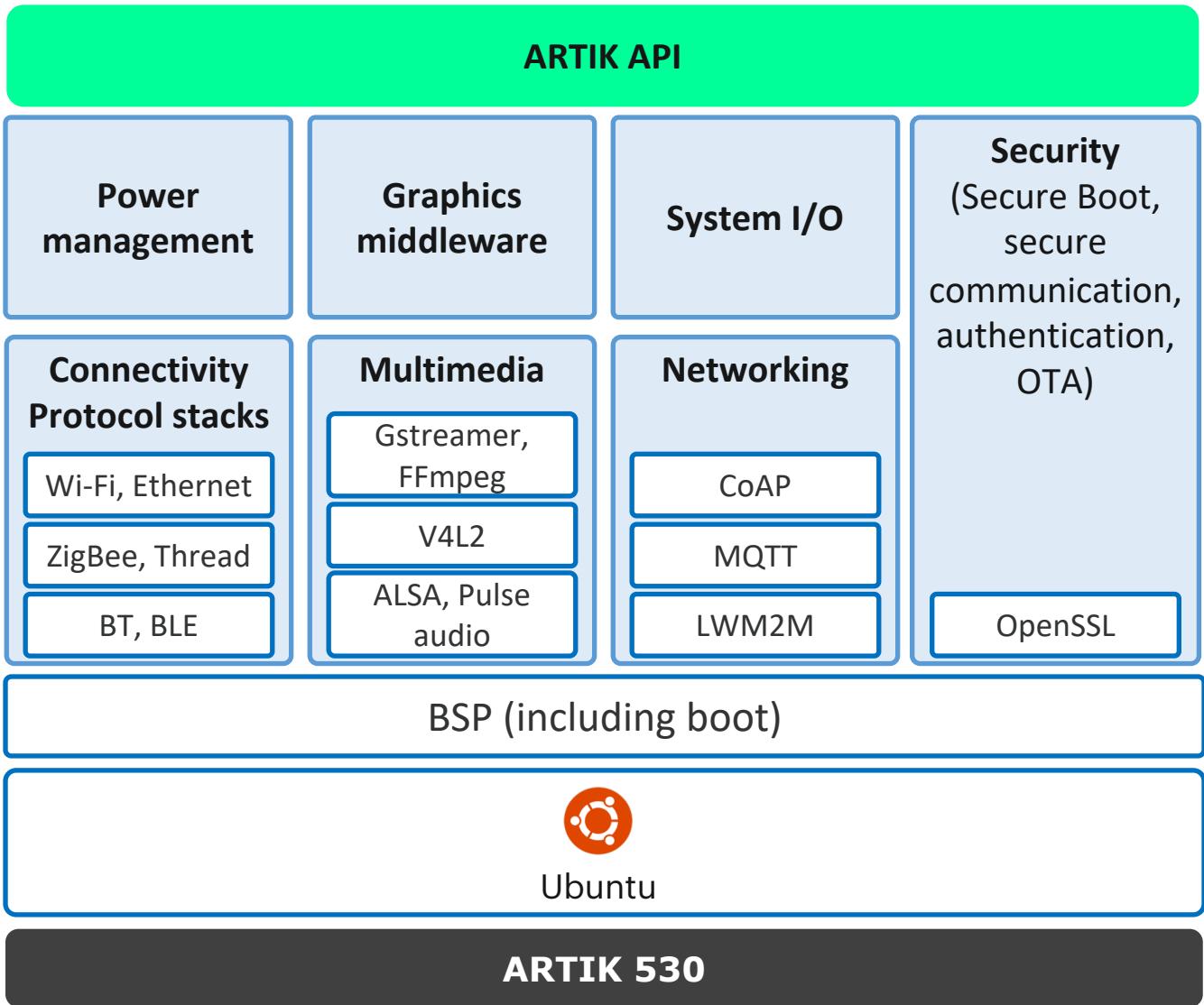
	520	530	710
Peripheral Interfaces	I2C	6	3
	SPI	2	2
	GPIO	100	107
	UART	2	3
	USB	USB 2.0*	USB 2.0
Analog and Power MGT	ADC	2	6
	PWM	2	2
	PMIC	✓	✓

*USB device mode only for 520, rest of the module is both device and host mode.

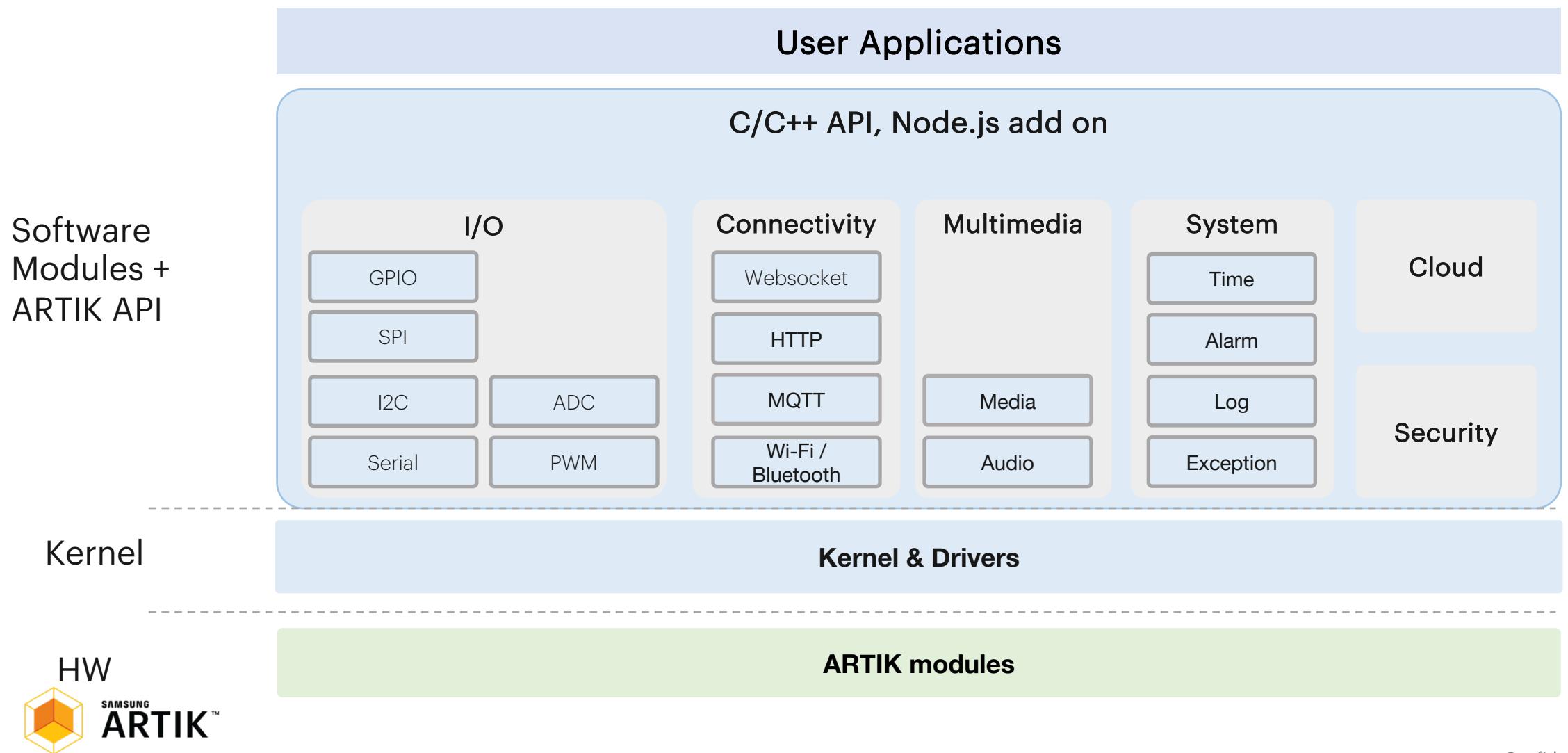


ARTIK 530s - Mid range gateway: Software

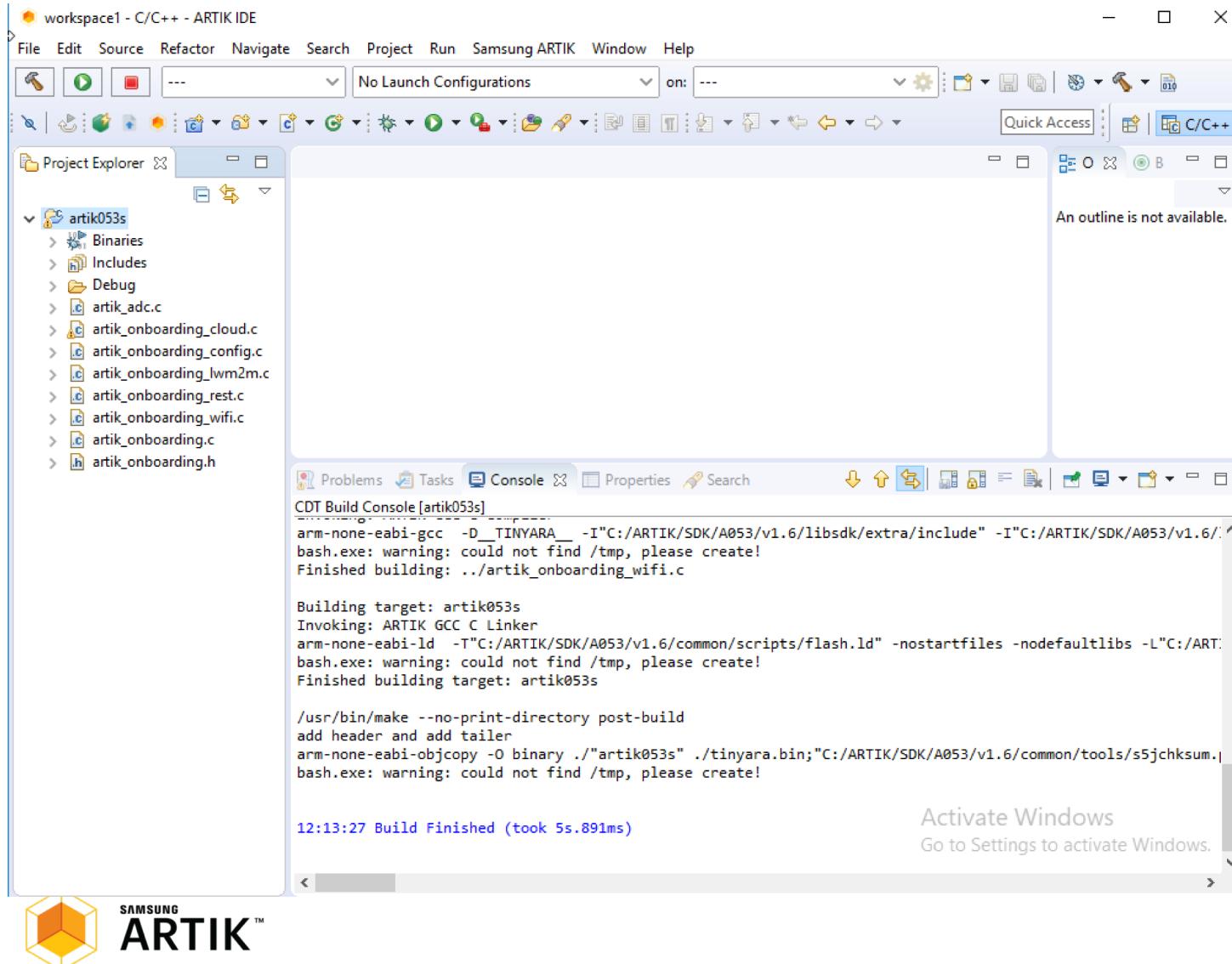
- Ubuntu Linux based solution
- Multimedia support for video, audio and camera
 - Video playback: Gstreamer, FFmpeg
 - Linux video libraries: V4L2
 - Audio: ALSA, Pulse audio
- Complete connectivity & networking solution
 - Connectivity stacks for RF: Ethernet, Wi-Fi, BLE, ZigBee, Thread
 - Networking stacks: CoAP, MQTT, LWM2M
- Strong security solution
 - OpenSSL based SSL/TLS solution
- Complete BSP for all HW peripherals on module



ARTIK SDK (5, 7 series)

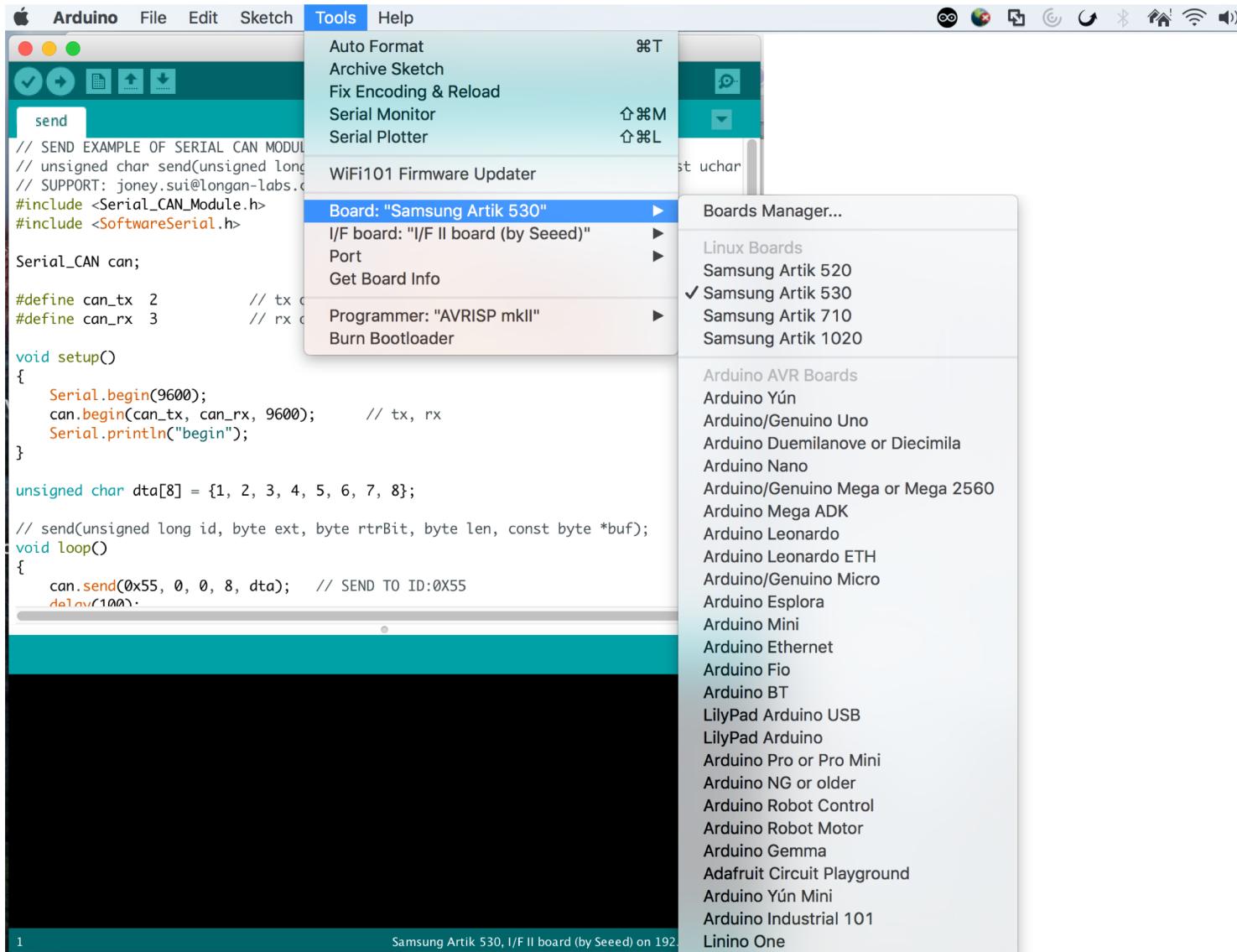


ARTIK IDE



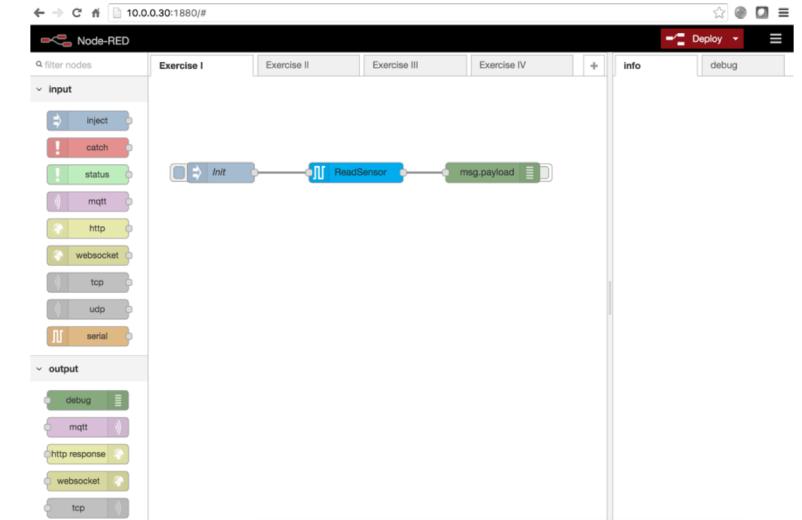
gcc-arm-linux-gnueabihf
(32 bit for ARTIK 5x)
and
aarch64-linux-gnu
(64 bit for ARTIK 7x)

Arduino



Node-RED

- A visual tool for wiring the internet of things, based on Node.js
- Utilizes flow programming technique
- Construct program flow by drag-and-drop
- You have the option not to write code
- Growing ecosystem
- Cloud-based solutions: IBM Bluemix, Front end Node-RED



Native Development

- C/C++: Most popular programming languages for embedded devices. e.g, ARTIK SDK
- Python: Rich libraries
- JS: Node.js is the most popular JavaScript runtime for high-end IoT devices.
- Java:

3rd party Libraries/APIs

- Multimedia: PyAudio, OpenCV, Speech Recognition etc.
- Communication Protocols/Frameworks:
 - MQTT(Eclipse Mosquitto/Paho)
 - CoAP (libcoap)
 - LWM2M(Eclipse Wakama, Eclipse Leshan)
 - OPC-UA(Eclipse Milo, open62541)
 - IoTivity



Multi Clouds Support, Compatible Frameworks, Solutions

Gateway Solutions for ARTIK 5x/7x:

AWS Greengrass



Microsoft IoT Edge



Eclipse Kura



EDGE X FOUNDRY™



Google Cloud



SAP® Certified
Built on SAP Cloud Platform



thingworx®

Samsung ARTIK™ 530/s SoMs

Competitive advantages

- Fully integrated, production ready SoM:
Quad Core AP, Secure Element, RAM, Flash, PMIC, passives
Multimedia capabilities – 3D graphics acceleration
Fully certified – FCC, CE, IC, KC
- S-module security features: secure boot, secure OS, secure storage, secure communication, KMS, PKI
- Out of the box integration to SmartThings Cloud
- E2E Solution:
- Tools: Eclipse IDE, GNU toolchain



ARTIK 05x Module Overview

Samsung ARTIK™ 053/053s, 055s Wi-Fi® edge nodes

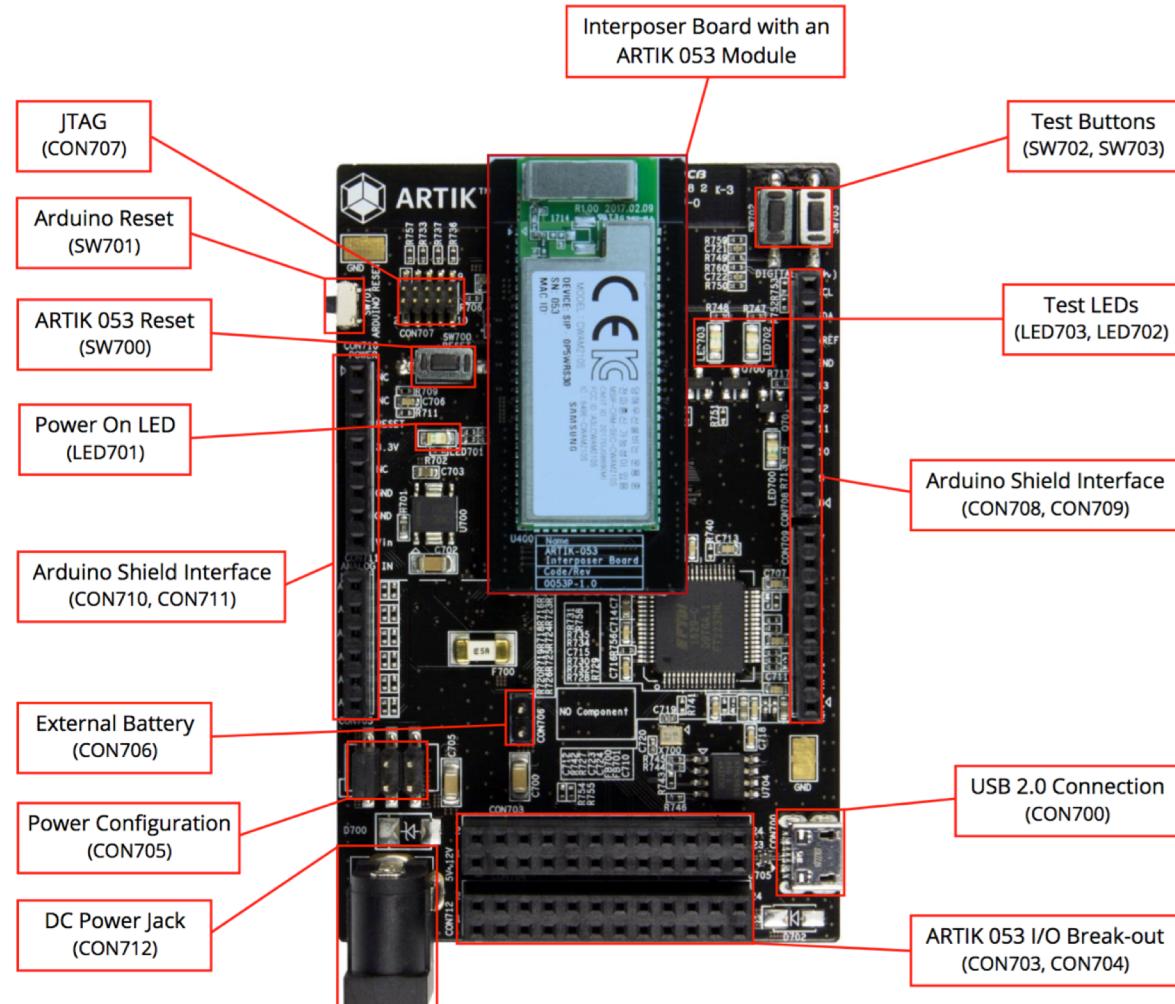
Create secure, next-gen edge products



- Home health monitors, AEDs, fitness equipment, CPAP
- Smoke detectors, thermostats, energy monitors, appliances
- Sensors, lighting controllers, motors, valves
- Access control, fire monitors, smart switches

Processor	Main: ARM Cortex® R4 @ 320 MHz WLAN: ARM Cortex® R4 @ 480 MHz Security: ARM Cortex M0
Memory	RAM: 1.4 MB Flash: 8 MB SPI Flash on module
Connectivity	WLAN (Wi-Fi): IEEE 802.11 b/g/n
Regulatory	FCC (US), IC(Canada), CE(EU), KC(Korea), SRRC(China)
I/O	2xSPI, 5xUART (2-pin), 4xI2C, 7xPWM, 28xGPIO, 1xJTAG, 4xADC
Operating voltage	053, 053s: 5-12 VDC; 055s: 3.3 VDC
Temperature	-20° to 85° (°C)
Size	055s: 15 mm W x 26 mm H x 3.9 mm D 053, 053s: 15 mm W x 40 mm H x 3.9 mm D
Security	Secure Subsystem, Hardware-protected key storage with secure point-to-point authentication and data transfer, secure boot*, KMS*

ARTIK 05x Starter Board



Wi-Fi Subsystem

- ARTIK05x supports 802.11b/g/n Wi-Fi at 2.4GHz
- Dedicated Wi-Fi Processor subsystem with 480MHz 32-bit ARM Cortex R4 supported by 32KB I-Cache and 16KB D-Cache
- WiFi throughput: ~25 Mbps single stream
- WPA/WPA2
- Support both Station mode and AP mode

Samsung ARTIK™ 05x Power Management

ARTIK 053/053s Module Power Consumption

(measured using 5-12V system power supply)

Category	Scenario	Condition	Throughput Conditions	Current (mA)	Power (W)
Wi-Fi	802.11b Tx	5V supply; transfer packet using iperf3 @ 11 Mbps & max TX power	-	362 ±30	1.8
		12V supply; transfer packet using iperf3 @ 11 Mbps & max TX power	-	151 ±15	1.8
	802.11n Tx	5V supply; transfer packet using iperf3 @ 25 Mbps	Max	254 ±25	1.27
		12V supply; transfer packet using iperf3 @ 25 Mbps	Max	110 ±10	1.32
	802.11n Rx	5V supply; transfer packet using iperf3 @ 25 Mbps	Max	191 ±20	0.955
		12V supply; transfer packet using iperf3 @ 25 Mbps	Max	85 ±10	1.02
	802.11n Idle	5V supply; DTIM3	-	46.5 ±5	0.233
		12V supply; DTIM3	-	23.3 ±3	0.279

ARTIK 055s Module Power Consumption

(measured using 3.3V system power supply)

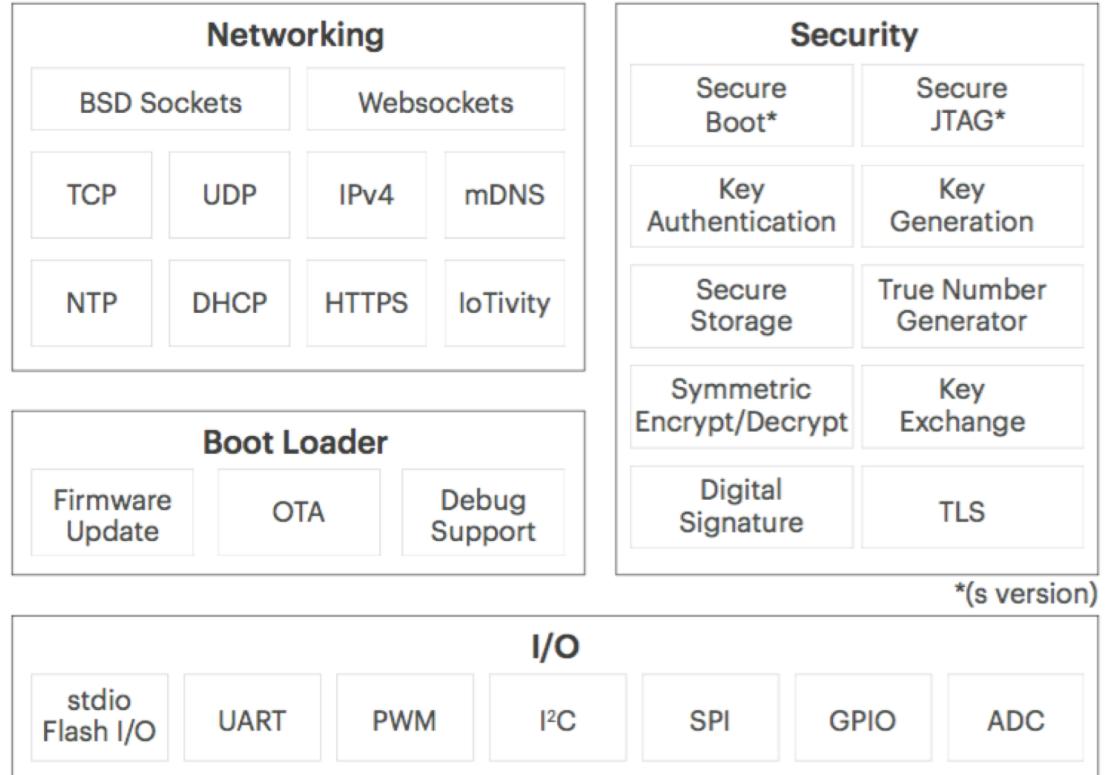
Category	Scenario	Condition	Throughput Conditions	Current (mA)	Power (W)
Wi-Fi	802.11n Tx	Transfer packet using iperf3 @ 25 Mbps	Max	320	1.06
	802.11n Rx	Transfer packet using iperf3 @ 25 Mbps	Max	240	0.79
	802.11n Idle	DTIM3	-	54	0.18

TizenRT OS Basics

- ARTIK 05x are powered by TizenRT RTOS.
- TizenRT is a lightweight RTOS-based platform to support low-end IoT devices, based on Nuttx
- TizenRT is Nuttx kernel plus middle wares, it is highly configurable and suitable for small to moderate sized embedded system
- Contains IP Network Stack

TizenRT OS Hierarchy

Kernel Services	
Realtime	Tasks, threads, queues, mutex, semaphore, signal
Time	Real-time clock, date/time, timer, sleep
Network Services	
Internet	DHCP, NTP Client, DNS Client, mDNS, BSD Sockets, Websockets
Services	Web client/server, MQTT client, IoTivity, cJSON
libc Services	
Libc Compatibility	Flash based Stdio, Stdlib, String, Unistd, Time
Security Services	
Encryption	AES 128/256, RSA 1024/2048, ECC BP/NIST 192/224/256/384/512
Authentication	HMAC 128/256, certificate
Certificate Storage	Secure Flash storage
Firmware Integrity	Secure boot and JTAG protection



*(s version)

TizenRT is easy for Linux developers

- Unix/Linux inspired OS(shell + apps)
- Comply with standards(POSIX/ANSI): uses GNU tools, GCC, gmake, Kconfig, GDB, openocd
- Filesystem(RO, RW), VFS(/dev/, /proc), MTD: handled by drivers(read, write, ioctl opts)
- Network: BSD sockets(TCP, UDP, IPv6), NTP, FTP, HTTP etc.
- Concurrency: Multi tasks & pthread support
 - + mutexes, message queues, signals, TLS, SMP, IPC, FIFO shed, preemptive
- Modular and configurable and scalable(Kconfig)



ARTIK IDE

workspace1 - C/C++ - ARTIK IDE

File Edit Source Refactor Navigate Search Project Run Samsung ARTIK Window Help

No Launch Configurations on: ---

Project Explorer X artik053s Binaries Includes Debug artik_adc.c artik_onboarding_cloud.c artik_onboarding_config.c artik_onboarding_lwm2m.c artik_onboarding_rest.c artik_onboarding_wifi.c artik_onboarding.c artik_onboarding.h

An outline is not available.

Problems Tasks Console X Properties Search

CDT Build Console [artik053s]

```
arm-none-eabi-gcc -D_TINYARA_ -I"C:/ARTIK/SDK/A053/v1.6/libsdk/extra/include" -I"C:/ARTIK/SDK/A053/v1.6/headers" -c artik_onboarding_wifi.c
bash.exe: warning: could not find /tmp, please create!
Finished building: ../artik_onboarding_wifi.c

Building target: artik053s
Invoking: ARTIK GCC C Linker
arm-none-eabi-ld -T"C:/ARTIK/SDK/A053/v1.6/common/scripts/flash.ld" -nostartfiles -nodefaultlibs -L"C:/ARTIK/SDK/A053/v1.6/lib" -L"C:/ARTIK/SDK/A053/v1.6/libsdk/extra/lib" artik053s.o
bash.exe: warning: could not find /tmp, please create!
Finished building target: artik053s

/usr/bin/make --no-print-directory post-build
add header and add tailer
arm-none-eabi-objcopy -O binary ./"artik053s" ./tinyara.bin;"C:/ARTIK/SDK/A053/v1.6/common/tools/s5jchksum." -g
bash.exe: warning: could not find /tmp, please create!
```

12:13:27 Build Finished (took 5s.891ms)

Activate Windows
Go to Settings to activate Windows.

SAMSUNG ARTIK™



gcc-arm-none-eabi

Cross Compilation from command line

- Github page: <https://github.com/SamsungARTIK/TizenRT>
- How to build:

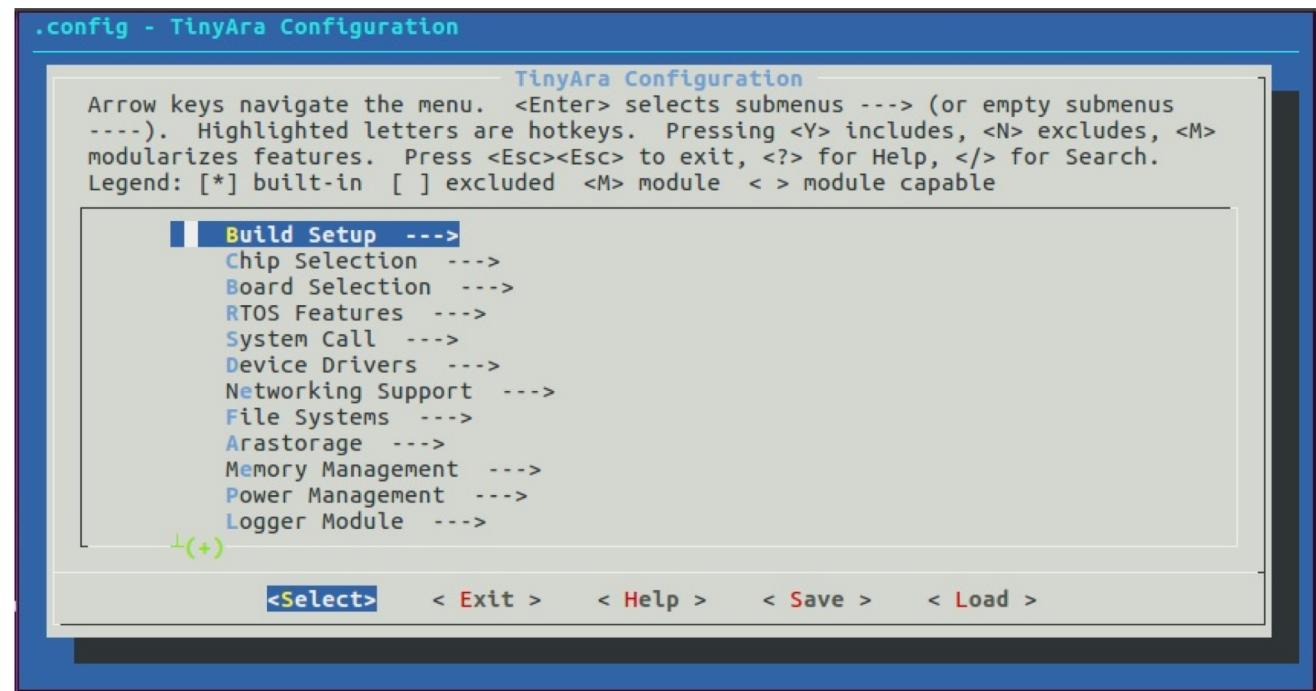
```
$ git clone https://github.com/SamsungARTIK/TizenRT.git
```

```
$ cd TizenRT/os
```

```
... •
```

```
$ make menuconfig
```

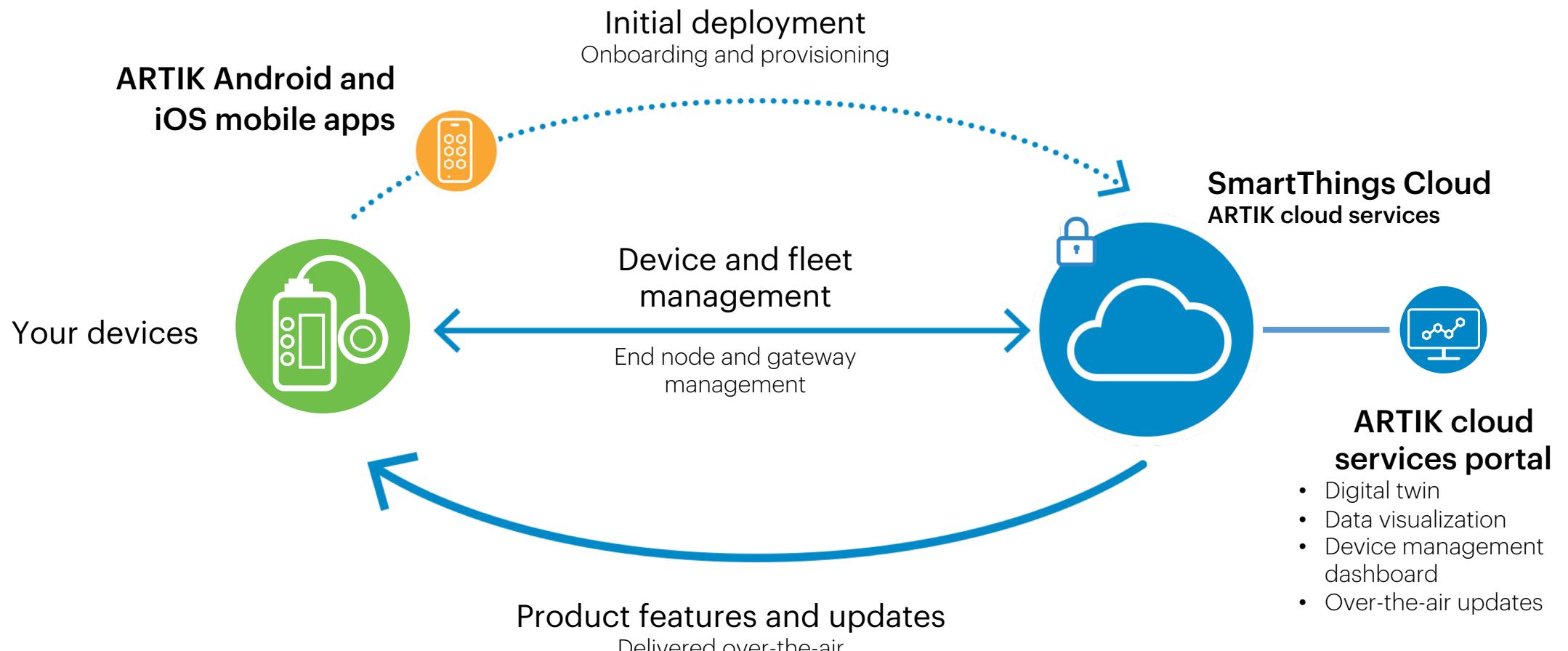
```
$ make
```



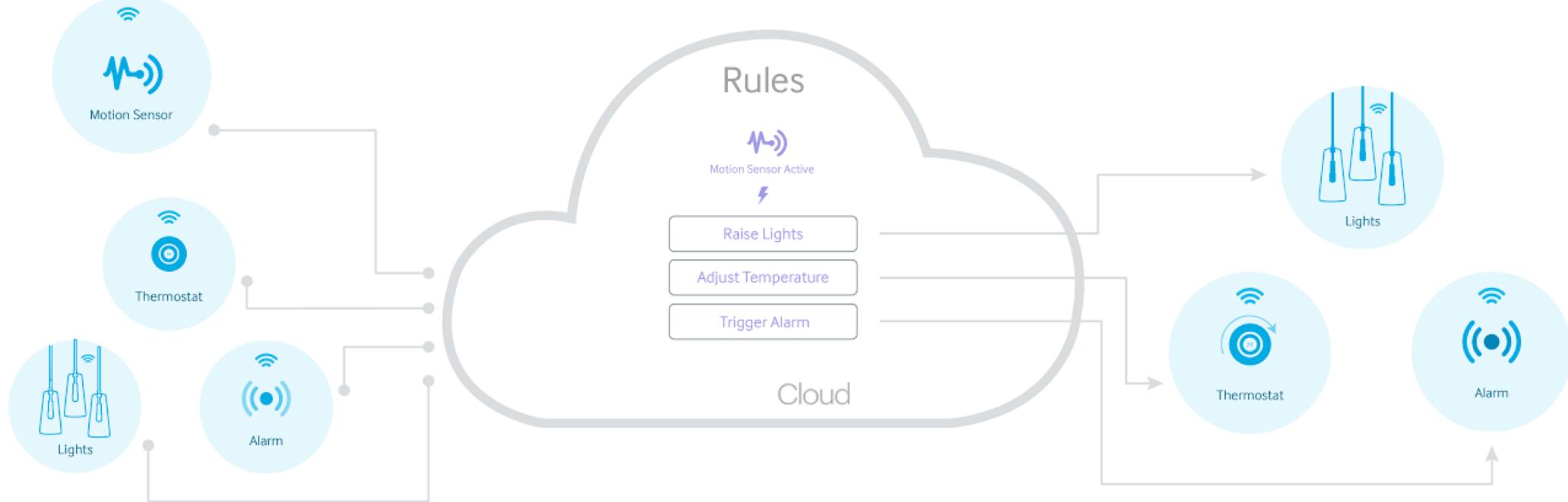
ARTIK Cloud service

Samsung ARTIK™ Device management and OTA

Onboard, manage, and service devices in the field



Data Management and Orchestration Engine



Secure Transaction

The screenshot shows the Samsung ARTIK developer console interface. On the left, there's a sidebar with sections for APPLICATIONS (Overview, Life Patterns, Permissions - highlighted in blue), DOCUMENTATION (Building Your First App, Platform Basics, API Specification), and a search bar. The main content area is titled "Life Patterns: Set Permissions". It shows a "PERMISSIONS" section with "Profile" and checkboxes for "Read" and "Write". Below that is a "DEVICE PERMISSIONS" section containing three entries: "Aqua Sense Moisture Sensor" with DTID: dt48b77c85e89b45fa8c584d5984763ab2, "Azumit Indoor Env. Smart Controller" with DTID: dt6ale49e696af4540820106d4966f13c4, and "Amazon Alexa" with DTID: dt15a0925c492043dcabbc15f61d1d2249. Each entry has "Read" and "Write" checkboxes. At the bottom are "ADD DEVICE TYPE", "SAVE", and "CANCEL" buttons.

- Secure Device Registration
- Authentication & Authorization
- Data Encryption
- Privacy Management

Samsung ARTIK™ cloud services on SmartThings Cloud

Connect devices, connect clouds, and put them to work

Serviceability features and unparalleled interoperability for ARTIK modules and third-party devices and clouds

- Interoperability: Data Normalization; Cloud Connectors;
- Device Management: Provisioning, and over-the-air updates
- Sophisticated orchestration engine to define one-to-many or many-to-many actions between connected devices and data sources
- Security & Privacy Management



ARTIK Security

Security Questionnaire

How do you provide security across all attack surfaces?

Question	ARTIK 5/7/053
Do you support secure communication from device to device or device to cloud? How do you secure communication? Are you using TLS1.2 or higher?	Yes, HTTPs using TLS 1.2
How do you establish identity of device?	Using unique certificate on each device
How does the device establish identity of cloud?	Both device and cloud are chained to ARTIK Root CA and can verify each other certificates
Do you have mutual authentication when enabling secure communication?	Yes
Do you have the infrastructure to inject unique key and certificate in each device to establish unique identity per device? How much does it cost?	Yes (Done at Samsung factory. Cost included in module)
How do you protect your certificate, keys? Are your certificate and keys safe if software is hacked?	Specialized HW on module (secure element)
Is your certificate infrastructure secure? How do you secure your Root Certificates? How much does it cost?	Yes (Root CA secured by 3 rd party security vendor)
How do you guarantee your firmware integrity?	Secure Boot

Non-S vs. S Modules

- Same HW specifications other than security features
- "S" type modules can be identified by **blue** labeling

Standard module



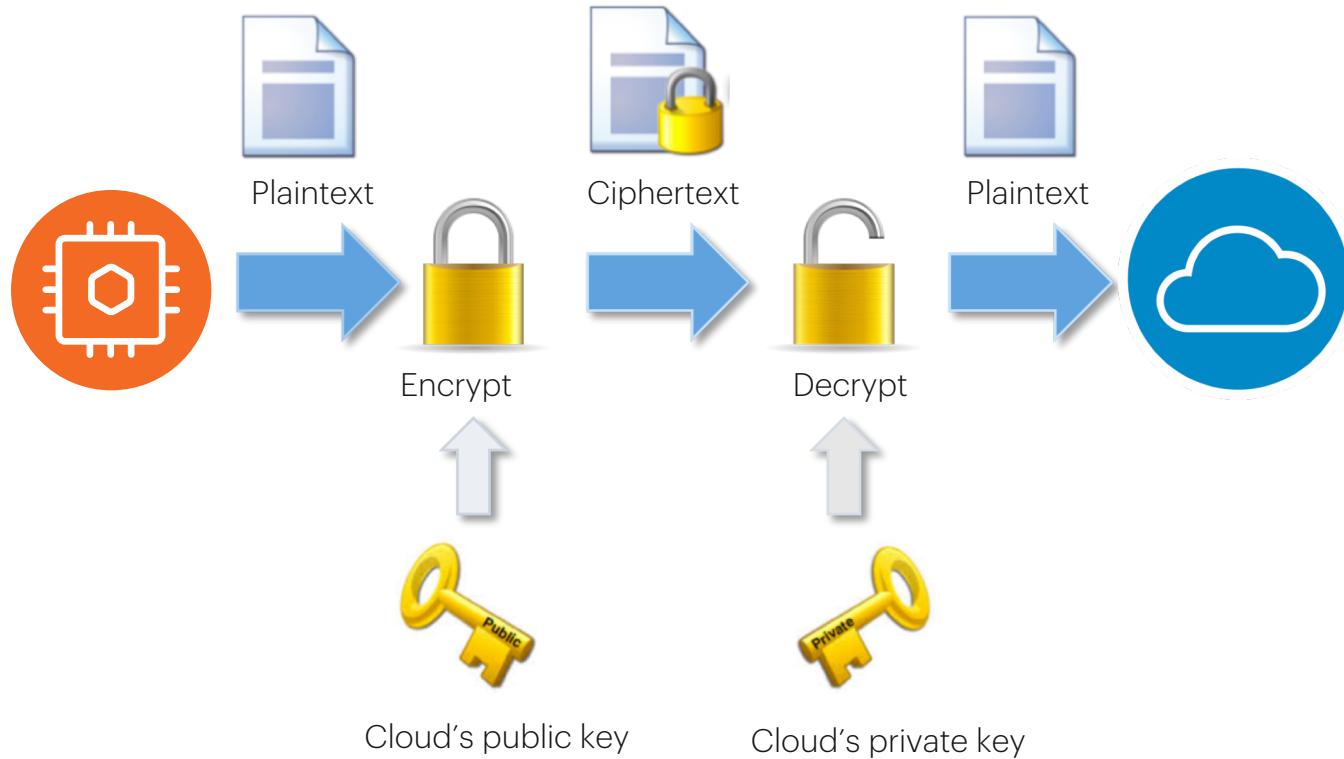
"S" module



ARTIK Security

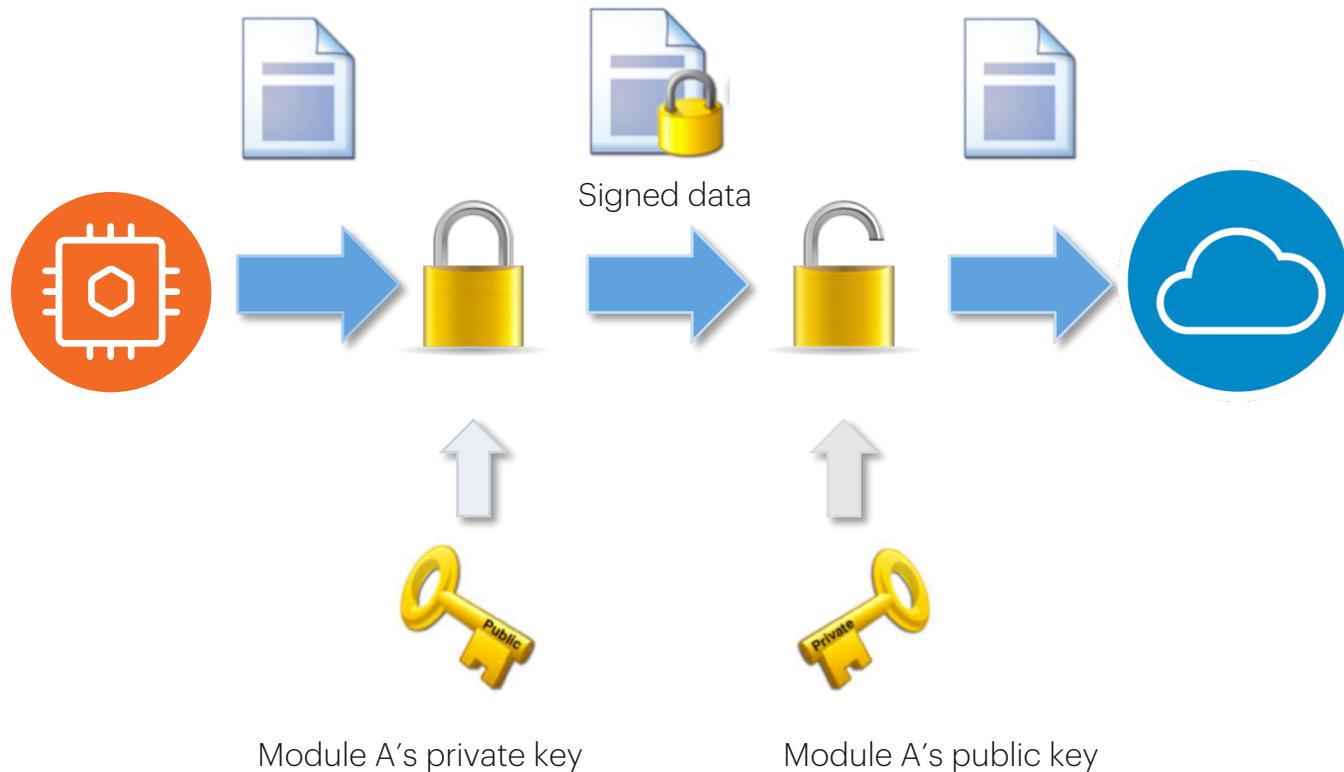
		ARTIK module (05x, 5, 7)	ARTIK S-module	Comments
Secure communication	Per device unique key & certificate	✓	✓	Uniquely identifies device
	Key stored in HW secure element	✓	✓	Secure key storage
	PKI infrastructure: Mutual authentication of device and cloud	✓	✓	Device talks to authorized cloud and vice versa
	Post Provisioning		✓	Provision with your own keys and certificates
Device protection/ secure code execution	KMS infrastructure for code signing		✓	Key Management Service
	Code verification key in HW		✓	Secure key storage
	Secure boot (check for authorized code)		✓	Boot image verification
	JTAG access locked		✓	Lock out debug access
Data protection/ Secure storage	Secure OS (separate normal & secure operations)		✓	Hardware enforced secure applications via TEE
	Security Lib API (27 API calls)	Limited(random number generator, get cert and signature)	✓	Key Manager, Authentication, Secure Storage, Post Provisioning, Encrypt/Decrypt
	Secure storage		✓	Encrypt data stored on Flash

Encryption and Decryption



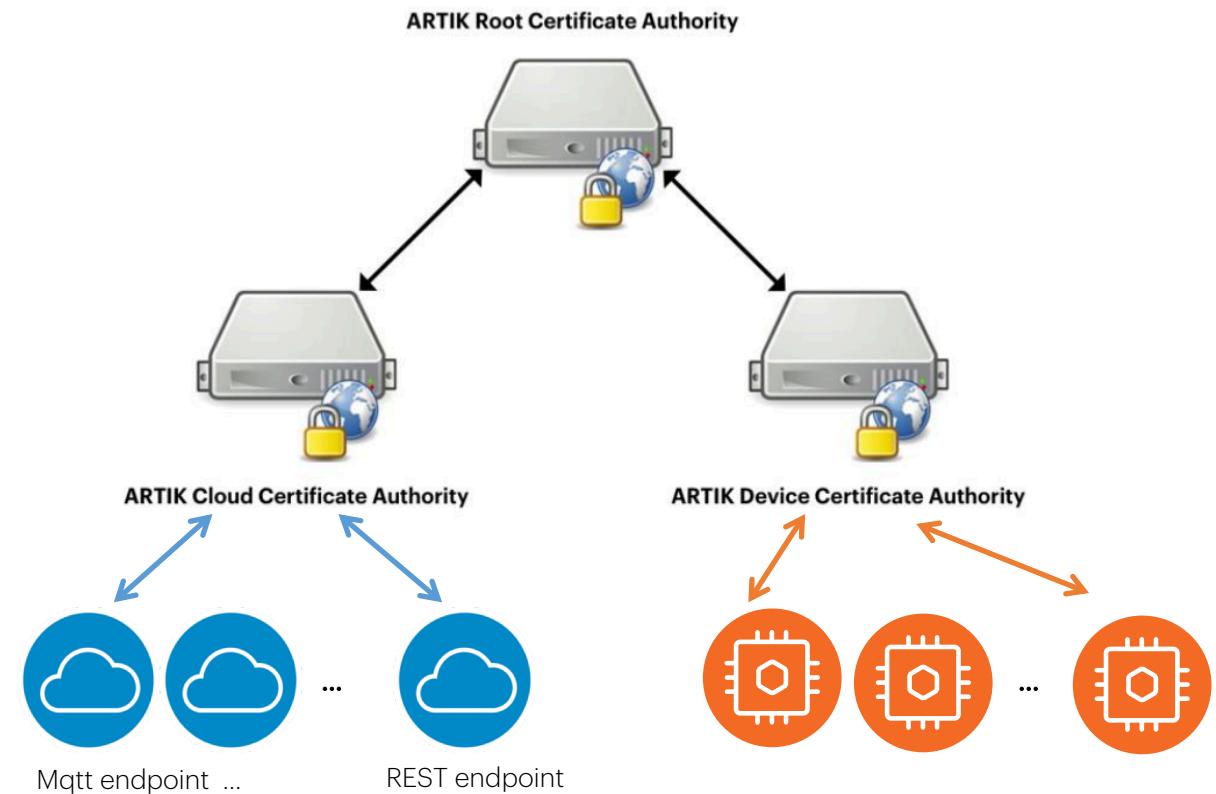
Different keys are used to encrypt and decrypt messages

Signature



ARTIK PKI

- A Public Key Infrastructure (PKI) supports the distribution and identification of public encryption keys, establishing authenticity and trust in a system.
- ARTIK provides its own PKI, which is used to generate and apply unique certificates and key pairs to each ARTIK Module during manufacturing.
- PKI's core concept is (Digital) Certificate. Issued by a **Certificate Authority**, e.g, GlobalSign, Symantec
- ARTIK Root CA



Mutual Authentication

- Each ARTIK module is provisioned with:
 - An unique private key
 - Its associated certificate containing a public version of the key.
 - An ARTIK Root CA certificate
- ARTIK Cloud's server certificate is also rooted to the ARTIK Root CA certificate
- At connect time, server and client exchange certificates for mutual authentication

Post Provisioning

- If you want to connect your ARTIK Module to a 3rd party Cloud service or implement a link between ARTIK modules, you need to generate your own certificate/key-pair
- We can use Post Provisioning to post provision customer credentials(key, certificate) to Secure Element

SSL/TLS/DTLS

- Transport Layer Security(TLS) and its predecessor, Secure Socket Layer(SSL) are cryptographic protocols designed to provide communication security.
- Use X.509 certificates(asymmetric) cryptography to authenticate the counterparty
- Negotiate a symmetric session key, which is to be used for data encryption
- DTLS is an implementation of TLS over UDP

Secure Communication

ARTIK Modules support:

- A unique pair of key and cert from ARTIK PKI
- True random number generator
- Cryptographic Accelerator, Encoding and decoding of packages
- TLS/DTLS library for creating the channel
- OpenSSL Engine which takes advantage of the hardware accelerated ARTIK security library to get keys from the secure element, encrypt and decrypt, encode and decode..
(Supported OpenSSL Ciphers: ECB, CBC, CTR etc.)

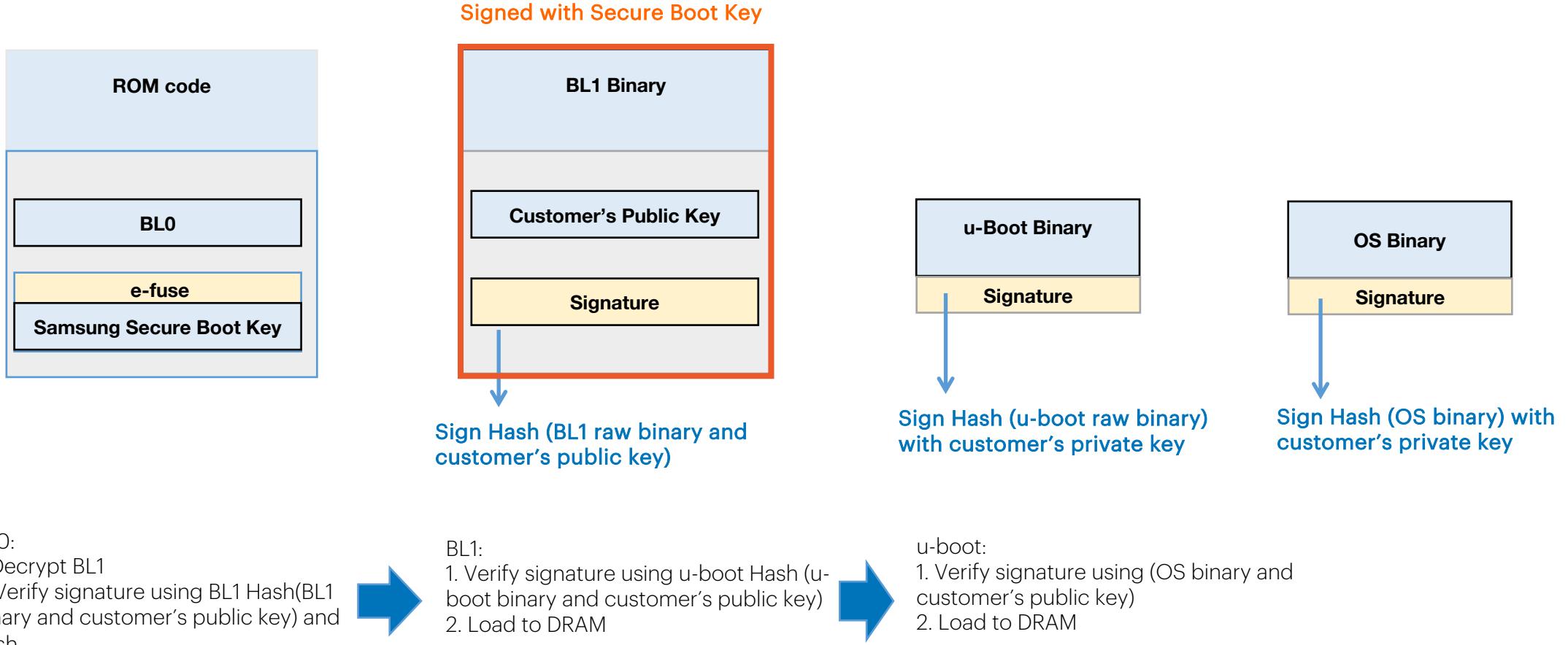
Secure Communication

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	Post Provisioning		✓	Provision with your own keys and certificates
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	Security Lib API (27 API calls)	Limited(random number generator, get cert and signature)	✓	Key Manager, Authentication, Secure Storage, Post Provisioning, Encrypt/Decrypt
	Secure storage		✓	Encrypt data stored on Flash

Secure Boot

- Secure Boot adds cryptographic checks to each stage of the boot process.
- The first element in the boot process authenticates the second, the second verifies the third.
- Authentication is based on digital signature verification.
- **Chain of Trust:** Every component can be authenticated before being executed.

Secure Boot for ARTIK S-Module



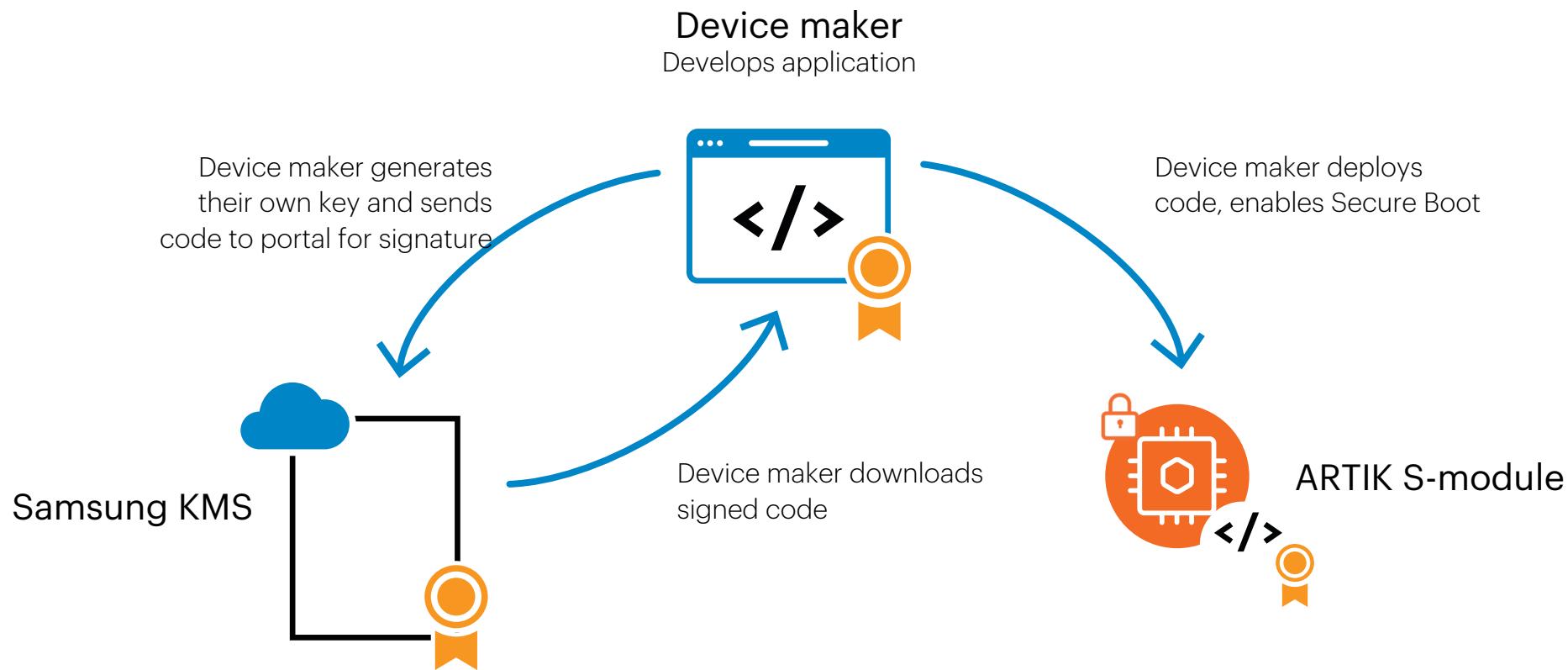
Key Management System

- Signing keys are stored and operated within FIPS 140-2 certified Hardware security modules (HSM)
- Images are signed through a highly secure cryptography standard (SHA-256 w/ RSA2048 encryption)
- Strict access control policies
- Only accessible through whitelisted IP addresses

NEW

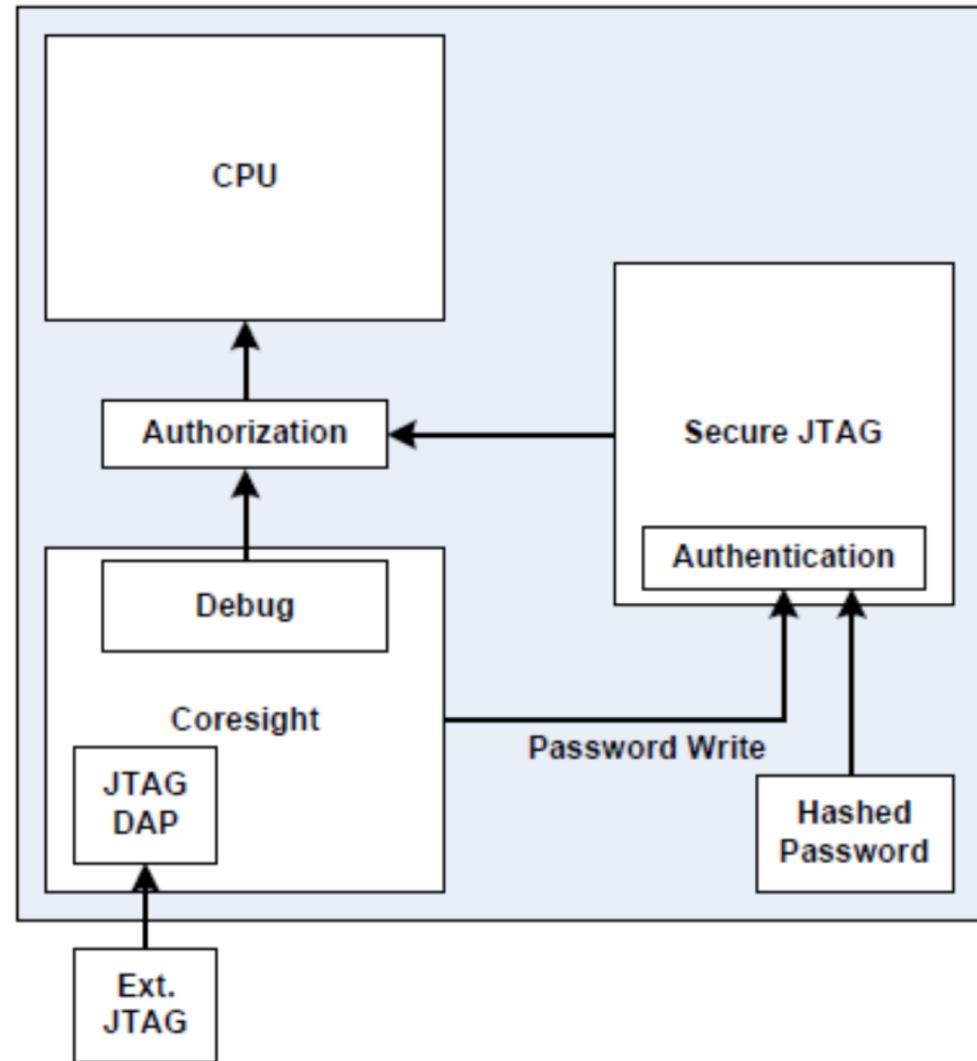
Samsung ARTIK™ Key Management System(KMS)

Code signing portal manages key signing



Secure JTAG

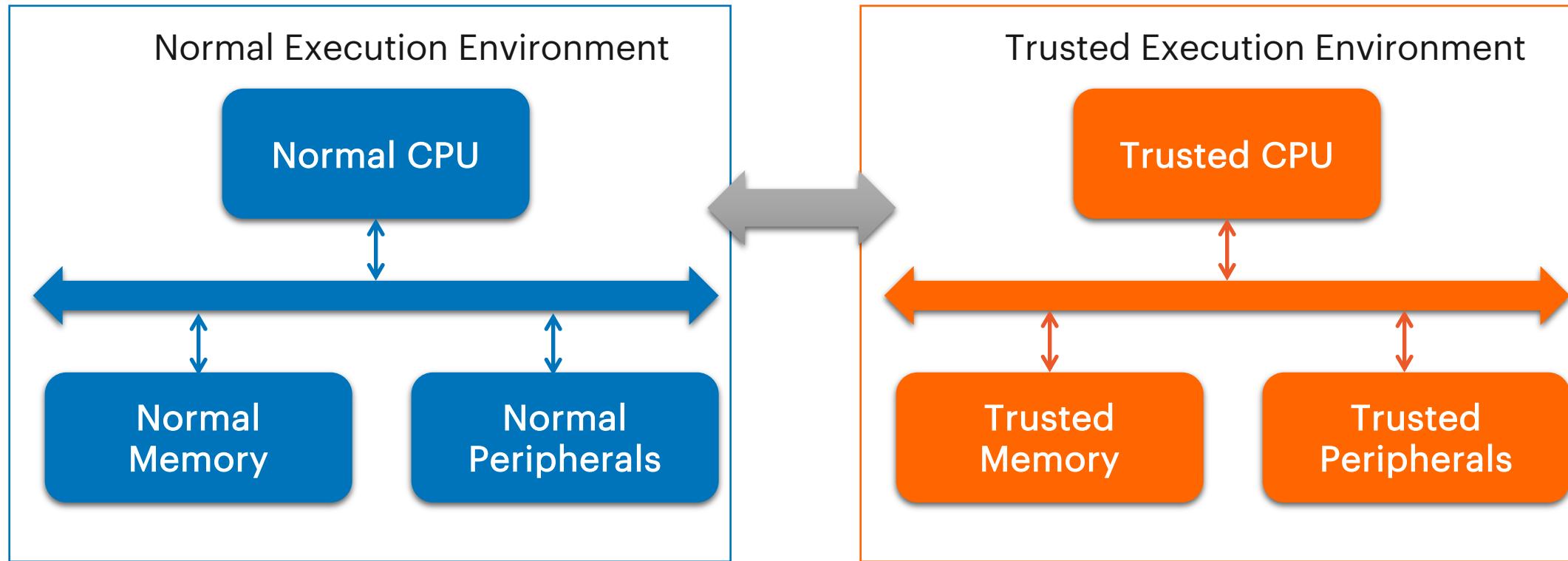
- JTAG is disabled by default.
- Secure JTAG can be enabled to an OEM, where it requires a password to authenticates and authorizes JTAG access. The password is based on the serial number of module.
- The information is only made available through an authorized request to Samsung.



Device Protection

		ARTIK module (05x, 5, 7)	ARTIK S-module (053s, 055s, 530s, 710s)	Comments
Secure communication	Per device unique key & certificate	✓	✓	Uniquely identifies device
	Key stored in HW secure element	✓	✓	Secure key storage
	PKI infrastructure: Mutual authentication of device and cloud	✓	✓	Device talks to authorized cloud and vice versa
	Post Provisioning		✓	Provision with your own keys and certificates
Device protection/ secure code execution	KMS infrastructure for code signing		✓	Key Management Service
	Code verification key in HW		✓	Secure key storage
	Secure boot (check for authorized code)		✓	Boot image verification
	JTAG access locked		✓	Lock out debug access
Data protection/ Secure storage	Secure OS (separate normal & secure operations)		✓	Hardware enforced secure applications via TEE
	Security Lib API (27 API calls)	Limited(random number generator, get cert and signature)	✓	Key Manager, Authentication, Secure Storage, Post Provisioning, Encrypt/Decrypt
	Secure storage		✓	Encrypt data stored on Flash

Trusted Execution Environment on 5/7x (TEE)



- ARTIK 5 and 7 module families support Trusted Execution Environment(TEE)
- Samsung TEE implementation is based on ARM TrustZone hardware architecture
- TEE provides a fully-isolated and secured operation environment

Secure Storage – eMMC file system

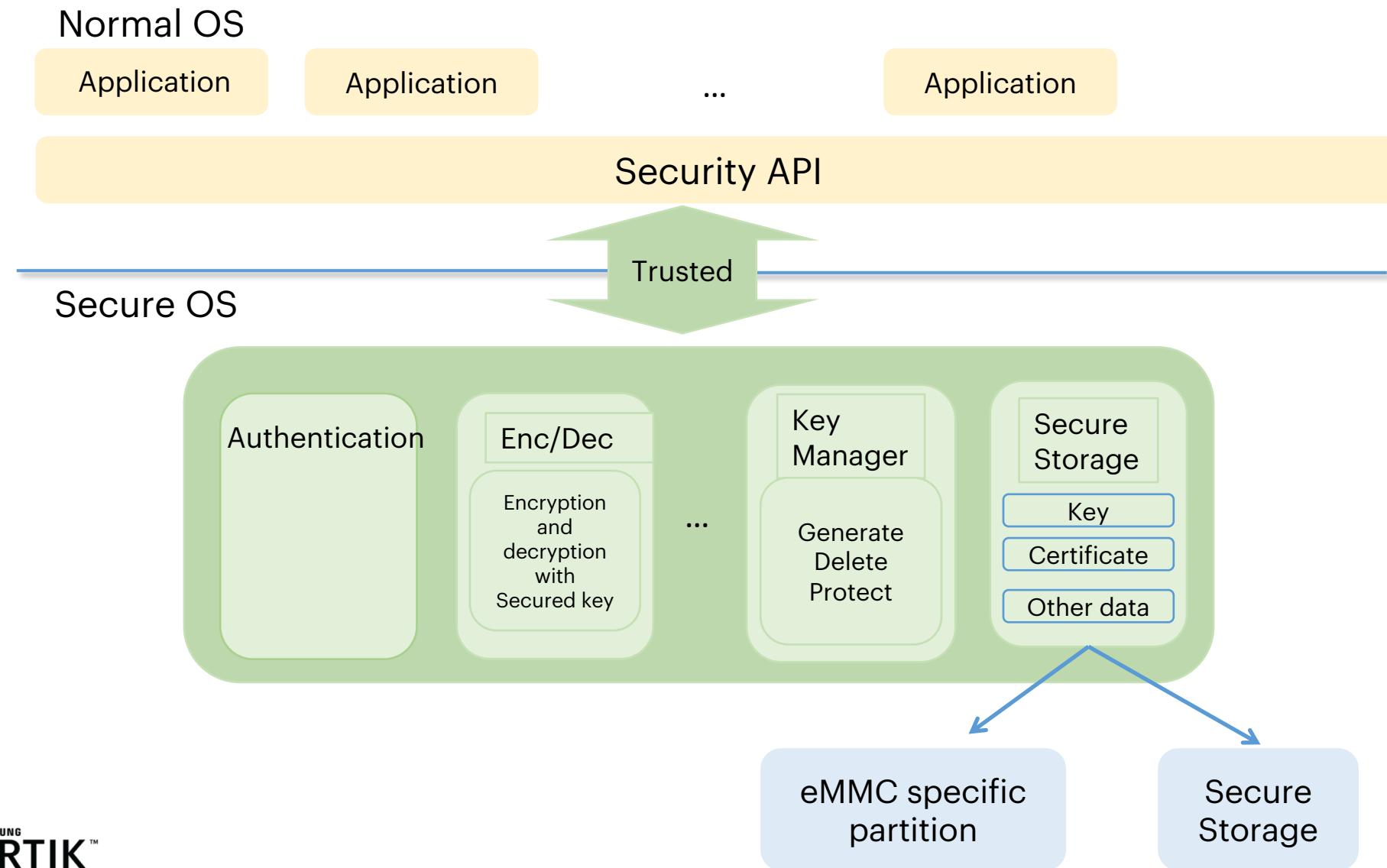
- eMMC file system (Flash-based)
 - Uses the same storage as the normal operating system. However, a specific partition is managed by Secure OS.
 - All data in this partition is encrypted with a unique key generated at run time, and is stored as a file unit of 32KB with a maximum of 1024 files that may be stored.
 - Applies to ARTIK 05x and 5/7 modules.

Secure Storage – Secure Element

Secure Element – an isolated storage device that supports 2 slots of ECDSA key pairs (16 AES 128-bit keys).

- The Secure Element provides high levels of security as hardware with anti-tamper measures.
- It includes cryptographic services such as random-number generation, key/data secure storage, and certificates handling and processing.
- All communication from the Secure Element to the processor is secured and encrypted.
- Uses Power glitch detector, Active Shield removal detector etc. technologies to achieve the highest level of security and protection.
- The Secure Element meets the Common Criteria (CC) certification for security and for Evaluation Assurance Level (EAL) 5.

ARTIK SEE Architecture



ARTIK SEE APIs

Category	ARTIK API	Description
Initialize	see_init	
	see_deinit	
Key Management	see_generate_key	generate symmetric and asymmetric keys(AES, ECC Curve, HMAC type)
	see_set_key	set external symmetric and asymmetric key to secure storage
	see_get_pubkey	get public key of asymmetric key from secure storage
	see_remove_key	remove a key from secure storage
Authentication	see_generate_random	Generate a random number
	see_generate_certificate	Generate, set and get a certificate
	see_set_certificate	
	see_get_certificate	
	see_get_rsa_signature	Get , verify signature using RSA, ECDSA algorithm
	see_verify_rsa_signature	
	see_get_ecdsa_signature	
	see_verify_ecdsa_signature	
	see_get_hash,see_get_hmac	Hash Messages
	see_generate_dhparams(ecdhkey)	

ARTIK SEE APIs

Category	ARTIK API	Description
Secure Storage	see_read_secure_storage	Read data from secure storage
	see_write_secure_storage	Write data to secure storage
	see_delete_secure_storage	Remove data from secure storage
	see_get_size_secure_storage	Get data size from secure storage
	see_get_list_secure_storage	List data in secure storage
Post Provision	see_post_provision	Injecting an HMAC key or asymmetric key pair(ECC/RSA) into the secure element
	see_post_provision_lock	
Encryption/Decryption	see_aes_encryption	AES Encryption/Decryption
	see_aes_decryption	
	see_rsa_encryption	RSA Encryption/Decryption
	see_rsa_decryption	

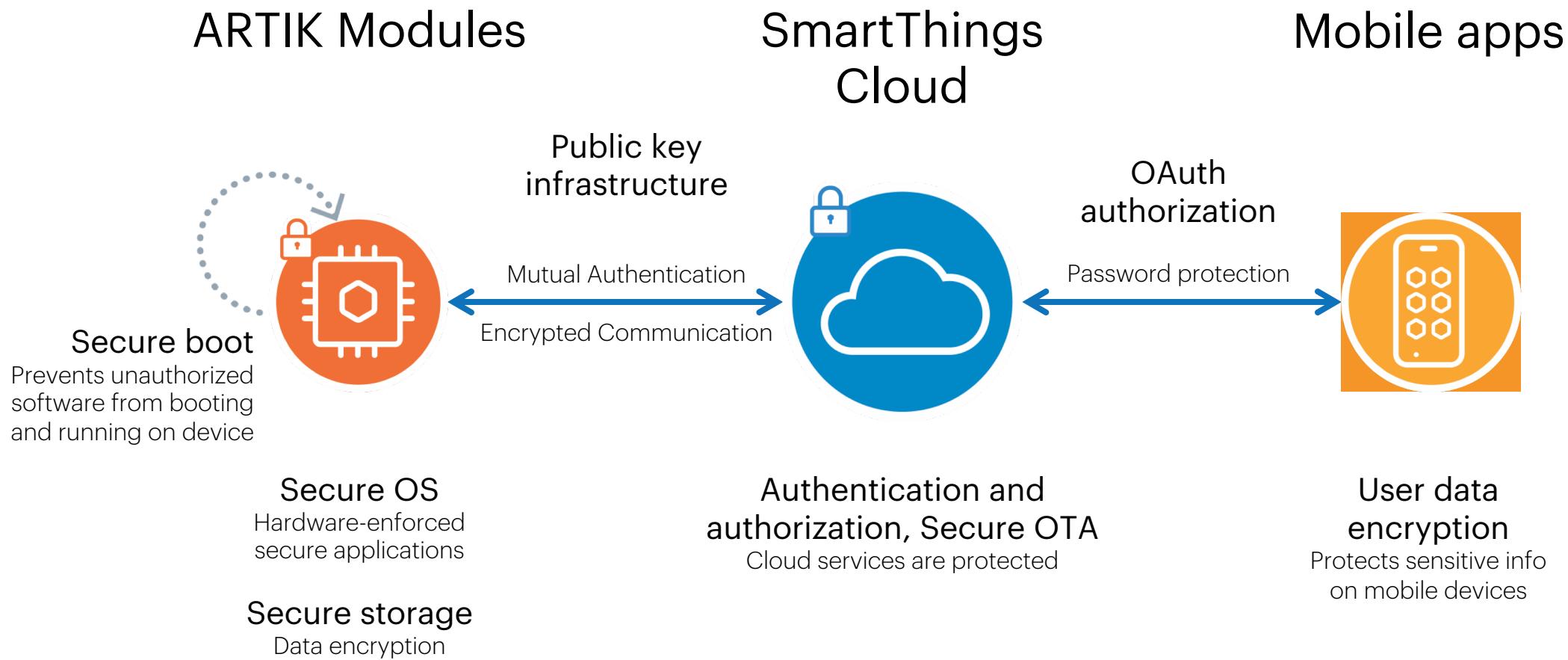
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Platform Security

Samsung ARTIK™ End-to-end Platform Security

End-to-end protection for you and your customers



Samsung ARTIK™ End-to-end Platform Security*

	Feature	ARTIK
Modules	Secure element key storage, secure boot	Included
	Security infrastructure: PKI and KMS	Included
	Unique device ID and certificate	Included
	Secure data storage with data encryption	Included
Platform software	Secure device registration	Included
	Secure OTA updates	Included
Cloud Infrastructure	Supports HIPAA compliant solutions	Included
	OWASP top 10	Included
	Internal and external security audits	Included
Cloud services	AAA (Authentication, Authorization, Accounting)	Included
	API Security	Included
	3 rd party device discovery and mutual authentication	Included
	Data privacy management, identity, permissions,	Included
Communications	TLS, VPN	Included
	DTLS Application level security; BLE session security	Included
Applications	Key and secure app data encryption and storage	Included
	2-factor authentication; OAuth2; client side certificates	Included

* Feature list is not exhaustive

ARTIK Use Cases

RushUp Kitra GTI

Leverage IoT with industrial I/O, sensors, and LTE

Building automation, manufacturing, remote asset management:
connect easily to existing infrastructure with analog I/O

- **Retrofit in minutes:** Multiple analog I/O for external sensors such as current, temperature and humidity, relay and contact; digital input for contact switches; support for Mod bus
- **Based on ARTIK 710s:** includes 4G LTE, GNSS, for long range connectivity and location; security includes secure boot, secure OS, secure storage, secure communication, KMS, PKI
- **Embedded sensors:** temperature, accelerometer, gyro & microphone
- **Cloud ready:** ARTIK cloud services SDK pre-installed, works with Azeti asset monitoring or PTC Thingworx



Beck CTS 140.K

Integrate existing industrial equipment into the IoT

Beck's long experience in the industrial market makes IoT easy.

The CTS 140.K features a wide range of field bus protocols, WIFI, BT, and cellular

- **Cloud native:** use Beck's cloud broker or ARTIK cloud services
- **On premise:** connect to a local server and manage via a simple Web interface using PC, tablet or smartphone
- **Customize:** Add/remove RS485, Ethernet, I/O options; Beck's experience provides for smooth integration
- **Security features:** ARTIK 710s provides secure boot, secure OS, secure storage, secure communication, KMS, PKI



Customer Use Cases



Legrand: Global residential and commercial digital building infrastructure

Challenge: Transform product line to meet new connected digital mkt requirements.
Fast time to mkt. Interoperability.

Products: ARTIK 530s, 710s secure system-on-modules, ARTIK cloud services

Why ARTIK? Reduced product development time. Built-in software eliminated internal dev skills roadblock. Security allows them to meet new customer reqs. Interoperability expands switch capabilities, helped them get POC with Marriott "Room of the Future".



NDA Customer: Factory automation provider

Challenge: Retrofit customer OT to meet requirements for Industrie 4.0, enable access to data and create digital twins for more efficient operations. Ensure secure operations.

Products: ARTIK 530s secure system-on-module, ARTIK partner PTC

Why ARTIK? Secure gateway solution for their industrial gateway with access to local sensors, ability to do local processing and edge node management, application to view data via integration with PTC Thingworx front end application.

Customer Use Cases



NDA Customer: On-body multimedia hub for first responders

Challenge: Performance and capabilities including high-resolution video. Connectivity with other on-body sensors. Reliability.

Products: ARTIK 710s secure system-on-module, evaluating cloud services for data capture and management

Why ARTIK? Best performance and value relative to cost. Secure data storage and communications.

Samsung Device Solutions

Challenge: Quickly develop a cost affordable android-based multi-dwelling control panel that runs video.

Products: ARTIK 7x secure system-on-module, ARTIK cloud services on SmartThings Cloud

Why ARTIK? No product on the market which meets their specs for Android/video and security. Ability to customize 710 to meet their high volume requirements. Interoperability and access to additional service with ARTIK cloud services on SmartThings Cloud. Built-in security.

Customer Use Cases



NDA Customer: Assisted Living platform to provide status and data without being intrusive

Challenge: Started with Intel Edison, which EOLd the product. Needed a fast replacement, with minimal development time, BT beacon tracking, WiFi, video and sensor inputs.

Products: ARTIK 530 system-on-module, evaluating ARTIK cloud services

Why ARTIK? Were able to quickly replace the module with factory-ready, pre-certified product, and minimize lost time to market with an added bonus - ability to access ARTIK integrated cloud services.



NDA Customer: Telecommunications company providing low-cost high speed data access platform and base station for homes

Challenge: Needed high end processor capable of complex operations for edge computing.

Product: ARTIK 710 system-on-module

Why ARTIK? Provides price performance to meet their requirements. Allowed them to quickly "prove" their product with ability to quickly scale up on production-ready product.

Machine Learning Inference

ARTIK 5x/7x

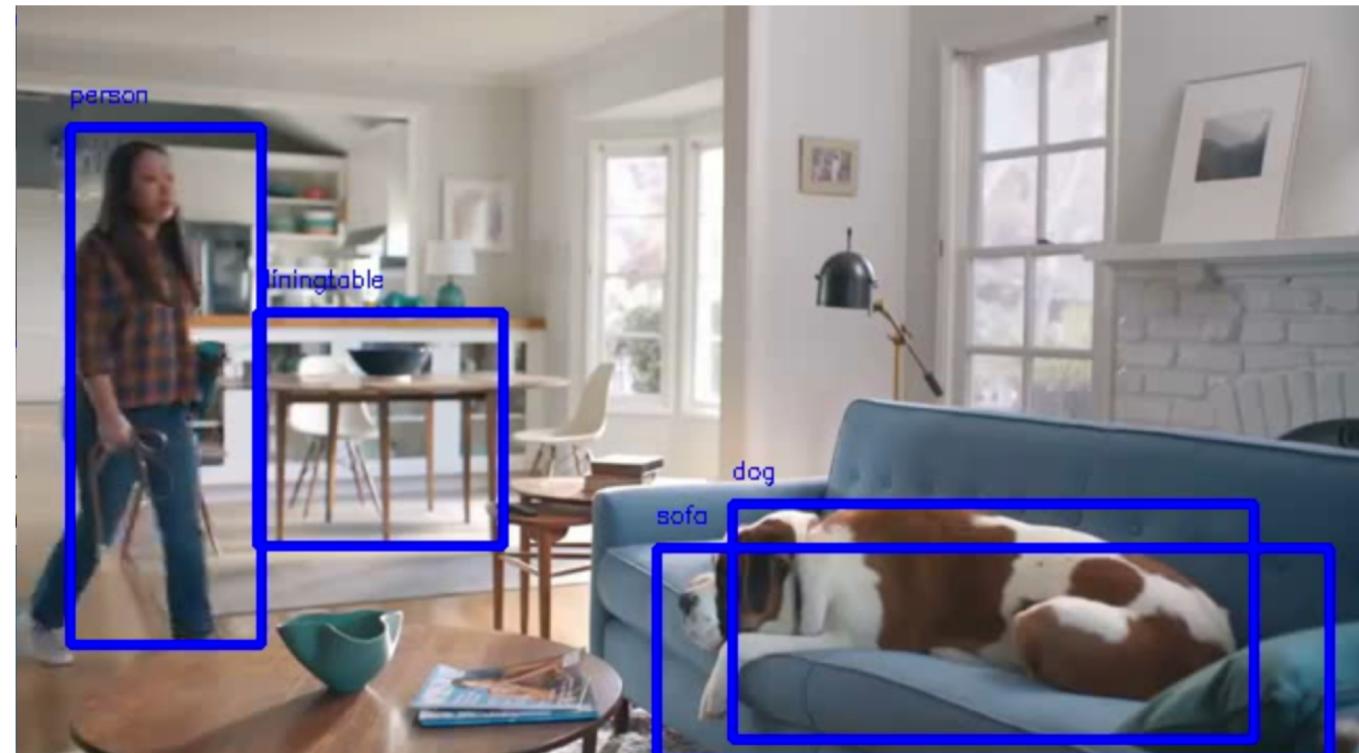
Run Machine Learning Inference on ARTIK gateway devices

Use case: Smart Factory, Smart Building etc.

Hardware: ARTIK 5x/7x

Software: Tensorflow (Lite);

AWS Greengrass ML Inference;



Shoreline iCast2 Modbus Solution

ARTIK 05x

- ARTIK 05x Module
- Wi-Fi 2.4GHz, BLE 5.0 including 802.15.4 Radio and Thread SW stack
- Analog I/O, GPIO, I2C etc.
- Isolated RS485 serial port
- Supports ARTIK Cloud, PTC ThingWorx, AWS IoT



Smart appliances and edge analytics

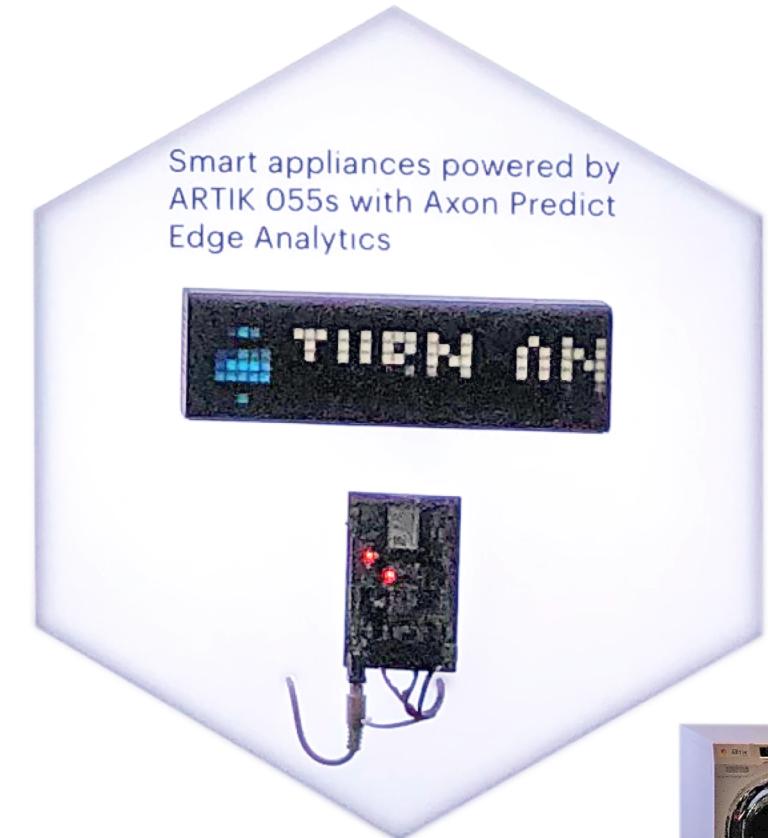
ARTIK 055s SoM and Axon Predict Edge Analytics

ARTIK 055s-powered smart washer with edge analytics for detergent level check, predictive maintenance, etc. Washer can be controlled by a mobile app or voice. Alerts show on LaMetrics display.

Use case: Smart home appliances

Hardware: ARTIK 055s WiFi module, washer with weight sensor, water level sensor etc., mobile device, LaMetrics display (optional)

Software: SmartThings Cloud cloud connector, rules engine; Android mobile app; AXON Predict Analytics

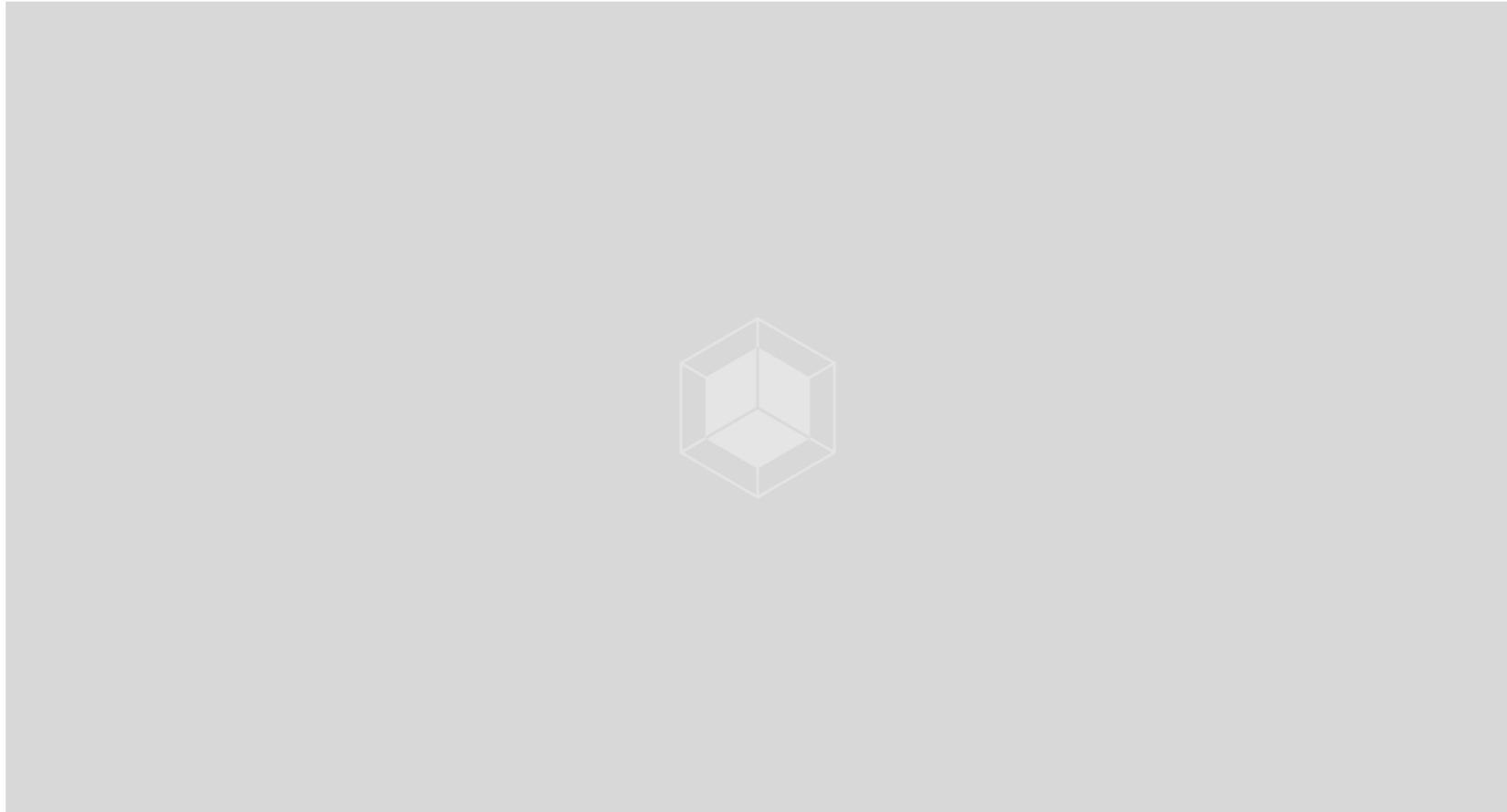


Con

Online Resources

Online Resources

- Datasheets
- User-guides
- Schematics
- PCB layout
- BOM
- Firmware
- Tools



Online Resources



The screenshot shows the Samsung ARTIK website at https://www.artik.io. The header includes the ARTIK logo, navigation links for Overview, Products, Resources, Partners, Contact, and News, a search icon, and a Log Out button. A banner on the left features a cityscape background with the text "Your fastest path to the Internet of Things" and a description of the ARTIK platform. To the right, a section introduces the ARTIK 530 module, showing its image and a link to "See the specs >". Below this, a large section titled "The ARTIK End-to-end IoT Platform" highlights three main components: Modules, Cloud, and Ecosystem, each with a corresponding icon and brief description.

Samsung ARTIK™

Overview Products Resources Partners Contact News

Datasheets

User-guides

Schematics

PCB layout

BOM

Firmware

Tools

Your fastest path to the Internet of Things

Samsung ARTIK™ is the integrated Smart IoT platform providing the fastest path to secure, interoperable, and intelligent IoT products and services.

Watch the video Learn more

Introducing ARTIK 530

Higher power, lower cost module for multimedia and gateway devices.

See the specs >

The ARTIK End-to-end IoT Platform

The Samsung ARTIK Smart IoT platform brings hardware modules and cloud services together with an ecosystem of tools and partners to speed up your time-to-market.

Modules

Dream big. Integrate and scale fast.
Lock it up tight.
Meet our family of flexible, pre-

Cloud

Everything you need in one place and easy to use. Collect, store, and act on any data from any device or cloud

Ecosystem

If you'd like help designing, prototyping, or manufacturing, ARTIK Partners can help make your IoT

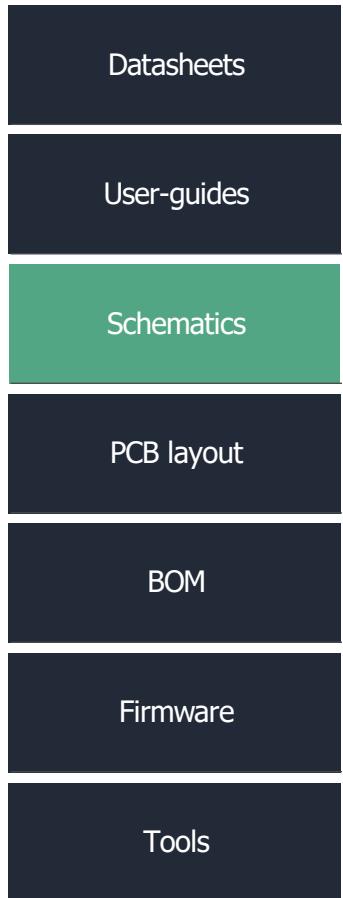
Online Resources



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Online Resources



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Online Resources



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SAMSUNG ARTIK™

Overview Products Resources Partners Contact News

Datasheets User-guides Schematics PCB layout BOM Firmware Tools

Your fastest path to the Internet of Things

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Watch the video Learn more

Certified Partners

Get to market even faster with Certified ARTIK Partners.

Partner directory >

The ARTIK End-to-end IoT Platform

The Samsung ARTIK Smart IoT platform brings hardware modules and cloud services together with an ecosystem of tools and partners to speed up your time-to-market.

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Dream big. Integrate and scale fast.
Lock it up tight.
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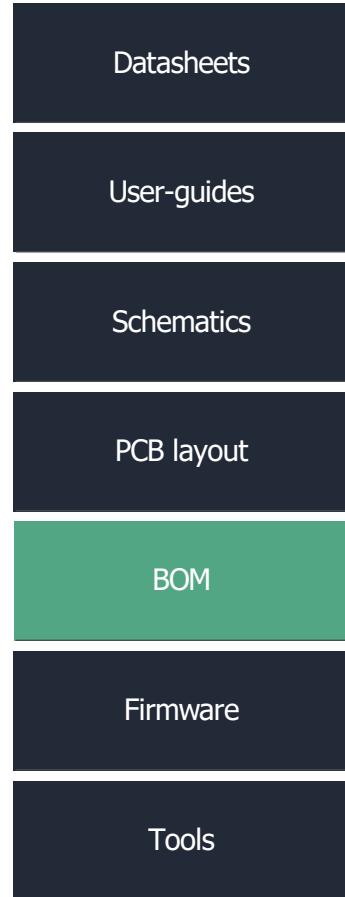
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Everything you need in one place and easy to use. Collect, store, and act on any data from any device or cloud

Ecosystem

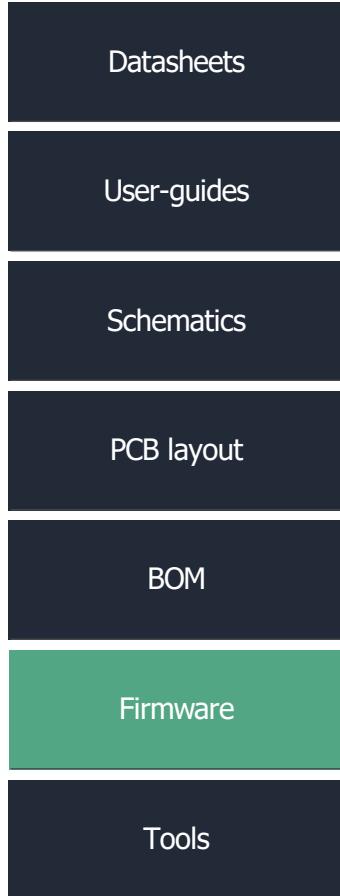
If you'd like help designing, prototyping, or manufacturing, ARTIK Partners can help make your IoT

Online Resources



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Online Resources



Samsung ARTIK™

Overview Products Resources Partners Contact News

Log Out

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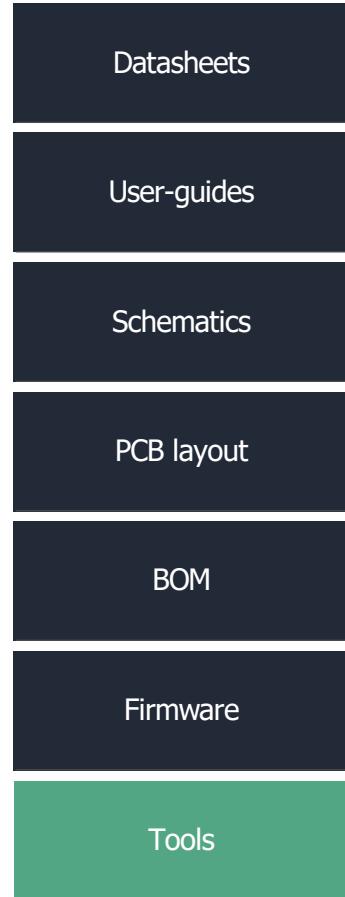
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Overview Products Resources Partners Contact News

Log Out

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Smart Lighting eBook

Don't create smart lighting solutions in the dark. Our new eBook asks 7 key questions.

Learn more >

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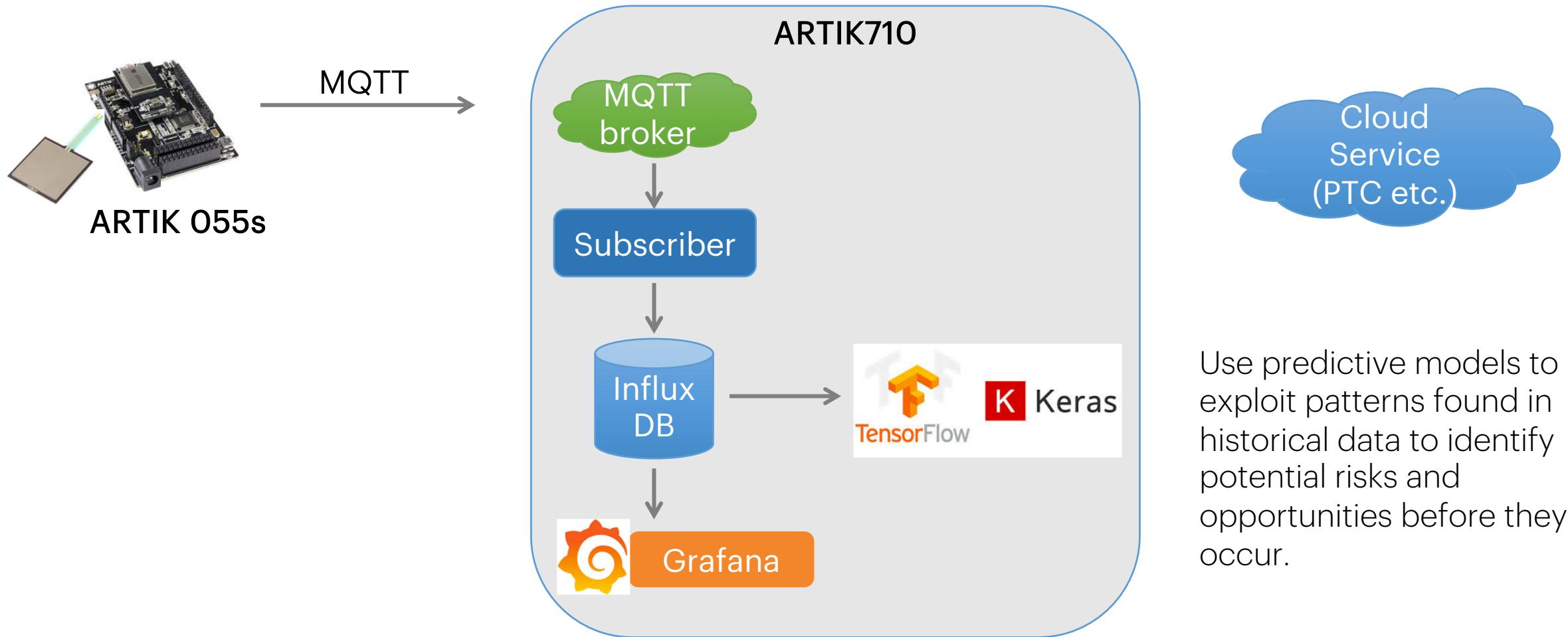
Samsung ARTIK™

Helpful web resources

Web Documentation	https://developer.artik.io/documentation/
Document Library	https://www.artik.io/library/
Forums	https://developer.artik.io/forums/
Blog	https://www.artik.io/blog/
File Tickets	https://support.artik.io
Github Repository	https://github.com/SamsungARTIK
YouTube Channel	https://www.youtube.com/channel/UC4rolvSm8ikmnymdbznNJw

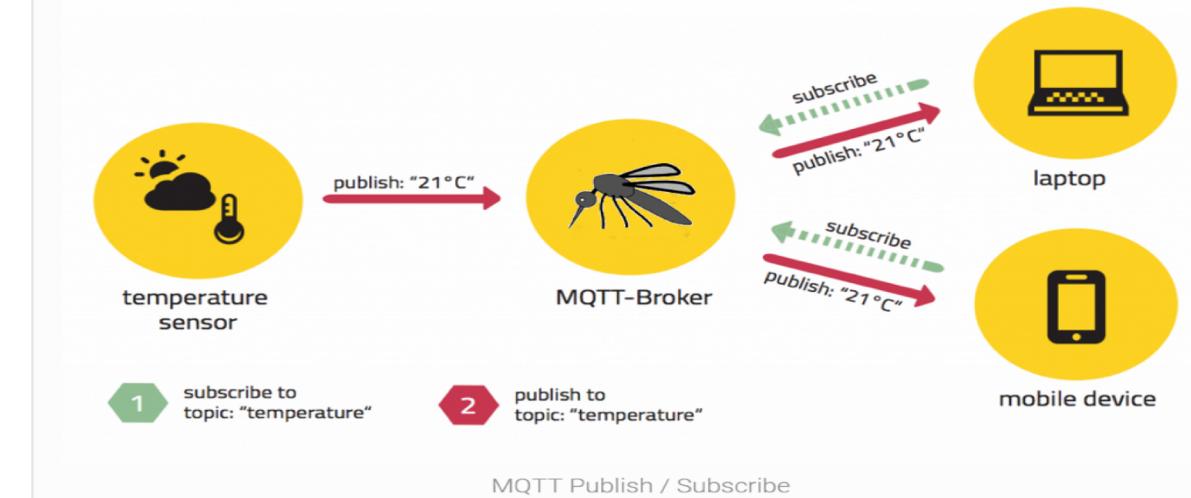
Hands-On Exercises

Diagram



Message Queue Telemetry Transport (MQTT)

- MQTT history
- Light-weight messaging protocol, rides on TCP
- Broker / Clients architecture
- Publication / Subscription messaging model
- No pre-defined format for payload



MQTT Broker

- MQTT Broker is responsible for receiving all messages, filtering them, and sending the messages to all subscribed clients.
- It holds the session of all persistent clients including subscriptions and missed messages
- Authentication and authorization of clients.
- Self Hosted MQTT brokers:

Eclipse Mosquitto



HiveMQ(licensed/open)



- Cloud based MQTT brokers:

AWS



IBM Bluemix



HiveMQ (broker.hivemq.com)



Microsoft Azure



Eclipse Mosquitto (test.mosquitto.org)



MQTT Client

- MQTT client includes publisher or subscriber
- In general, a MQTT client can be both a publisher & subscriber at the same time
- A MQTT client can run on any device from a micro controller up to a server. MQTT C client code only takes 30KB, Java code is about 100KB.
- MQTT client libraries are available for a huge variety of programming languages, e.g, C/C++, Arduino, Java, JavaScript, Android, iOS, C#, .NET

<https://github.com/mqtt/mqtt.github.io/wiki/libraries>

- MQTT client: Eclipse Paho



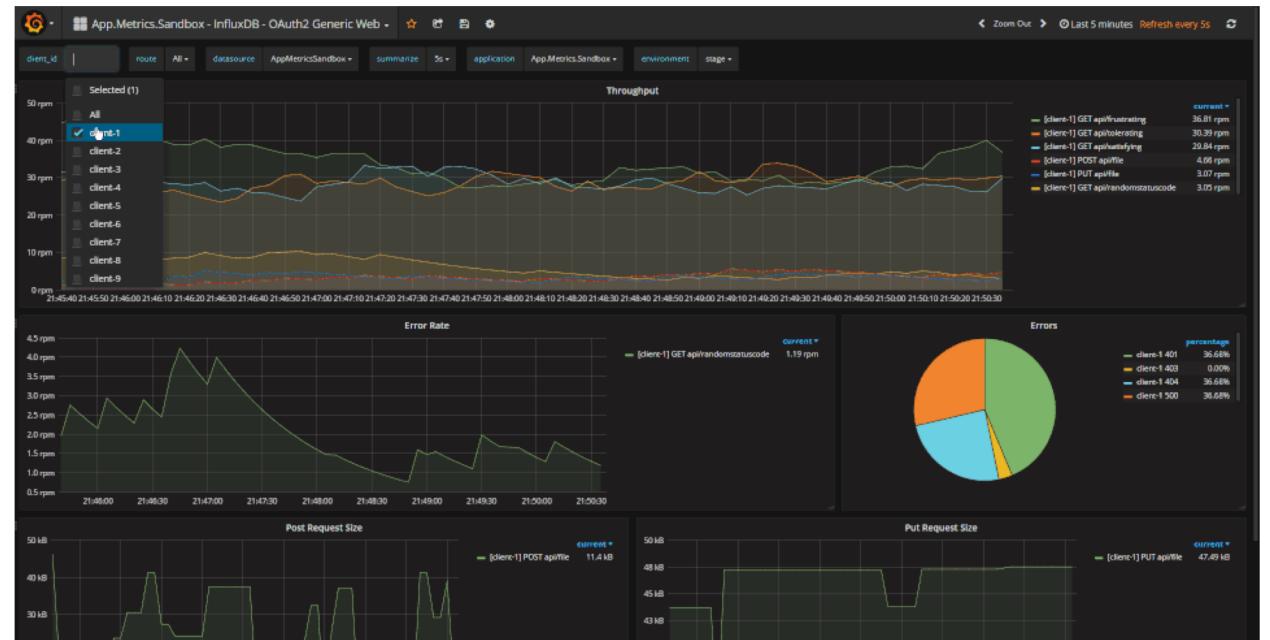
MQTT.fx(available for Win/MacOS/Linux) etc.

InfluxDB

- Time series database
- SQL-like query language

Grafana

- Grafana is a visualization and dashboarding tool for time series data
- Supports data source including InfluxDB, Graphite, Elasticsearch, CloudWatch etc.



TensorFlow

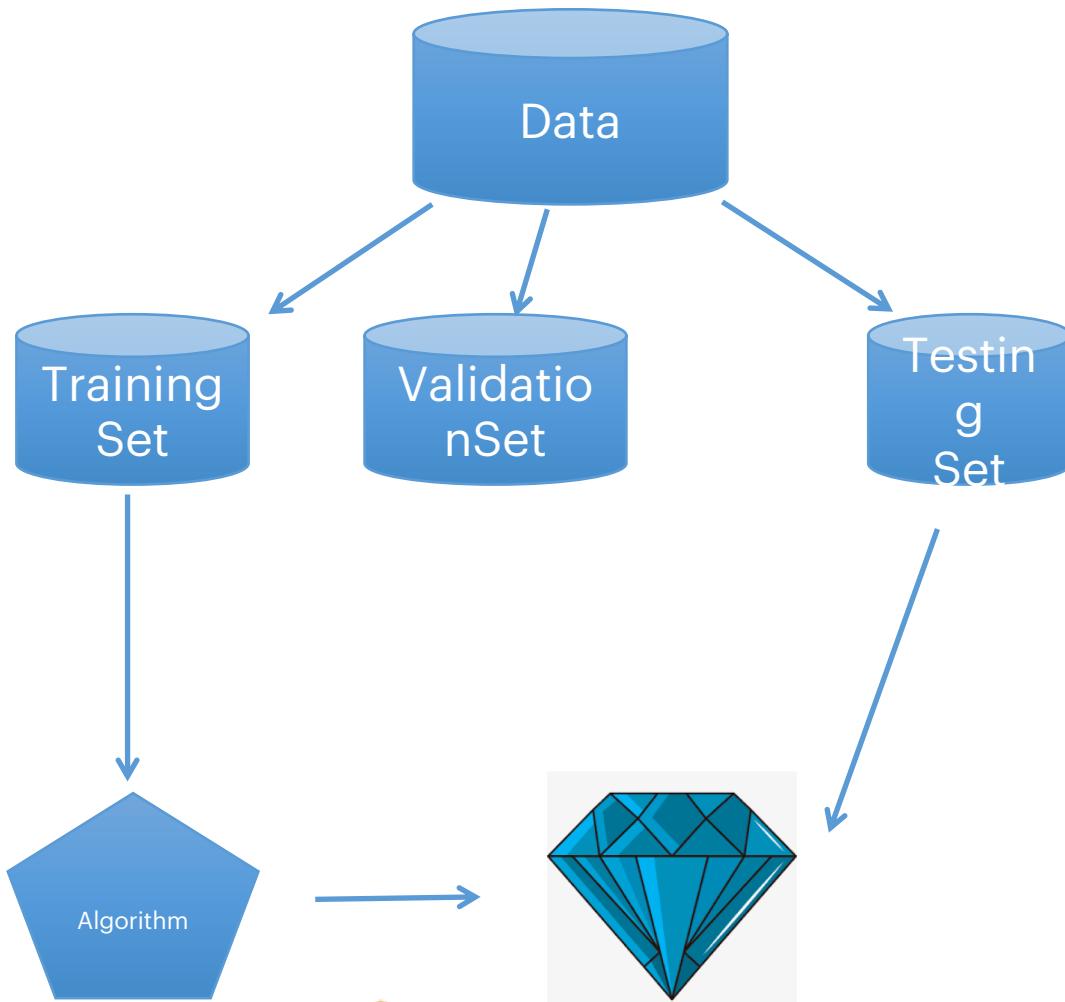
- Library for numerical computation using data flow graphs
- Gives user platform to describe high level modeling without exposing the underlying implementation (hardware etc.)
- Built/Maintained by Google
- Quickly becoming the standard for machine learning and data science

Keras

- High-level python API which can be used to quickly build and train neural networks using either Tensorflow or Theano as backend. Can run the same code with different back-end.
- Light-weight and quick.

Model Building

Machine#	Pressure	Temperature	Humidity	Churn
----------	----------	-------------	----------	-------



Long short-term Memory(LSTM):
Multivariate Time Series
Forecasting

 TensorFlow™

PTC/ThingWorx

- Product Advisor
- Asset Advisor
- Manufacture App



Tasks

- On ARTIK 055s, Collect sensor data and stream to ARTIK 710 by using MQTT
- On ARTIK 710s, Listen for incoming
- InfluxDB and Grafana for sensor time series
- TensorFlow for Machine Learning Inference

ARTIK Training Tues

Samsung ARTIK™ Training Tues

2-hour training sessions every other Tues starting from Aug, 14th

Level 1: ARTIK Fundamentals (Lecture. No ARTIK hardware is required)

- L1_1: ARTIK Intro: ARTIK Intro and guide audience through online resources
- L1_2: Cloud communication
- L1_3: ARTIK 310 Intro

Level 2: ARTIK HW/SW Features (Lecture + interactive exercise / hands-on)

- L2_1: ARTIK System Design, ARTIK 05x Overview
- L2_2: Security
- L2_3: HW Interfaces
- L2_4: Connectivity

Level 3: ARTIK Applications and Solutions (mostly hands-on.)

- L3_1: How to use ARTIK with AWS (05x hands-on)
- L3_2: Use TensorFlow (Lite) on ARTIK gateway for Machine Learning Inference (5x/7x hands-on)
- L3_3: Build an AVS/Google Assistant voice-enabled gateway(5x hands-on)

