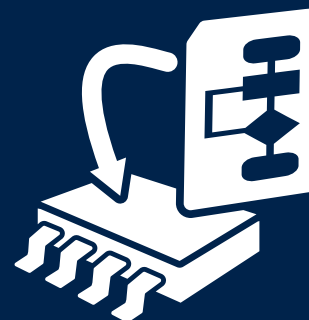




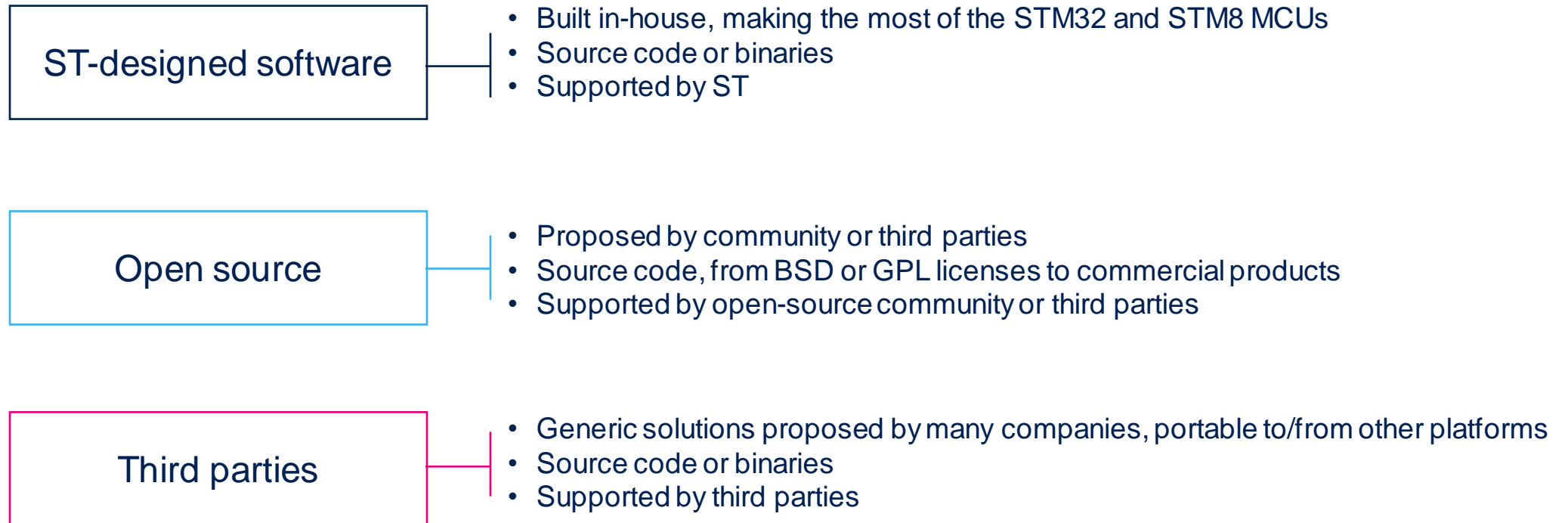
life.augmented

# Embedded software solutions ST, 3<sup>rd</sup> parties and open source



# A full portfolio and several models

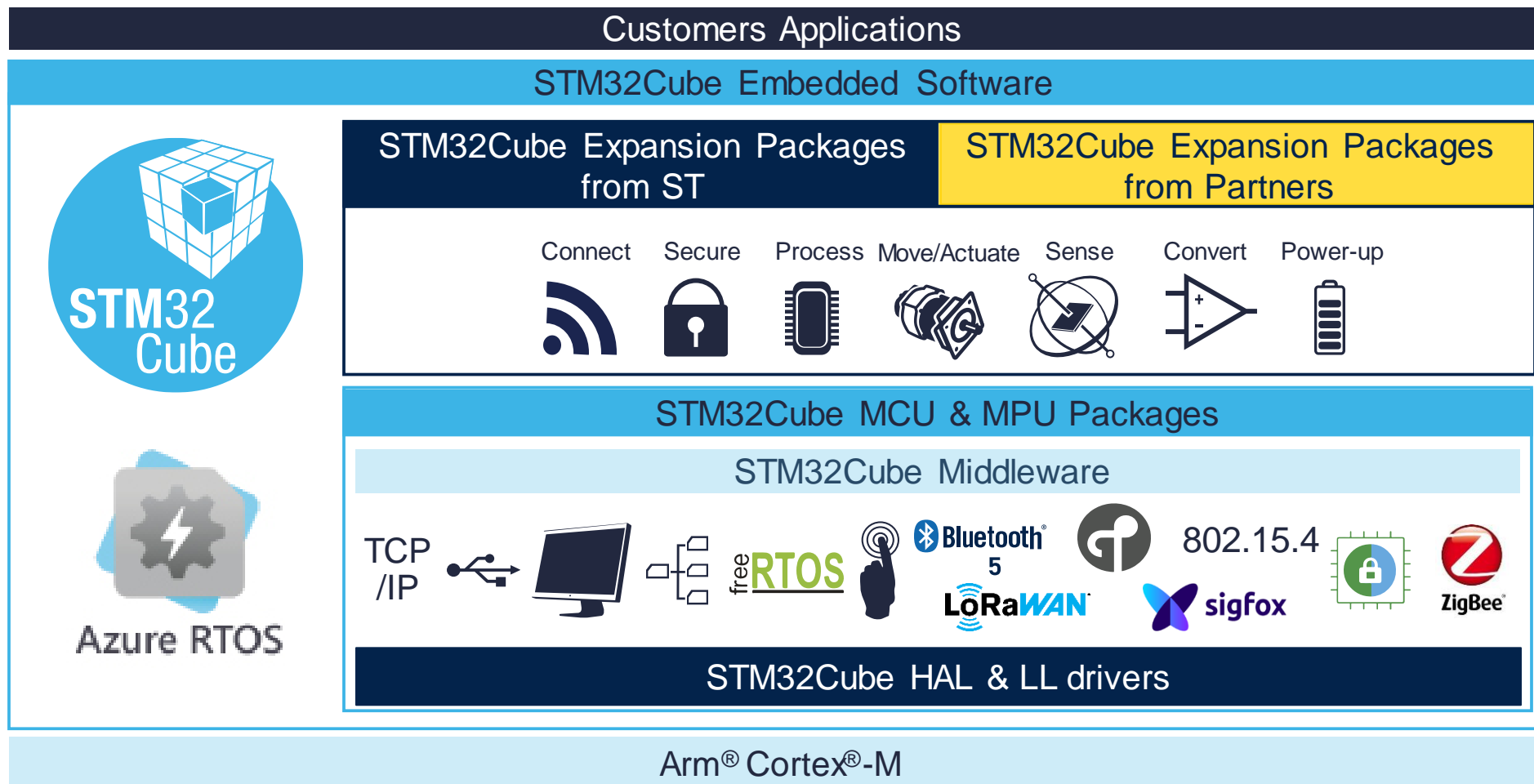
- Extensive Embedded Software ecosystem around the STM32 and STM8 microcontrollers
- You will find your solution, fitting your requirements in terms of price, feature, license scheme and support



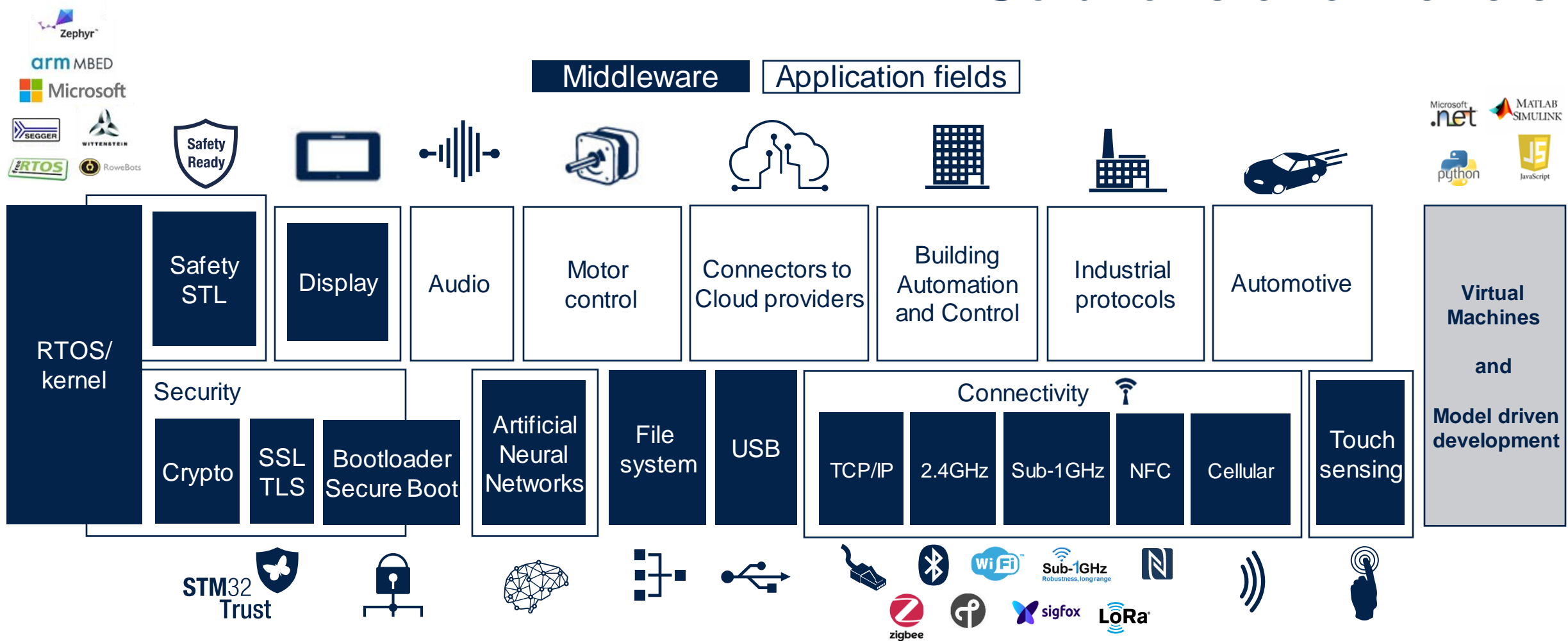
# A large community of third parties... and growing !



# STM32 MCUs embedded software offer - overview



# Solutions at all levels



Hardware abstraction layer (HAL)

Select the area of interest for more details

# Hardware abstraction layer (HAL)

# Hardware abstraction layer

**This layer is the first one to interact with the MCU hardware**

- **Consistent programming interface**
  - When microcontrollers have different hardware implementations
- **Full microcontroller coverage**
  - All peripherals are handled



# STM32 - hardware abstraction layer

Provider	Solution name	Model	Cost	Availability																
				WB	WL	F0	G0	F1	F2	F3		G4	F4	F7	H7	L0	L1	L4 /L4+	L5	U5
										F30x	F37x									
ST	<a href="#">STM32Snippets</a>	Source	Free	N¹	N¹	Y	N¹									Y	N¹			
ST	Standard peripheral library	Source	Free	N¹	N¹	<u>Y</u>	N¹	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	N¹	<u>Y</u>	N¹	N¹	N¹	<u>Y</u>	N¹		
ST	<a href="#">STM32Cube - HAL Hardware Abstraction Layer</a>	Open Source	Free (BSD)	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	
ST	<a href="#">STM32Cube – LL Low-Layer</a>	Open Source	Free (BSD)	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	

1/ Not plan to make it available

More details about hardware abstraction layer solutions: [STM32 Embedded Software overview](#)





# STM8 - hardware abstraction layer

Provider	Solution name	Model	Cost	Availability		
				STM8S STM8AF	STM8L10x	STM8Lx5x STM8Lx6x STM8AL
ST	Standard peripheral library	Source	Free	<u>Y</u>	<u>Y</u>	<u>Y</u>

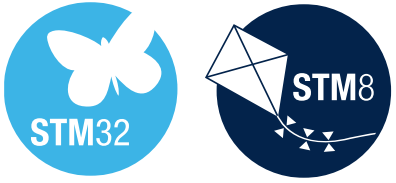
# Middleware and application fields

# Middleware and application fields

Middleware stacks fill the gap between hardware and your application. ST and third parties bring the required solutions, as well as application software bricks to speed up customer development

- **All standard middleware covered**

- RTOS/kernel
- File system
- USB
- Security (crypto, SSL/TLS, secure boot)
- Connectivity (TCP/IP, Bluetooth LE, Zigbee, Thread, Sub-1GHz, Sigfox, LoRa, Wi-Fi, NFC...), Connectors to Cloud providers
- Display, Audio
- Safety
- Industrial protocols
- Motor Control



# Middleware – RTOS / kernel

**A multitude of solutions for STM32 and STM8 available now**

- This is the root component to share time between several tasks on a single core. It ensures task switching within a known and limited duration.



# STM32 – RTOS / kernel (1/4)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4 /L4+	L5	U5
Alibaba	<a href="#">Rhino RTOS</a>	Open Source (Apache 2.0)	Free	N	N	N	N	N	N	N	N	Y	Y	N	Y	N	Y	N	N
Arduino	<a href="#">STM32Duino</a>	Open source LGPL v2.1	Free	N	Y <sup>6</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>7</sup>	Y	Y	Y	Y <sup>5</sup>	Y <sup>5</sup>
arm	<a href="#">mbed OS</a> <sup>4</sup>	Open Source (Apache 2.0)	Free	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y <sup>5</sup>	Y <sup>5</sup>
AWS	<a href="#">FreeRTOS kernel</a>	Source <sup>2</sup>	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ChibiOS	<a href="#">ChibiOS/RT</a> <a href="#">ChibiOS/NIL</a>	Open source (GPL3) or Source	Free or License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
CMX	<a href="#">CMX-RTX</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>
CMX	<a href="#">CMX-Tiny+</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N	Y	Y	Y	N <sup>3</sup>	Y	Y	N	Y	Y	N	N <sup>3</sup>	N <sup>3</sup>
eCosCentric	<a href="#">eCosPro</a>	Modified GNU GPL or Source <sup>1</sup>	Free or License	N <sup>3</sup>	N <sup>3</sup>	N	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N	Y	Y	N <sup>3</sup>	N <sup>3</sup>

1/ eCos is an open-source kernel, a subset of eCosPro. eCosPro comes with TCP/IP stack, FAT, jFFS2, RAM and ROM FS

2/ FreeRTOS kernel license is MIT from V10 (former versions are under a modified GPL license)

3/ Please contact supplier

4/ Mbed OS is [Thread](#) certified

5/ With TrustZone disactivated

6/ no LoRa

7/ single core only

# STM32 – RTOS / kernel (2/4)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
eForce	<a href="#">μC3/Compact</a>	Source	License	N	N <sup>2</sup>	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	Y	N <sup>2</sup>
eForce	<a href="#">μC3/Standard</a>	Source	License	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
Emcraft	<a href="#">uClinux</a>	Open Source (GPL) <sup>1</sup>	Free <sup>1</sup>	N	N	N	N	N	N	N	N	Y	Y	N <sup>2</sup>	N	N	N	N	N
Embedded Office	<a href="#">Flexible Safety RTOS</a>	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
EUROS	<a href="#">EUROS</a>	Binaries or source	License	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
Microsoft	<a href="#">Azure RTOS ThreadX</a>	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Green Hills	<a href="#">μ-veLOsity</a>	Source	License	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
Keil / arm	<a href="#">RTX5</a>	Open Source (Apache 2.0)	Free <sup>3</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
Mentor	<a href="#">Nucleus Kernel</a>	Source	License	N <sup>2</sup>	N <sup>2</sup>	N	N	Y	Y	N <sup>2</sup>	N <sup>2</sup>	Y	Y	N <sup>2</sup>	N	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>

1/ uClinux is open source, but this company proposes some ports on STM32

2/ Please contact supplier

3/ RTX5 is part of arm Keil MDK software development tool



# STM32 – RTOS / kernel (3/4)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Micrium	<u>µC-OS</u>	Open Source (Apache 2.0)	Free	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Weston Embedded	Cesium RTOS <u>Cs/OS2</u> and <u>Cs/OS3</u>	Source	License	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
Micro Digital	<u>SMX</u>	Source	License	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y
NuttX	<u>NuttX</u>	Open Source <sup>6</sup>	Free	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N
Prove & Run	<u>ProvenCore-M</u>	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quadros	<u>RTXC RTOS</u>	Source	License	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	Y	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
Riot	<u>Riot</u>	Open Source <sup>4</sup>	Free	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N
Rowebots 	<u>UNISON software expansion for STM32Cube (I-CUBE-UNISON)</u> <sup>3</sup>	Source	Free <sup>1</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Rowebots	<u>UNISON</u>	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
RT-Thread	<u>RT-Thread</u>	Open Source <sup>5</sup>	Free	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N

1/ UNISON kernel is available free of charge to run on STM32 devices

2/ Please contact supplier

3/ Available as STM32Cube Expansion enhanced for STM32 Toolset

4/ LGPL V2.1 license

5/ GPL V2 till v3.1.0, Apache 2.0 from V3.1.0 onwards

6/ BSD till v8.2, Apache 2.0 from V9.0.0 onwards



# STM32 – RTOS / kernel (4/4)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Sciopta	<a href="#">SCIOPTA 61508</a> <sup>2</sup>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N <sup>4</sup>	N <sup>4</sup>
SEGGER 	<a href="#">embOS software expansion for STM32Cube (I-CUBE-EMBOS)</a>	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SEGGER	<a href="#">embOS</a>	Source	License	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	Y	N <sup>4</sup>
ST	<a href="#">STM32Cube – FreeRTOS kernel</a>	Open source (MIT) <sup>5</sup>	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
ST	<a href="#">STM32Cube – Azure RTOS ThreadX</a>	Source <sup>5</sup>	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
ST	<a href="#">X-CUBE-AZRTOS – Azure RTOS ThreadX</a>	Source <sup>6</sup>	Free	22Q4 <sup>7</sup>	<u>Y</u>	N	<u>Y</u>	N	N	N	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	N	N	<u>Y</u>	<u>Y</u>	N.A. <sup>5</sup>
Wittenstein - High Int. Sys.	<a href="#">OpenRTOS</a> <sup>1</sup>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	N <sup>4</sup>	N <sup>4</sup>
Wittenstein - High Int. Sys.	<a href="#">SafeRTOS</a> <sup>2</sup>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	N <sup>4</sup>	N <sup>4</sup>
Wittenstein - High Int. Sys.	<a href="#">SafeRTOS CORE</a> <sup>3</sup>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	N <sup>4</sup>	N <sup>4</sup>
<b>Zephyr project</b>	<a href="#">Zephyr RTOS kernel</a>	Open Source (Apache 2.0)	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y





# STM8 – RTOS / kernel

Provider	Solution name	Model	Cost	Availability	
				STM8S STM8AF	STM8L STM8AL
AtomThreads	<a href="#">AtomThreads RTOS</a>	Open source (BSD)	Free	Y	N <sup>1</sup>
Chibios	<a href="#">ChibiOS/RT</a>	Open source (GPL3) or Source	Free or License	Y	Y
CMX	<a href="#">CMX-Tiny+</a>	Source	License	Y	N <sup>1</sup>
SEGGER	<a href="#">embOS</a>	Source	License	Y	Y

1/ Please contact supplier

Cryptology helps users ensure the security of data or authentication. This is a key element in ensuring the integrity of IoT applications for instance.

- Many supported algorithms
  - Through third parties (some with certifications) or directly from ST

Often-seen acronyms	
Symmetric ciphering	Ciphering method that ensures the reuse of a unique key, both for encryption and decryption. Example: AES, DES, 3DES, ARC4, ...
Asymmetric ciphering	Ciphering method based on pair of key, a private and a public one. This also brings some kind of authentication: only the owner of private key can decrypt content that was encrypted with a public one. And people able to decrypt with public key can be sure it was encrypted by owner of private key. Example: ECDSA, RSA, ...
Hashing	Method to calculate a unique value for a given data content. This allows ensuring a content was not modified for instance. Example: MD5, SHA, ...



# STM32 – crypto (1/2)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
CypherBridge	<u>uVPN SDK</u> IKEv1/IKEv2/IPsec	Source	License	N	N	N	N	N	N	N	N <sup>1</sup>	Y	Y	Y	N	N	Y	N <sup>1</sup>	N <sup>1</sup>
EUROS	<u>SSL/TLS</u> SSL v3, TLS 1.0, 1.1, 1.2	Binaries	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
EUROS	Cryptographic library, Verifiable Encryption manager 1. Encryption methods: - ARC4, - Blowfish, -Camellia- CAST5 - DES, - DAS, - ECC, - MD4, - MD5 - RSA, - SHA1, - SHA256, - SHA512 - TwoFish, - Whirpool, - HMAC96 - HMAC256 2. Coding: - Rice, - RLE (Run-length encoding) 3. Compression: - zlib, - libbz2, - LZ77, - LZW based (ZIP, GZ) - Huffman, - Shannon-Fano	Binaries	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
HCC	<u>Embedded Encryption Manager</u> AES, 3DES, DSS, EDH, MD5, RSA, SHA1, SHA256, ECC, TIGER, CHACHA20	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Oryx Embedded	<u>CycloneCrypto</u> Lite: MD2, MD4, MD5, SHA-1, SHA-2, HMAC, RC4, DES, triple DES, AES, ECB, CBC, CFB, OFB, CTR, RSA, X.509 Pro: RIPEMD-128/160, Tigger/192, RC6, IDEA, Camellia, SEED, ARIA, CCM, GCM, Diffie-Hellman, DSA Ultimate: SHA-3, Keccak, CkaCha, Poly 1305, ChaCha20Poly1305 AEAD, PKCS #5, ECC, ECDSA, ECDH, NIST-P, Brainpool	Open source (GPL2) or Source	Free or license	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ please contact supplier



# STM32 – crypto (2/2)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Rowebots	<u>UNISON SSL/TLS Stack</u> AES, Blowfish, Triple-DES (3DES), DES, ARC4, Camellia, XTEA ECB, CBC, CFB, CTR, GCM, CCM MD2, MD4, MD5, SHA-1, SHA-224, SHA-256, SHA-384, SHA-512, RIPEMD-160 ECC	Source	License	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N <sup>4</sup>	N <sup>4</sup>
SEGGER	<u>emSecure signatures</u>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>4</sup>	N <sup>4</sup>
SEGGER	<u>emLib AES</u> and <u>emLib DES</u>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>4</sup>	N <sup>4</sup>
SEGGER	<u>emFile encryption</u>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>4</sup>	N <sup>4</sup>
ST	<u>STM32 Cryptographic library</u> <sup>1, 2</sup> AES, DES, 3DES, ARC4, MD5, SHA1, SHA2, RSA sig, ECC Key gen, ECDSA, ...	Binaries	Free	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	Y	Y	N <sup>6</sup>	N <sup>6</sup>	Y	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	Y	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>
ST	<u>X-CUBE-CRYPTOLIB</u>	Binaries	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
wolfSSL	<u>wolfCrypt</u> <sup>1</sup> , part of wolfSSL MD2, MD4, MD5, SHA-1, SHA-256, SHA-384, SHA-512, BLAKE2b, RIPEMD-160, Poly 1305 AES (CBC, CTR, GCM, CCM), Camellia, DES, 3DES, ARC4, RABBIT, HC-128, ChaCha20 RSA, DSS (DSA), DH, EDH, NTRU ECDH-ECDSA, ECDHE-ECDSA, ECDH-RSA, ECDHE-RSA	Open source (GPL2) or Source	Free or license	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	N <sup>4</sup>	N <sup>4</sup>

1/ Can benefit from hardware acceleration when available.

2/ Subject to trade regulations. See website.

3/ delivered as a patch

4/ please contact supplier

5/ Available on STM32Cube, so porting is very easy


6/ Not plan to make it available

# Middleware – SSL/TLS (1/2)

- Transport Layer Security (TLS) and its predecessor, Secure Sockets Layer (SSL), are cryptographic protocols that provide communications security.
- The Transport Layer Security protocol aims primarily to provide privacy and data integrity between a client and a server



# STM32 – SSL/TLS solutions

Provider	Solution name	Model	Cost	Availability									
				WB	WL	F1	F2	F4	F7	H7	L4/L4+	L5	U5
arm	<a href="#">Mbed TLS<sup>1</sup></a>	Open source	Free	N	N	Y	Y	Y	Y	Y	Y	Y	Y
CypherBridge	<a href="#">Embedded TLS SDK (uSSL™)</a>	Source	License	N	N	N	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
HCC	<a href="#">Verifiable TLS</a>	Source	License	N <sup>2</sup>	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
Oryx Embedded	<a href="#">CycloneSSL</a>	Open source (GPL2) or Source	Free or license	N <sup>2</sup>	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
SEGGER	<a href="#">emSSL</a>	Source	License	N <sup>2</sup>	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
ST	<a href="#">STM32Cube – mbed TLS<sup>3</sup></a>	Open source	Free	N <sup>4</sup>	N <sup>4</sup>	Y	Y	Y	Y	Y	N <sup>4</sup>	Y	N <sup>4</sup>
wolfSSL	<a href="#">Embedded SSL Library</a>	Open source (GPL2) or Source	Free or license	N <sup>2</sup>	N <sup>2</sup>	N	Y	Y	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
wolfSSL	<a href="#">HCUBE-WOLFSSL</a> <a href="#">MadeForSTM32</a>  <b>V2</b>	Open source (GPL2) or Source	Free or license	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Formerly known as PolarSSL. Apache 2.0 open source or GPL 2.0 open source license

2/ Please contact supplier

3/ Apache 2.0 license, included in STM32Cube MCU packages (Middlewares\Third\_Party folder)

4/ Available on STM32Cube, so porting is very easy



# STM32 – SSL/TLS solution details

Provider	Solution name	Details
arm	<a href="#">Mbed TLS</a>	SSL version 3, TLS version 1.0, 1.1, 1.2, <a href="#">More...</a>
CypherBridge	<a href="#">Embedded TLS SDK (uSSL™)</a>	IETF standard SSL 3.0/TLS 1.2 protocols. Supported crypto and hash functions include: RSA, DSS, PKCSv1.5, OAEP, DES, 3DES, AES, RC4, SHA1, SHA2, MD2, MD4, MD5, RNG, X.509 certificate Processing
HCC	<a href="#">Verifiable TLS</a>	TLS 1.0, 1.1, 1.2, 1.3 (RFC 5246), CHACHA20, POLY1305, SSL3.0, DTLS 1.2 (RFC6347), 1.0 (RFC 4347), RFC 6520, HTTP over TLS (RFC 2818), HTTPS, FTPS, embedded encryption manager for full certificate management, cipher suites: DH/DHE/DSS/ECDHE/RSA, AES/RC4/3DES, SHA/MD5
Oryx Embedded	<a href="#">CycloneSSL</a>	Server and/or client operation, Supports TLS 1.0, 1.1, 1.2, 1.3 and SSL 3.0, Supports DTLS 1.0 and DTLS 1.2, Robust and efficient implementation, Supports ECC (Elliptic Curve Cryptography), Rich set of TLS cipher suites (including Suite B profile), RSA, Diffie-Hellman and ECDH key exchange algorithms, PSK (Pre-Shared Key) cipher suites, Supports stream ciphers, CBC block ciphers as well as AEAD ciphers (CCM and GCM), ChaCha20Poly1305 AEAD, Cryptographic library for common encryption algorithms (RC4, IDEA, DES, 3DES, AES, Camellia, SEED and ARIA), Supports MD5, SHA-1, SHA-256 and SHA-384 hash algorithms, SSL/TLS session resumption, PKIX path validation, Compliant with BSD socket API, Supports hardware accelerated encryption engines (when available), Flexible memory footprint. Built-time configuration to embed only the necessary features, Portable architecture (no processor dependencies), The library is distributed as a full ANSI C and highly maintainable source code
SEGGER	<a href="#">emSSL</a>	TLS 1.0, 1.1 and 1.2. <a href="#">More...</a>
ST	<a href="#">STM32Cube – mbed TLS</a>	SSL version 3, TLS version 1.0, 1.1, 1.2, <a href="#">More...</a>
wolfSSL	<a href="#">Embedded SSL Library</a>	SSL version 3.0 and TLS versions 1.0, 1.1, 1.2, and 1.3 (client and server), DTLS 1.0, 1.2 support (client and server) <a href="#">More...</a>



# Middleware – bootloader / secure boot

A bootloader aims to enable firmware update in the field through a communication interface.

STM32 devices embed a built-in bootloader in system memory, supporting UART, SPI, I2C, CAN, USB interfaces.

Alternatively, developers can implement their own bootloader in user flash memory (also called In-Application Programming)

ST also proposes a reference code for Secure Boot and Secure Firmware Update





# STM32 – bootloader / secure boot

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-IAP-USART<sup>3</sup></a>	Source	Free	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
ST	<a href="#">X-CUBE-IAP-SD<sup>3</sup></a>	Source	Free	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
ST	<a href="#">X-CUBE-SBSFU<sup>4</sup></a>	Source	Free	Y	N <sup>6</sup>	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	N <sup>5</sup>	N <sup>5</sup>
ST	<a href="#">STM32Cube – SBSFU</a>	Source	Free	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ST	<a href="#">STM32Cube – OpenBootloader</a>	Source	Free	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Y
ST	<a href="#">STM32Cube – TF-M</a>	Source	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y
CypherBridge	<a href="#">uLoadXL SDK</a>	Source	License	N	N	N	N	N	Y	N	N	Y	Y	Y	N	N	Y	N	N
eCosCentric	<a href="#">RedBoot</a>	Source	License	N	N	N	N	Y	Y	Y	N	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Feaser	<a href="#">OpenBLT</a>	Open source (GPL3) or Source	Free or Licence	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	N <sup>1</sup>
HCC	<a href="#">Bootloaders</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Simma Software	<a href="#">ssBL-target, ssBL-PC</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
wolfSSL	<a href="#">WolfBoot</a>	Open source (GPL2) or Source	Free or license	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Please contact supplier

2/ Available on STM32Cube, so porting is very easy

3/ In-application programming example

4/ Secure Boot + Secure Firmware update reference code to demonstrate best use of STM32 security protections

5/ For STM32L5, SBSFU is a TF-M example included in [STM32CubeL5 MCU Package](#)

6/ For STM32WL, SBSFU is included in [STM32CubeWL MCU Package](#)



# STM32 – bootloader / secure boot details

Provider	Solution name	Details
ST	<a href="#">X-CUBE-SBSFU</a>	Secure Boot to check firmware image before execution, Secure Firmware Update with anti-rollback and partial image update capabilities for over-the-air or local firmware image update, <a href="#">Secure key management services offering cryptographic services by means of the PKCS #11 APIs</a> , Standalone STM32 system solution example demonstrating best use of STM32 protections to protect assets against unauthorized external or internal access, Combined STM32 and STSAFE-A110 system solution example demonstrating hardware Secure Element protections for secure authentication services and secure data storage
CypherBridge	<a href="#">uLoadXL SDK</a>	Software updates and secure boot loader for embedded platforms. Safe install, to manage multiple images for an update, activation and safe-boot to rollback or factory version. The integrated boot loader provides secure root of trust and software integrity checks
eCosCentric	<a href="#">RedBoot</a>	Debug and bootstrap firmware
Feaser	<a href="#">OpenBLT</a>	UART, CAN, TCP/IP, USB, SD-CARD External flash and serial EEPROM
HCC	<a href="#">Bootloaders</a>	Serial, USB Device, USB Host , FAT Ethernet, Fail-safety, AES encryption
Simma Software	<a href="#">ssBL-target, ssBL-PC</a>	Supported protocols include CAN, J1939, J1708, CANopen, UDS, Bluetooth, USB, and RS232



# STM8 – bootloader

Provider	Solution name	Model	Cost	Availability	
				STM8S STM8AF	STM8L STM8AL
Simma Software	<a href="#">ssBL-target, ssBL-PC</a>	Source	License	Y	N <sup>1</sup>

1/ Please contact supplier



# Middleware – file system

A file system is the way in which files are named and how they are placed logically for storage and retrieval. Several standards exist: FAT; JFFS2...

- Safety solutions
  - Ensuring data is not corrupted in any way (power supply removal, ...)
- NAND, NOT, SSD memory access solutions
  - With error correction and wear-leveling



# STM32 – file system (1/3)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
AWS	<a href="#">FreeRTOS+™ FAT SL<sup>2</sup></a>	Source	Free	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
arm	<a href="#">Mbed LittleFileSystem</a> , <a href="#">FATFileSystem</a>	Open source	Free	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N <sup>3</sup>
ChaN	<a href="#">FatFS</a>	Open source (BSD)	Free	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N
CMX	<a href="#">CMX-FFS</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	N
CypherBridge	<a href="#">uFile</a>	Source	License	N	N	N	N	N	Y	N	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N	N	N	N <sup>3</sup>	N <sup>3</sup>
EmCraft	<a href="#">JFFS2</a> , <a href="#">YaFFS</a> , <a href="#">FAT</a> , <a href="#">NFS</a> , <a href="#">etc..</a>	Open source (GPL)	Free	N	N	N	N	N	Y	N	N	Y	Y	N <sup>3</sup>	N	N	N	N	N
eCosCentric	<a href="#">eCosPro-YAFFS<sup>1</sup></a> , <a href="#">MMFS</a>	Source	License	N	N	N	N	Y	Y	Y	N	Y	Y	N <sup>3</sup>	N	Y	Y	N	N
eForce	<a href="#">μC3-FileSystem</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
Microsoft	<a href="#">Azure RTOS FileX + LevelX</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	Y	Y	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>

1/ Free for non-commercial use

2/ For STM32 users, the license is the same as FreeRTOS kernel (MIT)

3/ Please contact supplier



# STM32 – file system (2/3)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
EUROS	<a href="#">FMS, SafeFAT</a>	Binaries	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>
HCC	<a href="#">FAT FS: FAT, THIN, exFAT SafeFAT / Flash FS: SafeFlash, TINY, SafeFTL SafeexFAT / FMSE</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>
Wittenstein - High Int. Sys.	<a href="#">CONNECT File System</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Green Hills	<a href="#">μ-velOSity File System</a>	Source	License	N	N	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Keil / arm	<a href="#">MDK-ARM Flash</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Mentor Embedded	<a href="#">Nucleus Storage</a>	Source	License	N	N	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Micrium	<a href="#">μC/FS</a>	Open Source (Apache 2.0)	Free	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Weston Embedded	<a href="#">Cesium RTOS Cs/FS</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>



# STM32 – file system (3/3)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Micro Digital	<a href="#">smxFS</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Quadros	<a href="#">RTXCfatfile</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Rowebots	<a href="#">Unison FAT File System</a>	Source	License	N	N	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
SEGGER	<a href="#">emFile</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32Cube - FatFS<sup>2</sup></a>	Open source (BSD)	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ST	STM32Cube – Azure RTOS File X	Source	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	<u>Y</u>
ST	X-CUBE-AZRTOS - FileX	Source	Free	Y <sup>4</sup>	<u>Y</u>	N	<u>Y</u>	N	N	N	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	N	N	<u>Y</u>	<u>Y</u>	N.A. <sup>3</sup>

1/ Please contact supplier

2/ Included in STM32Cube MCU packages (\Middlewares\Third\_Party folder)

3/ Included in STM32Cube MCU packages

4/ Github only



# STM8 – file system

Provider	Solution name	Model	Cost	Availability	
				STM8S STM8AF	STM8L STM8AL
ChaN	<a href="#">Petit FatFS</a>	Open source (BSD)	Free	N <sup>1</sup>	Y <sup>2</sup>
HCC	<a href="#">FAT FS</a> : FAT THIN, <a href="#">Flash FS</a> : TINY	Source	License	Y	Y
SEGGER	<a href="#">emFile</a>	Source	License	Y	Y

1/ Could be very easily ported.

2/ Petit FatFS ported on STM8 available in demos





# Middleware – USB

Universal Serial Bus requires a dedicated software stack. This serial bus is organized in a star topology with host and device roles, with the host organizing the traffic. Several device classes are specified, in order to ease communication in different application cases.

Often-seen acronyms	
OTG	On-The-Go: An OTG peripheral can switch host and device roles on the fly
HUB	Defines what protocols to implement to build a hub application
MS	Mass storage: Protocols to interact with storage block devices (for files)
HID	Human interface device: Protocols for peripherals interacting with humans (mouse, keyboard, etc.)
CDC	Communication device class: Protocols for serial communications, different sub-classes define details, for instance ACM for a standard COM port, or ECM for modems
Printer	Defines what protocols to implement to build a printer application
Audio	Defines what protocols to implement to build an audio application (microphone, headset, etc.)
DFU	Device firmware upgrade: Protocols to implement firmware upgrade ability
USB-PD	USB Power Delivery
TCPM	USB Type-C Port Manager



# STM32 – USB solutions (1/3)

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Chibios	<a href="#">ChibiOS/HAL</a>	Open source (GPL3) or Source	Free or License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
CMX	<a href="#">CMX-USB Device, Host</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	N	N <sup>1</sup>	N <sup>1</sup>
eCosCentric	<a href="#">eCosPro-Host, Device</a>	Source	License	N <sup>1</sup>	N	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
EUROS	<a href="#">USB Host</a>	Binaries	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
EmCraft	<a href="#">Linux USB Host</a>	Open source (GPL)	Free	N	N	N	N	Y	N	N <sup>1</sup>	Y	N	N <sup>1</sup>	N	N	N	N <sup>1</sup>	N <sup>1</sup>

1/ Please contact supplier



# STM32 – USB solutions (2/3)

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Microsoft	<a href="#">Azure RTOS USBX</a>	Source	Free	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
HCC	<a href="#">HCC-USB Host, Device</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Keil / arm	<a href="#">MDK-ARM USB</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Mentor Embedded	<a href="#">Nucleus USB</a>	Source	License	N	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Micrium	<a href="#">USB Host, USB Device</a>	Open Source	Free	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Weston Embedded	<a href="#">Cesium RTOS Cs/USBH, Cs/USBD</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
Micro Digital	<a href="#">smxUSBH, smxUSBD, smxUSBO</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Quadros	<a href="#">RTXCusb</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>

1/ Please contact supplier



# STM32 – USB solutions (3/3)

Provider	Solution name	Model	Cost	Availability															
				WB	F0	G0			F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
							Others	F105 F107											
Rowebots	<a href="#">Unison USB System</a>	Source	License	N	N	N	Y		Y	Y	N <sup>1</sup>	Y	N	N <sup>1</sup>	Y	N	Y	N <sup>1</sup>	N <sup>1</sup>
SEGGER	<a href="#">emUSB Device</a> , <a href="#">emUSB Host</a>	Source	License	N <sup>1</sup>	Y	N <sup>1</sup>	Y		Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
ST	USB FS device library	Source	Free	N	<u>Y</u>	N	<u>Y</u>	N	N	<u>Y</u>	N	N	N	N	N	<u>Y</u>	N	N	N
ST	USB FS&HS Host&Device lib	Source	Free	N	N	N	N	<u>Y</u>	<u>Y</u>	N	N	<u>Y</u>	N	N	N	N	N	N	N
ST	<a href="#">STM32Cube – USB Host&amp;Device<sup>4</sup></a>	Source	Free	Y <sup>2</sup>	Y <sup>2</sup>	N	Y <sup>2</sup>		Y	Y <sup>2</sup>	Y <sup>2</sup>	Y	Y	Y	Y <sup>2</sup>	Y <sup>2</sup>	Y <sup>2</sup>	Y <sup>2</sup>	N
ST	<a href="#">STM32Cube – USB-C Power Delivery<sup>4</sup></a>	Source	Free	N	N	Y	N		N	N	Y	N	N	N	N	N	N	Y	Y
ST	<a href="#">X-CUBE-USB-PD<sup>5</sup></a>	Binary	Free	N <sup>6</sup>	Y	N <sup>6</sup>	N <sup>6</sup>		N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>	N <sup>6</sup>
ST	STM32Cube - USBX	Source	Free	N	N	N	N		N	N	N	N	N	N	N	N	N	N	<u>Y</u>
ST	X-CUBE-AZRTOS - USBX	Source	Free	Y <sup>3</sup>	N	<u>Y</u>	N		N	N	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	N	N	<u>Y</u>	<u>Y</u>	N.A. <sup>7</sup>
<b>Zephyr</b>	<a href="#">USB device stack</a>	Open Source (Apache 2.0)	Free	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Please contact supplier

2/ Device only

3/ Github only

4/ Included in STM32Cube MCU packages (Middlewares\Third\_Party folder)

5/ Examples for [P-NUCLEO-USB001](#) and [P-NUCLEO-USB002](#) Nucleo Packs, and for [ON-FUSB3-STM32](#)

6/ Available on STM32Cube, so porting is very easy

7/ Included in STM32Cube MCU Package



# STM32 – USB solutions details (1/2)

Provider	Solution name	Details
Chibios	<a href="#">ChibiOS/HAL</a>	Device: HID, MS, CDC
CMX	CMX-USB <a href="#">Device</a> , <a href="#">Host</a>	Device: HID, MS, CDC (ACM, ECM, RNDIS), Audio, Midi, MTP, PHDC Host: HID, MS, CDC (ACM, ECM, RNDIS, OBEX), Audio, Midi, Printer, HUB
eCosCentric	<a href="#">eCosPro-Host, Device</a>	Device: MS, CDC (ACM, ECM, EEM, RNDIS) Host: MS, CDC (ACM, ECM, EEM, RNDIS), Hub
EUROS	<a href="#">USB Host &amp; Device Stack</a>	Device: HID, MS, CDC (ACM, ECM) Host: HID, MS, CDC (ACM, ECM), HUB
Microsoft	<a href="#">USBX</a>	Device: HID, MS, CDC (ACM, ECM, RNDIS), Still Image, PTP, PictBridge, DFU, PIMA w/MTP Host: HID, MS, CDC (ACM, ECM), Audio, Printer, HUB, ASIX, PIMA, GSER, PROLIFIC
EmCraft	<a href="#">Linux USB Host</a>	Host: HID, MS, CDC (ACM, ECM), HUB
HCC	<a href="#">HCC-USB</a>	Device: Connectivity (HID), File System & Storage (Mass Storage), Ethernet & Serial Interface (RNDIS, CDC-ACM, CDC-ECM, CDC-EEM, CDC-NCM), Audio (AUDIO, 1.0, 2.0, MIDI), Multi-media & Printing (MTP, Pictbridge, Printer PCL, TEC), Healthcare (PHDC) Host: Connectivity (HID, Hub, lan7500, lan9500, CCID, CP201x), File System & Storage (Mass Storage), Ethernet & Serial Interface (RNDIS, CDC-ACM, CDC-ECM, CDC-EEM, CDC-FTDI, CDC-NCM), Audio (AUDIO, MIDI), Multi-media & Printing (MTP, Printer)
Keil / arm	<a href="#">MDK-ARM USB</a>	Device: HID, MS, CDC (ACM), Audio Host: HID, MS
Mentor Embedded	<a href="#">Nucleus USB</a>	Device: HID, MS, CDC (ACM, ECM) Host: HID, MS, CDC (ACM, ECM), HUB
Micrium	<a href="#">USB Host</a> , <a href="#">USB Device</a>	Device: HID, MS, CDC (ACM), Audio, PHDC (Medical) Host: HID, MS, CDC (ACM), Audio, Printer, PHDC (Medical)
Weston Embedded	Cesium RTOS <a href="#">Cs/USBH</a> , <a href="#">Cs/USBD</a>	Device: HID, MS, CDC (ACM), Audio, PHDC (Medical) Host: HID, MS, CDC (ACM), Audio, Printer, PHDC (Medical)



# STM32 – USB solutions details (2/2)

Provider	Solution name	Details
Micro Digital	<a href="#">smxUSB</a>	Device: HID, MS, CDC (ACM, RNDIS), Audio+Midi, Video, PTP, MTP, DFU Host: HID, MS, CDC (ACM, ECM, Ethernet Adapter, WiFi and wireless modem,), Audio+Midi, Video, Printer, HUB
Quadros	<a href="#">RTXCusb</a>	Device: MS, CDC (ACM, ECM, RNDIS) Host: HID, MS, CDC (ACM), HUB
Rowebots	<a href="#">Unison USB System</a>	Device: MS, CDC (ACM) Host: MS, CDC (ACM), HUB, others on demand (inc . PHDC)
SEGGER	<a href="#">emUSB Device</a> , <a href="#">emUSB Host</a>	Device: HID, MS, CDC (ACM), RNDIS, Printer, MTP Host: HID, MS, CDC (ACM), HUB
ST	<a href="#">USB FS device library</a>	Device: HID, MS, CDC (ACM), Audio, DFU
ST	<a href="#">USB FS&amp;HS Host&amp;Device</a>	Device: HID, MS, CDC (ACM), Audio, DFU Host: HID, MS
ST	<a href="#">STM32Cube – USB Host&amp;Device</a>	Device: HID, MS, CDC (ACM), Audio, DFU Host: HID, MS, CDC (ACM), Audio, MTP
ST	<a href="#">STM32Cube – USB-C Power Delivery<sup>4</sup></a>	USB PD 3.0, PPS, FRS, TCPCi, TCPM, source, sink, DRP, USB Type-C CC logic
ST	STM32Cube – USBX and X-CUBE-AZRTOS – USBX	Device: HID, MS, CDC (ACM, ECM, RNDIS), Still Image, PTP, PictBridge, DFU, PIMA w/MTP Host: HID, MS, CDC (ACM, ECM), Audio, Printer, HUB, ASIX, PIMA, GSER, PROLIFIC
Thesycon	<a href="#">Embedded USB Device</a>	Device: Audio, CCID, Mass Storage, network, HID, CDC (ACM)
Zephyr	<a href="#">USB device stack</a>	<b>Device:</b> Audio (experimental), CDC (ACM, ECM, EEM, RNDIS), MSC, <b>DFU</b> , Bluetooth HCI over USB, HID



# Middleware – TCP/IP (1/2)

- TCP and IP were developed by a US Department of Defense research project to connect a number of different networks designed by different vendors into a network of networks (the Internet).
- It was initially successful because it delivered a few basic services that everyone needs (file transfer, electronic mail, remote logon) across a very large number of client and server systems and is now widely deployed.

# Middleware – TCP/IP (2/2)

## Often-seen acronyms

ARP	Address resolution protocol: Provides physical address from IP address
IP	Internet protocol: Primary protocol in Internet Protocol Suite. 2 flavors: IPv4 and IPv6. IPv4 will disappear as it only supports up to $2^{32}$ addresses, not enough for future needs, while IPv6 supports $2^{128}$
6LoWPAN	IPv6 over low-power wireless personal area networks: Provides IPv6 connectivity to low-rate wireless networks
IPSec	Internet protocol security: Secured version of IP, using cryptography
TCP	Transmission control protocol: Provides reliable, ordered delivery of a stream of bytes
UDP	User datagram protocol: Provides unreliable service. Datagrams may arrive in any order, duplicated, or may be missing. Used for time-sensitive applications, when data drop is better than delay
DHCP	Dynamic host configuration protocol: Provides means to allocate IP address dynamically
DNS	Domain name system: Translates domain names meaningful to humans into numerical IP ones
FTP	File transfer protocol: Provides means to copy files from one host to another
TFTP	Trivial file transfer protocol: Similar to FTP, but based on UDP, and simpler (for example, no directory)
SMTP	Simple mail transfer protocol: Used to send e-mail to a server
POP	Post office protocol: Used to retrieve e-mail from a server
HTTP	Hypertext transfer protocol: Used by web browsers
SSL/TLS	Transport layer security: Secured container for application protocols using cryptography. Example: HTTPS means HTTP over SSL, FTPS, etc.. IPSec applies cryptography at a lower level than SSL/TLS, making it more universal. However, SSL is widely used.





# STM32 – TCP/IP solutions (1/2)

Provider	Solution name	Model	Cost	Availability								
				WB	F1	F2	F4	F7	H7	L4/L4+	L5	U5
AWS	<a href="#">FreeRTOS+™ TCP<sup>2</sup></a>	Source	Free	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
AWS	<a href="#">FreeRTOS+™ UDP<sup>2</sup></a>	Source	Free	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
CMX	<a href="#">CMX-TCP/IP</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
CMX	<a href="#">CMX-MicroNet</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
CypherBridge	<a href="#">Embedded SSH SDK (uSSH™)</a>	Source	License	N <sup>1</sup>	N	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
EUROS	<a href="#">TCP/IP stack</a>	Binaries	License	N <sup>1</sup>	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Microsoft	<a href="#">NetX</a> and <a href="#">NetX Duo</a> IPv4/IPv6 and NetX Secure SSL/TLS/DTLS	Source	Free	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	Y	Y	Y
eCosCentric	<a href="#">SecureSockets</a> , <a href="#">SecureShell</a> <a href="#">eCosPro stacks</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
eForce	<a href="#">µNet3</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
EmCraft	<a href="#">Linux TCP/IP stack</a>	Open source (GPL)	Free	N	N	Y	Y	Y	N <sup>1</sup>	N	N	N
Green Hills	<a href="#">µ-velOSity TCP/IP v4/v6</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Wittenstein - High Integrity Systems	<a href="#">CONNECT TCP</a>	Source	License	N <sup>1</sup>	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
HCC	<a href="#">MISRA HCC-TCP/IP v4/v6</a>	Source	License	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>



# STM32 – TCP/IP solutions (2/2)

Provider	Solution name	Model	Cost	Availability								
				WB	F1	F2	F4	F7	H7	L4/L4+	L5	U5
Keil / arm	<a href="#">MDK-ARM TCPNET</a>	Source	License	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
Mentor Embedded	<a href="#">Nucleus Network</a>	Source	License	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
Micrium	<a href="#">μC/TCP-IP</a>	Open Source	Free	N	Y	Y	Y	Y	N	Y	N	N
Weston Embedded	<a href="#">Cesium RTOS Cs/NET</a>	Source	License	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>
Micro Digital	<a href="#">smxNS</a> and <a href="#">smxNS6</a> (Dual IPv6/v4)	Source	License	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
Oryx Embedded	<a href="#">CycloneTCP</a>	Open source (GPL2) or source	Free or license	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	Y	Y
Quadros	<a href="#">RTXC Quadnet</a>	Source	License	N <sup>2</sup>	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
Rowebots	<a href="#">Unison TCP-IP/v4-v6</a>	Source	License	N <sup>2</sup>	N	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
SEGGER	<a href="#">embOS/IP</a>	Source	License	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>
ST	<a href="#">STM32Cube – LwIP<sup>1</sup></a>	Open source (BSD)	Free	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>
ST	<a href="#">STM32Cube – NetX / NetX duo</a>	Source	Free	N	N	N	N	N	N	N	N	<u>Y</u>
ST	X-CUBE-AZRTOS – NetX / NetX duo	Source	Free	<u>Y</u>	N	N	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	N <sup>4</sup>
<b>Zephyr</b>	<a href="#">Zephyr Networking</a>	Open Source (Apache 2.0)	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ A port to STM32 was implemented by ST, as part of STM32Cube, Licensing model cascaded to end-user.

Included in STM32Cube MCU packages (Middlewares\Third\_Party folder)

2/ Please contact supplier

3/ Available on STM32Cube, so porting is very easy

4/ Included in STM32Cube MCU Package



# STM32 – TCP/IP solution details (1/3)

Provider	Solution name	Details
AWS	<a href="#">FreeRTOS+™ TCP</a>	ARP, DHCP, DNS, LLNMR, NBNS, UDP
AWS	<a href="#">FreeRTOS+™ UDP</a>	ARP, DHCP and DNS
CMX	<a href="#">CMX-TCP/IP</a>	PPP, PPPoE, ARP, IGMP, ICMP, IPv4, UDP, TCP, DHCP(cs), DNS, FTP(cs), IMAP4, NAT, POP3(c), SMTP, SNMP, SNTP, Telnet(s), SSL/TLS, SSH, TFTP(cs), HTTP(s)
CMX	<a href="#">CMX-MicroNet</a>	PPP, ARP, IGMP, ICMP, IPv4, UDP, TCP, DHCP(c), DNS, FTP(cs), POP3(c), SMTP, SNMP, SNTP, Telnet(s), SSL/TLS, TFTP (c), HTTP(s)
CypherBridge	<a href="#">Embedded SSH SDK (uSSH™)</a>	SSH 2.0, Configurable DSS and RSA asymmetric session, Configurable crypto with 3DES AES and blow fish support, SCP, SFTP
EUROS	<a href="#">TCP/IP stack</a>	PPP, PPPoE, ARP, IGMP, ICMP, IPv4, IPv6, IPSec/IKE, UDP, TCP, DNS, DHCP(cs), FTP(cs), NAT, POP3(c), SMTP, SNMP, SNTP, Telnet(s), SSL/TLS, TFTP, HTTP(cs), SFTP, FTPS, SSH
Microsoft	<a href="#">NetX</a> and <a href="#">NetX Duo</a> IPv4/IPv6	PPP, ARP, IGMP, ICMP, IPv4, IPv6, IPSec/IKE, UDP, TCP, DNS, DHCP(c), FTP(cs), NAT, POP3(c), SMTP, SNMP, SNTP, Telnet(s), TFTP, HTTP(s)
eCosCentric	<a href="#">SecureSockets</a>	SSH2
eCosCentric	<a href="#">SecureShell</a>	SSL/TLS
eCosCentric	<a href="#">eCosPro stacks</a>	PPP, ARP, ICMP, UDP, TCP, IPv4, IPv6, DHCP, BOOTP, SMTP, TFTP, FTP(c+s), HTTP, SNMP, NTP, mDNS, Bonjour
eForce	<a href="#">µNet3</a>	PPP, ARP, IGMP, ICMP, IPv4, IPv6, UDP, TCP, DNS, DHCP(c), FTP(s), HTTP(cs), TFTP, SNMP, SNTP, Telnet(s), POP3(c), SMTP, SSL/TLS
EmCraft	<a href="#">Linux TCP/IP stack</a>	PPP, DNS, NAT, SSH (cs), DHCP (cs), SNMP (cs), Telnet (cs), FTP (cs), HTTP (cs)
HCC	<a href="#">MISRA HCC-TCP/IP v4/v6</a>	IPv4, IPv6, UDP, TCP, DNS, DHCP(cs), FTP(cs), SMTP, TFTP(s), SLIP, PPP, PPPoE, IGMP, IPSec/IKE, NAT, POP3(c), SNMP, SNTP, Telnet(s), RTP/RTCP, EAP, EST, ESMTP, SSH, MLDv2, NDP, MQTT
Wittenstein - High Integrity Systems	<a href="#">CONNECT TCP</a>	TCP, UDP, ARP, ICMP, IPv4, DNS, DHCP, FTP, TFTP, HTTP, LLNMR, NBNS, Auto-IP, standard sockets or callback interface



# STM32 – TCP/IP solution details (2/3)

Provider	Solution name	Details
Green Hills	<u><a href="#">μ-velOSity TCP/IP v4/v6</a></u>	ARP, ICMP, IGMP, IPv4, IPv6, IPv4/6, UDP, TCP, DNS, DHCP(c),
Keil / arm	<u><a href="#">MDK-ARM TCPNET</a></u>	SLIP, PPP, ARP, IPv4, ICMP, UDP, TCP, DNS, DHCP(c), FTP(s), SMTP, SNMP, Telnet(s), TFTP(s), HTTP(s)
SICS	<u><a href="#">LwIP</a></u>	PPP, ARP, ICMP, IPv4, UDP, TCP, DHCP(c), IPv6
Mentor Embedded	<u><a href="#">Nucleus Kernel</a></u>	PPP, PPPoE, ARP, IGMP, ICMP, IPv4, IPv6, IPSec/IKE, UDP, TCP, DHCP(c), FTP(cs), NAT, SNMP, SNTP, Telnet(cs), SSL/TLS, TFTP (cs), HTTP(cs)
Micrium	<u><a href="#">μC/TCP-IP</a></u> (and <u><a href="#">μC/SSL</a></u> )	ARP, ICMP, IPv4, UDP, TCP, DNS, DHCP(c), FTP(cs), SMTP, POP3(c), SNTP, Telnet(s), SSL/TLS, TFTP, HTTP(s)
Weston Embedded	<u><a href="#">Cesium RTOS Cs/NET</a></u>	ARP, ICMP, IPv4, UDP, TCP, DNS, DHCP(c), FTP(cs), SMTP, POP3(c), SNTP, Telnet(s), SSL/TLS, TFTP, HTTP(s)
Micro Digital	<u><a href="#">smxNS</a></u> and <u><a href="#">smxNS6</a></u> (Dual IPv6/v4)	SLIP, PPP, PPPoE, ARP, IGMP, ICMP, IPv4, IPv6, IPv4/6, UDP, TCP, DNS, mDNS, DHCP(cs), FTP(cs), NAT, POP3(c), SMTP, SNMP, SNTP, Telnet(s), SSL/TLS, TFTP, HTTP(cs), SSH
Oryx Embedded	<u><a href="#">CycloneTCP</a></u>	Dual stack (IPv4 and/or IPv6), Built-in support for multiple network interfaces, BSD style socket API, Blocking/non-blocking socket operation and event-driven functions (select and poll), Efficient data transfer (zero copy), Well-crafted TCP module with selective ACK and congestion control, Raw socket interface, Multicast support (IGMPv2 and MLDv1), IP fragmentation and reassembly, Flexible memory footprint, Portable architecture, Host name resolution (DNS client), DHCP and SLAAC auto-configuration, SMTP client, FTP client and server, TFTP client and server, Web server with SSI and CGI scripting, HTTP/2 client, MQTT and MQTT-SN clients, CoAP client, SNMPv1/v2c/v3 agent, WebSocket client and server

(c): Client  
(s): Server  
(cs): Client and Server



# STM32 – TCP/IP solution details (3/3)

Provider	Solution name	Details
Quadros	<a href="#">RTXC Quadnet</a>	PPP, PPPoE, ARP, IGMP, ICMP, IPv4, IPv6, IPSec/IKE, UDP, TCP, DNS, DHCP(cs), FTP(cs), NAT, POP3(c), SMTP, SNMP, SNMP, Telnet(s), SSL/TLS, TFTP, HTTP(cs), UPnP, Prioritized Packets Handling
Rowebots	<a href="#">Unison TCP-IP/v4-v6</a>	PPP, ARP, ICMP, IGMP, IPv4, IPv6, IPv4/6, 6Low Pan, IPSec, UDP, TCP, DNS, DHCP(cs), SMTP(c), SNMP, Telnet(s), TFTP(cs), HTTP(cs), NAT
SEGGER	<a href="#">embOS/IP</a>	PPP, PPPoE, ARP, ICMP, IGMP, IPv4, UDP, TCP, DNS, DHCP(cs), FTP(cs), SMTP(c), SNMP(c), Telnet(s), TFTP(cs), HTTP(s), PTP IEEE 1588
SICS	<a href="#">Contiki/uIP6</a>	IPv6, 6LoWPAN
ST	<a href="#">STM32Cube - LwIP</a>	PPP, ARP, ICMP, IPv4, UDP, TCP, DHCP(c), IPv6
ST	<a href="#">STM32Cube – NetX / NetX duo</a> <a href="#">X-CUBE-AZRTOS – NetX / NetX duo</a>	PPP, ARP, IGMP, ICMP, IPv4, IPv6, IPSec/IKE, UDP, TCP, DNS, DHCP(c), FTP(cs), NAT, POP3(c), SMTP, SNMP, SNMP, Telnet(s), TFTP, HTTP(s)
Zephyr	<a href="#">Zephyr Networking</a>	IPv4, IPv6 (dual stack support), ICMPv4, ICMPv6, UDP, TCP, HTTP, MQTT, CoAP, LWM2W, RPL, DNS/ 6LoWPAN



# Middleware – 2.4GHz – Bluetooth

BLE is a wireless communication technology for exchanging data over short distances, typically used in the mobile world

- Solutions with STM32WB or STM32 + Bluetooth transceiver
  - Several solutions are available, using STM32WB or STM32 with SPBTLE-RF, BlueNRG-MS or other components

Often-seen acronyms	
Bluetooth Low Energy	(Also called Bluetooth Smart) very interesting for application running out of battery (coin cell type) as power consumption is very low, with a lower data rate and connection time
Classic Bluetooth	Original Bluetooth before Bluetooth Low Energy appearance. Still required for certain Audio applications.
Dual mode devices	Devices able to handle Classic Bluetooth, and Bluetooth Low Energy. Also called Bluetooth Smart ready
HCI	Host/controller interface: Standardized communication between controller and radio chips
SPP	Serial port profile: Profile that emulates serial line over Bluetooth
A2DP	Advanced audio distribution profile: Profile to stream high-quality audio
HSP	Headset profile: Profile to implement a basic headset application
HDP	Health device profile: Profile designed to facilitate transmission and reception of medical data
HFP	Hands-free profile: Typical profile used in cars for hands-free phone use



# STM32 – Bluetooth solutions

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-BLE1</a>	Binaries and Source	Free	N.A.	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	
ST	STM32Cube	Source	Free	N.A.	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	<u>Y</u> <sup>2</sup>	N <sup>1</sup>	<u>Y</u> <sup>3</sup>
ST	<a href="#">STM32Cube – BLE<sup>4</sup></a>	Source	Free	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N

1/ STM32L0 + BlueNRG-MS. Available on STM32Cube so porting is very easy

2/ point to point and HeartRate profile example running on [B-L475E-IOT01A](#) with ST [SPBTLE-RF](#)

3/ AT client with HeartRate profile example running on [B-U585I-IOT02A](#) with ST [STM32WB5MMG](#) module

4/ Certified BLE stack + HCI, certified OpenThread binary stack, BLE/OpenThread concurrent stack, BLE profiles and services, certified 802.15.4 MAC, Zigbee, BLE/Zigbee concurrent stack included in STM32Cube MCU package (\Middlewares\ST folder)



# STM32 – Bluetooth solutions

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
arm	<a href="#">Mbed BLE<sup>4</sup></a>	Source	Free	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
A&W	<a href="#">PhoneLink</a>	Binaries or Source	License and/or royalties	N	N	N	Y	Y	N	N	Y	Y	Y <sup>1</sup>	N	N	N	N	N
Clarinox	<a href="#">ClarinoxBlue<sup>8</sup></a>	Binaries or Source	License and/or royalties	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>
EUROS	<a href="#">BLE stack<sup>6</sup></a>	Binaries	License	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>1</sup>	Y <sup>1</sup>
Rowebots	<a href="#">UNISON Bluetooth System</a>	Source	License	N	N	N	Y	Y	Y	N	Y	Y	Y <sup>1</sup>	N	Y	Y	N	N
SEARAN	<a href="#">dotStack</a>	Binaries or Source	License and/or royalties	N	Y	Y	Y	Y	Y	N	Y	Y	Y <sup>1</sup>	Y	Y	Y	N	N
Zephyr	<a href="#">Bluetooth</a>	Open Source (Apache 2.0)	Free	N	N	N	Y	N	Y	N	Y	N	N	N	N	Y	N	N

1/ Available on customer request. Please contact supplier

2/ Available on specific conditions. Please contact supplier

4/ Support BLE, Heart Rate Service, iBeacon on ST boards: [DISCO-L475VG-IOT01A](#), [P-NUCLEO-WB55](#)

6/ SmartBond™ DA14681 Bluetooth® low energy SoC adapted to the EUROS RTOS

8/ ClarinoxBlue supports multiple RTOS and many wireless radio supporting HCI (UART, USB)





# STM32 – Bluetooth solution details

Provider	Solution name	Details
ST	<u>X-CUBE-BLE1</u>	BT4.0, BT4.1 All profiles supported
ST	<u>STM32Cube – BLE</u>	BT 5.0 PTS Profiles/Services: Client: Heart Rate Profile (HRP): Collector, Location and Navigation (LNP), Time Profile (TIP), Weight Scale Profile (WSP), Alert Notification Profile (ANP), Health thermometer Profile (HTP): Collector, Phone Alert Status Profile (PASP), Find Me Profile (FMP), Proximity Profile (Px Monitor, PXP), HID Over GATT Profile (HOGP): Boot Host, Report Host Server: Heart Rate Profile (HRP): Heart Rate Sensor, Device Information Service (DIS), Link Loss (LLS), Battery Service (BAS), Tx Power Service (TPS), Scan Parameters (ScPP), Location and Navigation (LNS), Immediate Alert (IAS), Next DST Change Service (NDCS), Reference Time Update Service (RTUS), Current Time Service (CTS), Weight Scale Profile (WSP), Alert Notification Profile (ANP), Environmental Sensing (ESS), Blood Pressure Profile (BLP), Bond Management Service (BMS), Cycling Power Profile (CPP), Cycling Speed and Cadence Profile (CSCP), Health thermometer Profile (HTP): Thermometer, Automation IO Service (AIO), HTTP Proxy Service (HPS), Phone Alert Service (PASS), Find Me Profile (FMP + IAS), Environmental Sensing (ESS) Proximity Profile (Px Reporter, PXP), Running and Speed Cadence Service (RSCS), HID Service (HIDS), Glucose Service (GLS).
Zephyr	<u>Bluetooth</u>	BT5.0, GAP, GATT, BR/EDR, Mesh



# STM32 – Bluetooth solution details

Provider	Solution name	Details
arm	<a href="#">Mbed BLE</a>	<a href="#">More...</a>
A&W	<a href="#">PhoneLink</a>	BT2.1+EDR, BT4.0 Supported Profiles: HFP, HSP, PBAP, A2DP, AVRCP, HID, OBEX, FTP, OPP, SPP, PAN, MAP and more
Clarinox	<a href="#">ClarinoxBlue</a>	BT4.2, BT 4.1, BT4.0 + EDR + LE + Mesh Supported profiles: Classic Profiles (A2DP, AVRCP, BIP, BPP, CTN, DI, FTP, GAP, GAVDP, HCRP, HDP, HFP, HID, HSP, MAP, MPS, OPP, PAN, PBAP, SDAP, SPP), Classic Protocols (AVCTP, AVDTP, BNEP, HCI, L2CAP, MCAP, OBEX, RFCOMM, SDP), Smart Profiles / Services (AIOP, AIOS, ANP, ANS, BAS, BCS, BMS, BLP, BLS, CGMP, CGMS, CPP, CPS, CSCP, CSCS, CTS, DIS, ESP, ESS, FMP, GAP, GLP, GLS, HIDS, HOGP, HPS, HRP, HRS, HTP, HTS, IAS, IPS, IPSP, LLS, LNP, LNS, NDCS, OTP, OTS, PASP, PASS, PLXP, PLXS, PXP, RSCP, RSCS, RTUS, ScPP, SCPS, TIP, TDS, TPS, UDS, WSP, WSS, Mesh, Custom), Smart Protocols (ATT, GATT, SM, MESH)
SEARAN	<a href="#">dotStack</a>	BT2.1+EDR, BT4.0, BT4.1, BT 4.2, and 5.0 ready. Single and dual mode. Apps on iOS and Android BLE (GATT) - ANP/ANS, FMP, HIDS, HOGP, PASP/PASS, PXP, TIP, BAS, DIS, IAS, LLS, TPS, ANCS, BLP/BLS, GP, HTP, HRP/HRS BR/EDR - SPP, HID, PAN, MAP, FTP, HSP, HFP, A2DP, AVRCP, PBAP, iAP, HCRP



# Middleware – 2.4GHz – Thread

## Solutions with STM32WB

Thread is an IPv6-based, low-power mesh networking technology for IoT products. Thread uses 6LoWPAN and IEEE 802.15.4 wireless protocol with mesh communication



# STM32 – Thread solutions

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">STM32Cube – OpenThread<sup>1</sup></a>	Source	Free	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N

1/ Certified OpenThread binary stack, BLE/OpenThread concurrent stack included in STM32Cube MCU package (\\Middlewares\\ST folder)

## Solutions with STM32WB

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection.



# STM32 – Zigbee solutions

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">STM32Cube – Zigbee<sup>1</sup></a>	Source	Free	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Provider	Solution name	Details
ST	<a href="#">STM32Cube – Zigbee<sup>1</sup></a>	Support following clusters: Basic, Device Temperature Configuration, Identify, On/Off, Power Profile, Thermostat-UI-Config, Ballast-Configuration, Illuminance-Measurement, Temperature Measurement, Pressure Measurement, Occupancy-Sensing, Messaging, Meter Identification

1/ Certified Zigbee stack, BLE/Zigbee concurrent stack included in STM32Cube MCU package (\Middlewares\ST folder)



# Middleware – 2.4GHz – Wi-Fi™

- Wi-Fi™ is an implementation of the IEEE 802.11 radio communication specification for wireless local area networking. It is usually used with a TCP/IP stack, so all TCP/IP bricks can be reused on Wi-Fi, adapting the lowest firmware layer
- Solutions with STM32 + Wi-Fi transceiver
  - Several solutions are available, using STM32 with modules: MXCHIP EMW3080B, Murata Type 1LD and 1MD (CYW43438), Espressif ESP8266, Inventek ISM43362-M3G-L44, Innophase INP1010/INP1011



# STM32 – Wi-Fi™ solutions

Provider	Solution name	Model	Cost	Availability														
				WB	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
arm	<a href="#">Mbed Wifi<sup>5</sup></a>	Source	Free	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N
Clarinox	<a href="#">ClarinoxWiFi<sup>6</sup></a>	Binaries or Source	License and/or Royalties	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N
Infineon	<a href="#">STM32 Connectivity Expansion Pack</a>	Source	Free	N	N	N	N	N	N	N	N	Y	Y	N	N	Y	Y	Y
Innophase	<a href="#">I-CUBE-T2-STW<sup>8</sup></a>	Binaries or Source	License	N	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	N <sup>7</sup>	Y	N <sup>7</sup>	N <sup>7</sup>
ST	<a href="#">STM32CubeL4/L4+ – WiFi<sup>2</sup></a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32CubeF4 – WiFi<sup>3</sup></a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32CubeF7 – WiFi<sup>4</sup></a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32CubeU5 – WiFi<sup>9</sup></a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y
Zephyr	<a href="#">Zephyr Wifi</a>	Open Source (Apache 2.0)	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Available on STM32Cube, so porting is very easy

2/ Client Server application and HTTP Server application examples running on [B-L475E-IOT01A](#) with Inventek ISM43362-M3G-L44

3/ Client Server application and HTTP Server application examples running on [STM32F413H-DISCO](#) with Inventek ISM43362-M3G-L44

4/ In-Application programming client example running on [STM32F723E-DISCO](#) and [STM32F769I-DISCO](#)

5/ Supports ST boards including [DISCO-L475VG-IOT01A](#), [DISCO-F413ZH](#)

6/ Clarinox WiFi protocol stack supports multiple RTOS, and SDIO, SPI, USB

7/ Available on STM32Cube, so porting is very easy

8/ Supports [I-NUCLEO-T2-EVB](#) with INP1010/INP1011

9/ ping, echo, scan, http application example running on [B-U585I-IOT02A](#) with MXCHIP EMW3080B

10/ Includes example for STM32H747I-DISCO + muRata uSD-M2 Adapter Kit (rev B1) + Embedded Artists 1LV or 1DX M.2 Module





# Middleware – sub-1GHz – Lora®

- LoRa® is a modulation used for wireless telecommunications. It is created to allow long-range communications at a very low bit-rate and enables long-life battery-operated sensors. LoRaWAN™ is a standard defined by the LoRa-Alliance which defines the communication and security protocol to ensure the interoperability.
- Solutions with STM32 + LoRa® radio
  - STM32WL
  - Semtech SX1276MB1MAS, SX1276MB1LAS and SX1272MB2DAS LoRa® radio expansion boards
  - Murata CMWX1ZZABZ-xxx LoRa® module (also used for Sigfox)
  - USI WM-SG-SM-42 LoRa® module
  - RiSiNGHF® RHF0M003 modem for LoRa®



# STM32 – LoRa® solution

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">ICUBE-LRWAN<sup>2</sup></a>	Source	Free	N.A.	N	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32Cube - LoRaWAN</a>	Source	Free	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
arm	<a href="#">mbedOS LoRa<sup>3</sup></a>	Source	Free	N.A.	Y	N	N	N	N	N	N	N	N	N	Y	N	N	N	N
StackForce	<a href="#">LoRaWAN stack</a>	Source/Object	License/Royalties	N.A.	Y	N	N	N	N	N	N	N	N	N	Y	N	N	N	N

1/ Available on STM32Cube, so porting is very easy

2/ Supports NUCLEO-L053R8, NUCLEO-L152RE and NUCLEO-L476RG with I-NUCLEO-LRWAN1  
B-L072Z-LRWAN1  
I-NUCLEO-LRWAN1

P-NUCLEO-LRWAN1 (NUCLEO-L073RZ + I-NUCLEO-SX1272D)

P-NUCLEO-LRWAN2 and P-NUCLEO-LRWAN3

3/ Available on DISCO-L072CZ-LRWAN1

- Sigfox™ is a Low-Power Wide Area Network allowing low-power sensors to benefit from a planetary network, enabling end-devices with low BOM cost
- Solutions with STM32 + radio
  - STM32WL
  - Murata CMWX1ZZABZ-xxx module



# STM32 – sigfox™ solution

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<u>X-CUBE-SFOX</u>	Source	Free	N.A.	N	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y <sup>2</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
ST	<u>STM32Cube - Sigfox</u>	Source	Free	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N

1/ Available on STM32Cube, so porting is very easy  
2/ Supports Murata CMWX1ZZABZ-xxx module only in B-L072Z-LRWAN1

- Sub 1GHz RF operates in the ISM spectrum bands below Sub 1GHz – typically in the 769 – 935 MHz , 315 MHz and the 468 MHz frequency range. This spectrum band below 1GHz is particularly useful for RF IOT applications
- Solutions with STM32WB, STM32WL or STM32 + radio (SPIRIT1 or S2-LP)



# STM32 – Sub-1GHz – others

Provider	Solution name	Model	Cost	Availability															
				WB	W L	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-SUBG1<sup>2</sup></a>	Source	Free	N.A.	N	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STM32Cube – 802.15.4<sup>4</sup></a>	Source	Free	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
StackForce	<a href="#">emb6 - 6LoWPAN based IoT stack<sup>3</sup></a>	Source/Object	Free / License	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N
StackForce	<a href="#">WM-Bus stack</a>	Source/Binaries	License	N	Y	N	N	N	N	N	N	N	N	N	Y <sup>3</sup>	N	N	N	N

1/ Available on STM32Cube, so porting is very easy

2/ Supports WM-bus with X-NUCLEO-IDS01A4, Contiki OS and Contiki 6LoWPAN protocol on STM32F4 and STM32L1

3/ STM32L0 + SPIRIT1

4/ Certified BLE stack + HCI, certified OpenThread binary stack, BLE/OpenThread concurrent stack, BLE profiles and services, certified 802.15.4 MAC included in STM32Cube MCU package (\Middlewares\ST folder)



# Middleware & drivers – NFC

- Complementary to other wireless technologies, Near Field Communication (NFC) is designed to execute short transactions between two devices in close proximity.
- Operating in the 13.56 MHz (RFID) HF band, it is based on ISO/IEC 14443 & ISO/IEC 15693 RFID standards, and regulated by NFC Forum industry association
- Solutions with STM32 + ST25 NFC / RFID Tag & Reader ICs
  - NFC / RFID reader ICs
    - ST25R3911B high performance HF Reader/NFC initiator (ISO14443, ISO15693, FeliCa) with 1.4 W output power, supporting VHBR, capacitive sensitive wake up and Automatic Antenna Tuning (AAT)
    - Other product variant: ST25R3912, ST25R3913, ST25R3914, ST25R3915 and ST25R3916
    - CR95HF entry level HF Reader/ NFC Initiator (ISO14443, ISO15693, FeliCa)
  - Dynamic NFC tag ICs
    - ST25DV dynamic RFID ISO15693 – NFC Type 5 Tag ICs
    - M24LR dynamic RFID ISO15693 / NFC compatible Tag ICs (M24LR04 is NFC Forum Type 5)
    - M24SR dynamic RFID ISO14443 type A – NFC Type 4 Tag ICs



# STM32 – NFC solutions

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-NFC1</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	
ST	<a href="#">X-CUBE-NFC2</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	
ST	<a href="#">X-CUBE-NFC3</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	
ST	<a href="#">X-CUBE-NFC4</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	
ST	<a href="#">X-CUBE-NFC5</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	
ST	<a href="#">X-CUBE-NFC6</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	

- NFC / RFID readers
  - X-CUBE-NFC3: Drivers and Middleware (NFC Lib, NDEF Lib) for CR95HF, HF Reader/ NFC Initiator, packaged to run on X-NUCLEO-NFC03A1
  - X-CUBE-NFC5: Drivers and Middleware (RFAL Lib) for ST25R3911B, HF Reader/ NFC Initiator, packaged to run on X-NUCLEO-NFC05A1
  - X-CUBE-NFC6: Drivers and Middleware (RFAL Lib) for ST25R3916 high performance NFC front-end IC, to run on X-NUCLEO-NFC06A1
- Dynamic NFC tags
  - X-CUBE-NFC1: Drivers and Middleware (NDEF Lib) for M24SR Dynamic NFC/RFID Tag IC, packaged to run on X-NUCLEO-NFC01A1
  - X-CUBE-NFC2: Drivers and Middleware (NDEF Lib) for M24LR Dynamic NFC/RFID Tag IC, packaged to run on X-NUCLEO-NFC02A1
  - X-CUBE-NFC4: Drivers and Middleware (NDEF Lib) for ST25DV Dynamic NFC/RFID Tag IC, packaged to run on X-NUCLEO-NFC04A1

1/ Available on STM32Cube, so porting is very easy





# Middleware & drivers – Cellular framework

STMicroelectronics framework for devices based on LPWAN cellular networks, with ready-to-run examples using the LPWAN LTE Cat M or NB-IoT protocols to support quick evaluation and development of IoT cloud applications

- BSD-like socket APIs for data plane
- TCP-UDP/IP connectivity with IP stack running on host or modem
- Flexible and modular SW architecture for the easy integration of different modems
- Modem Low Power support (PSM)
- Partial GSMA TS34/35 compliance
- Easy customization thanks to API and configuration flags
- Support Secure Element hosted in UICC HW or eUICC HW
- PC terminal for debug and configuration (APN, band...) using Command Line Interface (CLI)



# STM32 – Cellular framework

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-CELLULAR</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>

1/ Available on STM32Cube, so porting is very easy

## Supported Hardware and cellular partners

Host Board	STM32	Modem Vendor/Chipset	Modem Model	Modem Board	Description	Availability
P-L496G-CELL02	L4	Quectel/Qualcomm	BG96	MB1329	Cellular pack that includes the daughter board MB1329	Now
32L496Discovery	L4	Quectel/Qualcomm	BG96	MB1329	/	Now
32L496Discovery	L4	Sequans/Sequans	GM01Q/ GMS01Q	GM01Q-STMOD/ GMS01Q-STMOD	With SIM from Orange for GMS01Q	Now
B-L4S5I-IOT01A	L4+	Quectel/Qualcomm	BG96	w/ X-NUCLEO-STMODA1 with MB1329	Can re-use eSIM on	Now
B-L4S5I-IOT01A w/ X-NUCLEO-STMODA1	L4+	Sequans/Sequans	GM01Q	w/ X-NUCLEO-STMODA1 with GM01Q-STMOD	Modem without eSIM	Now
STEVAL-STWINKT1x	L4+	Quectel/Qualcomm	BG96	MB1329		Now
STEVAL-STWINKT1x	L4+	Sequans/Sequans	GMS01Q	GMS01Q-STMOD		Now
B-L462E-CELL1	L4	MURATA/Sony Semiconductor Israel	LBAD0XX1SC	Integrated in the Module	Module LBAD0ZZ1SE with integrated Modem and eSIM	1Q21



## Safety Packages for STM8 and STM32 from ST

- Safety targets protection of people and equipment from danger and harm, through a set of counter-measures ensuring defined targets

Often-seen acronyms	
ClassB	The IEC 60730 safety standard defines the test and diagnostic methods that ensure the safe operation of embedded control hardware and software for household appliances. The IEC 60730 standard category Class B prevents unsafe operation of the controlled equipment.
SIL	Safety Integrity Level (SIL) is defined by the industry standard IEC 61508 as a relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction.
ASIL	ASIL is a risk classification scheme defined by the ISO 26262 - Functional Safety for Road Vehicles standard. This is an adaptation of the Safety Integrity Level used in IEC 61508 for the automotive industry.



# STM32 – Safety solutions

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<u>X-CUBE-CLASSB</u> <sup>5</sup>	Source	Free	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
ST	<u>STM32-CLASSB-SPL</u>	Source	Free	N	22Q3	Y	N	Y	Y <sup>3</sup>	N	N	Y <sup>3</sup>	N	N	N	Y <sup>3</sup>	N	N	22Q2
ST	<u>X-CUBE-STL</u> <sup>4</sup>	Object	Free	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y

3/ Derived package only (not certified)

4/ IEC 61508 SC3 compliant self-test library, certified by TÜV Rheinland. Delivered as compiler independent object code. Safety Manual, FMEA and FMEDA. Available under NDA, please contact your ST sales office.

5/ IEC 60335-1 and 60730-1 compliant, certified by UL.





# STM8 – Safety solutions

Provider	Solution name	Model	Cost	Availability		
				STM8S	STM8AF	STM8L STM8AL
ST	<a href="#">STM8-SafeCLASSB</a>	Source	Free	Y	Y	Y
ST	<a href="#">STM8A-SafeASIL<sup>1</sup></a>	Document	Free	N	Y	Y

1/ Safety Manual, FMEA, FMEDA and specification for self-test library





# Middleware – graphical user interface

ST's MCUs can drive displays through serial or parallel interfaces

- Getting the most from hardware and software
  - ST has built a close relationship with third parties providing software solutions based on our microcontrollers. Customers can make the most of their hardware.

Often-seen acronyms	
Anti aliasing	Technique to minimize distortion artifacts known as aliasing when presenting a high-resolution image at a lower resolution. Aliased images show some stair effects on curves. Anti-aliasing removes this by modifying edge pixel colors.
Alpha blending	Alpha blending is the process of combining a translucent foreground color with a background color, thereby producing a new blended color.
GUI	Graphical user interface
bpp	Bits per pixel (also known as color depth: Number of bits used to represent the color of a single pixel in an image. 1 bpp corresponds to monochrome images.
Palette	Technique to lower image memory size by storing the set of colors used in a table and using this table for each pixel
JPEG	Commonly used method of lossy compression for digital image. The degree of compression can be adjusted, allowing a trade-off between storage size and image quality. JPEG typically achieves 10:1 compression with little perceptible loss in image quality.
RGB / ARGB	Color model in which red, green and blue are merged to reproduce a broad array of colors. "A" field in ARGB format handles transparency information.
Widgets	Element of a graphical user interface that can be changed by the user (such as text box, radio button)



# STM32 – graphical user interface solutions (1/2)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">STemWin</a>	Binaries	Free	N	N	N	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	N
ST	<a href="#">STM32Cube - STemWin</a>	Binaries	Free	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	N <sup>2</sup>	Y	Y	N <sup>2</sup>	N <sup>2</sup>
ST	<a href="#">TouchGFX<sup>4</sup></a>	Source	Free	Y <sup>3</sup>	Y <sup>3</sup>	N	Y <sup>3</sup>	N	N	Y <sup>3</sup>	Y <sup>3</sup>	Y	Y	Y	N	N	Y	Y <sup>3</sup>	Y <sup>3</sup>
Altia	<a href="#">Altia Design and Deep screen</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	<u>Y</u>	Y	Y	N <sup>1</sup>	Y	N	N <sup>1</sup>	N <sup>1</sup>
Crank	<a href="#">Storyboard</a>	Binaries	License	N <sup>1</sup>	N <sup>1</sup>	N	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N	N <sup>1</sup>	N	N <sup>1</sup>	N <sup>1</sup>
eCosCentric	<a href="#">eCosPro-PEG</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Microsoft	<a href="#">Azure RTOS GUIX</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>

1/ Please contact supplier

2/ Available on STM32Cube, so porting is very easy

3/ Although no project example is provided, the TouchGFX binary can be used on these series

4/ TouchGFX is available as a software expansion for STM32Cube



# STM32 – graphical user interface solutions (2/2)

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Korulab	<a href="#">Koru</a>	Binaries	License	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	Y	N	
Micrium	<a href="#">µC/GUI</a>	Open Source (Apache 2.0)	Free	N	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	
Micro Digital	<a href="#">PEG</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	
QT	<a href="#">QT</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	
Rowebots	<a href="#">emWin GUI</a>	Source	License	N	N	N	N	Y	Y	Y	N	Y	Y	Y	N	N	N	N	
SEGGER	<a href="#">emWin</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	
Tara Systems	<a href="#">Embedded Wizard</a>	Binaries / Source	License	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	Y	N	

1/ Please contact supplier





# Middleware – touch sensing

Capacitive touch sensing is an electrical cost-efficient technology, replacing conventional mechanical switches to detect user actions, to build modern GUI look and feel.

- NRE/royalty-free C source code
  - Complete solution for touch keys, linear and rotary touch sensors, with acquisition, post processing and API layers, debounce filtering and calibration functions

Often-seen acronyms	
Surface capacitance	The capacitance of a single ended electrode is modified when the finger gets close to it.
Projected capacitance	The capacitance between two sensing electrodes is modified when the finger gets close to them.
RC acquisition	Resistor-capacitor acquisition for surface capacitance only. It consists in measuring the charge and discharge time duration of a RC cell made of the electrode capacitance and a load resistor.
CT acquisition	Charge transfer acquisition for surface capacitance only. It consists in measuring the duration for charging the electrode capacitance and transferring part of the accumulated charge into a sampling capacitor. The CT acquisition is more robust than the RC one.



# STM32 – touch-sensing solutions

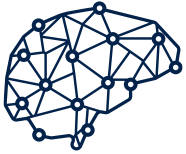
Provider	Solution name	Acquisition	Model	Cost	Availability															
					WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	STM32 Touch Sensing Library	CT	Source	Free	N	N	<u>Y</u>	N	N	N	<u>Y</u>	N	N	N	N	N	<u>Y</u>	N	N	N
ST	<a href="#">STM32Cube – Touch Sensing</a>	CT	Source	Free	Y	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	Y	Y



# STM8 – touch-sensing solutions

Provider	Solution name	Acquisition	Model	Cost	Availability	
					STM8S/ STM8AF	STM8L/ STM8AL
ST	STM8 Touch Lib	RC + CT	Source	Free	<u>Y</u> <sup>1</sup>	<u>Y</u> <sup>1</sup>

1/ RC for STM8S/STM8AF, RC for STM8AL, RC and CT for STM8L



# Middleware – artificial neural networks

Thanks to a wide set of Artificial Intelligence (AI) solutions from ST you now have the possibility to map and run Machine Learning (ML) such as Artificial Neural Networks (ANN) on the broad STM32 microcontroller portfolio. **STM32Cube.AI** is an extension pack of the widely used STM32CubeMX configuration and code generation tool converting and optimizing pre-trained ANN models on STM32 Arm® Cortex®-M-based microcontrollers

Often-seen acronyms	
AI	Artificial Intelligence
ML	Machine Learning
ANN	Artificial Neural Networks



# STM32 – artificial neural networks

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-AI<sup>1</sup></a>	Source	Free	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y
ST	<a href="#">NanoEdgeAIStudio</a>	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ST	<a href="#">FP-AI-SENSING<sup>12</sup></a>	Source	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
ST	<a href="#">FP-AI-VISION<sup>13</sup></a>	Source	Free	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y <sup>7</sup>	Y <sup>7</sup>	Y <sup>7</sup>
ST	<a href="#">FP-AI-FACEREC<sup>4</sup></a>	Source	Free	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y <sup>7</sup>	Y <sup>7</sup>	Y <sup>7</sup>
ST	<a href="#">FP-AI-MONITOR<sup>15</sup></a>	Source	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y

1/ Generation of an STM32-optimized library from pre-trained Neural Network models. Support various Deep Learning frameworks such as Keras, TensorFlow™ Lite and support of all frameworks that can export to the ONNX standard format such as PyTorch™, Microsoft® Cognitive Toolkit, MATLAB® and more.

2/ STM32Cube function pack for ultra-low power IoT node with artificial intelligence (AI) application based on audio and motion sensing.

3/ STM32Cube function pack featuring examples of computer vision applications based on Convolutional Neural Network (CNN).

4/ STM32Cube function pack featuring examples of face detection and face recognition with on-board enrollment.

5/ STM32Cube function pack for ultra-low power STM32 with artificial intelligence (AI) monitoring application based on a wide range of sensors.

6/ Available on STM32Cube, so porting is very easy.

7/ Demo and code example available on demand.



# STM32 – instrumentation

- Enabling your FreeRTOS application to process command line input

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
AWS	<a href="#">FREERTOS+™ CLI<sup>1</sup></a>	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ The license is the same as FreeRTOS kernel (MIT)



# Connectors to cloud providers

STM32 acts as an end device securely connected to cloud services providers

- Connectors to cloud provider (Amazon AWS, Microsoft Azure, IBM Watson...)

STM32Cube Expansion Packages

Amazon AWS, Google Cloud, IBM Watson, Microsoft Azure  
Exosite, Grovestream, AvSystem, Litmus Automation, Ubidots

- Configuration of the connectivity interfaces (WiFi, Ethernet...)
- Connection to the Internet and the cloud provider servers
- publication of messages
- Subscription over a variety of connectivity protocols (MQTT, HTTPS...)

- Examples of end device applications using ST sensors and RFID/NFC tag and connecting to cloud providers

STM32 ODE Functions packs

Amazon AWS, IBM Watson, Microsoft Azure

- Temperature and humidity sensor (HTS221)
- Pressure sensor (LPS25HB)
- Motion sensors (LIS3MDL, LSM303AGR, LSM6DS0, LSM6DSL, IIS2DH)
- Writing/reading the RFID/NFC tag (M24SR64-Y)



# STM32 - connectors to cloud providers

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-CLD-GEN<sup>1</sup></a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">X-CUBE-AWS<sup>2</sup></a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">X-CUBE-AZURE<sup>2</sup></a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">X-CUBE-WATSON</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">X-CUBE-GCP</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">FP-CLD-AWS1</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">FP-CLD-AZURE1</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>
	<a href="#">FP-CLD-WASTON1</a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>

1/ Supports [B-L475E-IOT01A](#), [32F413HDISCOVERY](#), [32F769IDISCOVERY](#), [P-L496G-CELL01](#) and [P-L496G-CELL02](#). Examples with Exosite, Grovestream, AvSystem, Litmus Automation and Ubidots cloud providers

2/ Supports [B-L475E-IOT01A](#), [32F413HDISCOVERY](#), [32F769IDISCOVERY](#) and [P-L496G-CELL02](#). Includes Secure Firmware Update (SBSFU), integration with X-CUBE-CELLULAR. May be connected to a provided AWS/AZURE web dashboard.

3/ Available on STM32Cube, so porting is very easy





# STM32 - connectors to cloud providers

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
AVSystem	<a href="#">Anjay LwM2M SDK</a>	Open source	Free	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
AWS	<a href="#">Amazon FreeRTOS<sup>1</sup></a>	Source	Free <sup>2</sup>	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	N	N
CypherBridge	<a href="#">uMQTT Toolkit</a>	Source	License	N	N	N	N	N	N	N	N	Y	Y	N	N	N	Y	N	N
GIZWITS	<a href="#">I-CUBE-GIZWITS</a>	Source	Free	N	N	N	N	N	N	N	N	Y	Y	N	N	N	Y	N	N
IoTerop	<a href="#">IOWA</a>	Binary, Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft	<a href="#">Azure IoT Middleware for Azure RTOS</a>	Source	License	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	N <sup>4</sup>
Keil / arm	<a href="#">IoT Client<sup>3</sup></a>	Source	License	N <sup>4</sup>	N <sup>4</sup>	Y	N <sup>4</sup>	Y	Y	Y	N <sup>4</sup>	Y	Y	Y	Y	Y	Y	N <sup>4</sup>	N <sup>4</sup>

1/ "Connect to AWS IoT" and "Connect to AWS Greengrass" packages are available for [STM32L4/L4+Discovery kit IoT node](#)

2/ MIT license

3/ Amazon AWS, Google Cloud, IBM Watson, Microsoft Azure

4/ Please contact supplier



# Application field – audio

- A complete solution for all audio aspects
  - All audio aspects can be covered by solutions from ST or third parties
- Optimized for ST products
  - Unlike open-source non-optimized solutions, ST works with third parties to propose optimized algorithms for ST platforms

## Often-seen acronyms

Codec	A codec is a program capable of encoding and decoding a digital data stream. The encoded stream can be compressed or not, with a lossy (MP3, WMA, ...) or lossless (FLAC, ALAC, ...) mechanism.
PCM	Pulse-code modulation: Digital representation of an analog signal, in which the magnitude of the analogue signal is sampled regularly, each sample being quantized to the nearest value within a range of digital steps.
MP3	Music codecs. MP3 is now now patent-free.
AAC, WMA	Music codecs with patents. Royalties need to be paid to patent owners.
Speex	Open source, no royalties speech codec
G711	Simple codec with no royalties often used in telephony
G726	ADPCM (adaptive differential pulse code modulation): Simple compression of PCM data



# STM32 – audio solutions

Provider	Solution name	Model	Cost	Availability																
				WB	WL	F0	G0	F1	F105 F107	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">ADPCM Vocoder, Speex Vocoder</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N	N	N	Y	N <sup>1</sup>	N	N
ST	G711, G726, G726A Vocoders	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N <sup>1</sup>	N <sup>1</sup>	Y <sup>3</sup>	N <sup>1</sup>	N <sup>1</sup>	Y <sup>3</sup>	N	N	N	N <sup>1</sup>	N <sup>1</sup>	N	N
ST	<a href="#">Audio Engine MP3 Decoder</a> With Channel Mixer, Equalizer and Loud	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	Y	N	N <sup>1</sup>	N <sup>1</sup>	N	N
ST	<a href="#">Audio Engine MP3 Codec</a> With Channel Mixer, Equalizer and Loud	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N	N	N	N <sup>1</sup>	N <sup>1</sup>	N	N
ST	<a href="#">Audio Engine WMA Decoder</a> With Channel Mixer, Equalizer and Loud	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N	N	N	N <sup>1</sup>	N <sup>1</sup>	N	N
ST	Audio Engine AAC Decoder AAC-LC, HE-AAC+ v1, HE-AAC+ v2	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N <sup>1</sup>	Y <sup>3</sup>	Y <sup>3</sup>	N <sup>1</sup>	N <sup>1</sup>	Y <sup>3</sup>	N	N	N	N <sup>1</sup>	N <sup>1</sup>	N	N
ST	Audio Engine Post Processing Smart volume control, Equalizer, Sample rate converters, Stereo widening	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	N	N	N	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N	N	N	N	N
ST	USB audio class and stream synchro. (feedback pipe, external PLL, ...)	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	Y	N	N	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	N	Y	N	N	N	N
ST	Source Rate Converter <sup>3</sup>	Binaries	Free	N <sup>1</sup>	N <sup>1</sup>	N	N	Y	Y	Y	N <sup>1</sup>	N <sup>1</sup>	Y	Y	N	N	N <sup>1</sup>	N	N	N



# STM32 – audio solutions

Provider	Solution name	Model	Cost	Availability																
				WB	WL	F0	G0	F1	F105 F107	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">X-CUBE-AUDIO</a> <sup>3</sup>	Binaries	Free	N <sup>5</sup>	N <sup>5</sup>	N	N	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	Y	Y	N <sup>5</sup>	N	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>
ST	<a href="#">STM32Cube – PDM2PCM library</a> <sup>6</sup>	Source	Free	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	Y	N <sup>5</sup>	N <sup>5</sup>	Y	Y	Y	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>	N <sup>5</sup>
ST	<a href="#">Amazon Alexa (AFI)</a> <sup>7</sup>	Source	Free	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
DSPConcept / ST	<a href="#">ST Audio Weaver free edition</a>	Binaries	License	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	Y	Y	Y
Craftwork	<a href="#">Remote Speakers (DLNA Media Renderer)</a>	Binaries	License	N	N	N	N	N	N	N <sup>1</sup>	N	N	Y	N <sup>1</sup>	N <sup>1</sup>	N	N	N	N	N
Sensory	Voice recognition <sup>2</sup>	Binaries	License	N	N	N	N	N	N	N	N	N	Y	N <sup>1</sup>	N <sup>1</sup>	N	N	N	N	N
Vestec	Voice recognition <sup>2</sup>	Binaries	License	N	N	N	N	N	N	N	N	N	Y	N <sup>1</sup>	N <sup>1</sup>	N	N	N	N	N

1/ The library will run immediately on these targets, even if not ported officially.

2/ Available on demand. Ask your local ST Sales office.

3/ Audio processing components (BAM, BIQ, CDC, GAM, GREQ, HPV, SRC236, SRC441, OMNI2, SVC, SDR, SMR), MP3 decoder (Cortex-M7/M4/M3), MP3 encoder (Cortex-M3/M4)

4/ Framework for the Alexa Voice Service (AVS)

5/ Available on STM32Cube, so porting is very easy

6/ Included in STM32Cube MCU packages (Middlewares\ST folder)

7/ Available on demand. Ask your local ST Sales office.



# Focus – STM32 audio post-processing (1/2)

Modules Names	Quality	Measured MHz	Flash Memory	Static RAM	Dynamic RAM	Remarks
SRC441	Standard	13.7 MHz	3204 Bytes	232 Bytes	3228 Bytes	Sampling Rate Conversion from 44.1 to 48 kHz
	High Quality	20.4 MHz	3894 Bytes	360 Bytes	3676 Bytes	
SRC236	Standard	8->16: 4.4 MHz 48->96: 25.3 MHz 16->48: 12.5 MHz 8->48: 12.3 MHz 32->48: 12.7 MHz 24->16: 6.2 MHz	1740 Bytes	972 Bytes	3364 Bytes	Sampling Rate Conversion supporting ratios 2, 3, 6, 1/2, 1/3, 1/6, 3/2 and 2/3.
	High Quality	8->16: 7.1 MHz 48->96: 40.7 MHz 16->48: 20.4 MHz 8->48: 20.2 MHz 32->48: 20.5 MHz 24->16: 10.2 MHz	2238 Bytes	1932 Bytes	4804 Bytes	
Omnisurround – Stereo Widening	Enhanced Mono to Stereo	6.4 MHz	3660 Bytes	1992 Bytes	384 Bytes	Signal is sampled at 48 kHz
	SW 2.0 to 2.0	13.2 MHz				
	Closely Spaced Speakers	4.0 MHz				
Omnisurround – 7.1 Virtualizer	5.1 or 7.1 -> 2.0	25.6 MHz	4764 Bytes	3028 Bytes	1152 Bytes	Signal is sampled at 48 kHz



# Focus – STM32 audio post-processing (2/2)

Modules Names	Quality	Measured MHz	Flash Memory	Static RAM	Dynamic RAM	Remarks
Gfx Equalizer (GrEq)	10-bands	14 MHz	4390 Bytes	552 Bytes	3840 Bytes	Graphical Equalizer. Signal is sampled at 48 kHz, 10 parallel bands with 6 available presets Can run in place (Input buf = Output buf)
Biquad Filters	10 Biquads	14.1 MHz	570 Bytes	600 Bytes	4 Bytes	Generic Biquads filter (used for Transducer Equalizer for instance) Signal is sampled at 48 kHz Can run in place (Input buf = Output buf)
Bass Manager (BAM)	with Limiter	17.1 MHz	9266 Bytes	2236 Bytes	5760 Bytes	Bass Manager. Up to +/- 24 dB, between 60 and 300Hz Can run in place (Input buf = Output buf)
	without Limiter	12.7 MHz				
Smart Volume Control (SVC)	Standard	6.2 MHz	6160 Bytes	2648 Bytes	4800 Bytes	Smart Volume Control (includes DRC) Signal is sampled at 48 kHz Can run in place (Input buf = Output buf)
	High Quality	10.9 MHz				
Gain Manager (GAM)	Standard	Stereo: 2.6 MHz	1472 Bytes	120 Bytes	1 Bytes	Gain Manager Signal is sampled at 48 kHz Can run in place (Input buf = Output buf)
		8 channels: 8.6 MHz				
Panning	L/R Panning F/R Balancing	8.4 MHz	5654 Bytes	6872 Bytes	7680 Bytes	Signal is sampled at 48 kHz 2.0 input, 4.0 output Contains Front and Rear Left/Right Panning, Front/Rear balancing.
	Sweet Spot Mode 1	4.2 MHz				
	Sweet Spot Mode 2 (Ambi)	4.7 MHz	7956 Bytes	6968 Bytes	7680 Bytes	Sweet Spot Mode for one user.



# Application field – building automation and control

Building automation is the automatic centralized control of a building's heating, ventilation and air conditioning, lighting and other systems through a building management system or building automation system (BAS). A building controlled by a BAS is often referred to as a smart building or a smart home.

## Often-seen acronyms

BACnet	communications protocol for Building Automation and Control (BAC) networks that leverage the ASHRAE, ANSI, and ISO 16484-5 standard protocol. BACnet was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control (HVAC), lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the particular building service they perform.
DALI	Digital Addressable Lighting Interface (DALI) is a trademark for network-based systems that control lighting in building automation. The underlying technology was established by a consortium of lighting equipment manufacturers as a successor for 0-10 V lighting control systems, and as an open standard alternative to Digital Signal Interface (DSI), on which it is based. DALI is specified by technical standards IEC 62386 and IEC 60929. Standards conformance ensures that equipment from different manufacturers will interoperate. The DALI trademark is allowed on devices that comply with the current standards when manufactured.
DLMS / COSEM	IEC 62056 is a set of standards for Electricity metering data exchange by International Electrotechnical Commission. The IEC 62056 standards are the International Standard versions of the DLMS/COSEM specification. DLMS or Device Language Message Specification (originally Distribution Line Message Specification[1]), is the suite of standards developed and maintained by the DLMS User Association and has been adopted by the IEC TC13 WG14 into the IEC 62056 series of standards. COSEM or Companion Specification for Energy Metering, includes a set of specifications that defines the Transport and Application Layers of the DLMS protocol
DMX-512	DMX512 (Digital Multiplex) is a standard for digital communication networks that are commonly used to control stage lighting and effects. It was originally intended as a standardized method for controlling light dimmers, which, prior to DMX512, had employed various incompatible proprietary protocols. It soon became the primary method for linking controllers (such as a lighting console) to dimmers and special effects devices such as fog machines and intelligent lights
KNX	KNX is a standardized (EN 50090, ISO/IEC 14543), OSI-based network communications protocol for building automation. KNX is the successor to, and convergence of, three previous standards: the European Home Systems Protocol (EHS), BatiBUS, and the European Installation Bus (EIB or Instabus)



# STM32 – building automation and control

Provider	Solution name	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
MBS	<a href="#">BACnet stack embedded</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Softdel	<a href="#">BACnet Stack</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>
ST	<a href="#">DALI<sup>2</sup></a>	Source	Free	N <sup>3</sup>	N <sup>3</sup>	N	N <sup>3</sup>	Y	N	N	N	N	N	N	N	Y	N	N	N
MBS	<a href="#">DALI 2 stack</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Andrea Informatique	<a href="#">DLMS / COSEM</a>	Binaries	License	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
ST	<a href="#">DMX-512<sup>4</sup></a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Softdel	<a href="#">DMX-512 Stack</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TAPKO	<a href="#">KAstack KNX</a>	Binaries / source	License + royalties	N <sup>3</sup>	N <sup>3</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
Weinzierl	<a href="#">KNX</a>	Source	License	N <sup>3</sup>	N <sup>3</sup>	Y	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>

1/ Can be ported

2/ Provided on demand to sales office, supporting DALI slave only

3/ Please contact supplier

4/ Provided on demand to sales office.





# STM8 – building automation and control

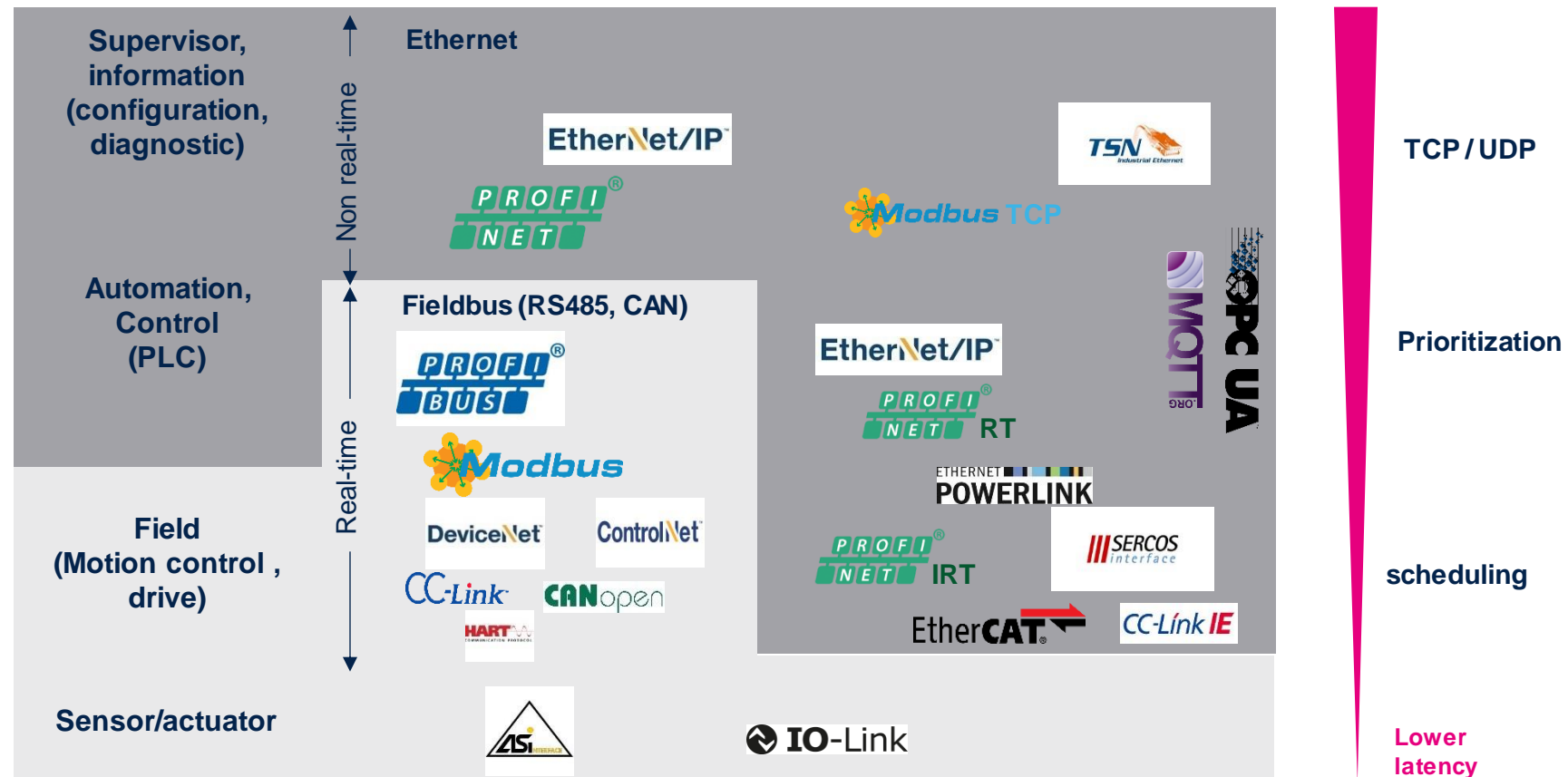
Provider	Solution name	Application	Model	Cost	Availability	
					STM8S/ STM8AF	STM8L/ STM8AL
ST	<u>DALI</u>	Lighting	Source	Free	Y	N <sup>1</sup>
TAPKO	<u>KAlstack KNX</u>	Building automation	Binaries / source	License	N	Y

1/ Can be easily ported



# Application field – industrial protocols

Industrial market needs are very fragmented in terms of communication protocols. Many different protocols are available for different target applications in factory automation





# STM32 – industrial protocols (1/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Acontis	<a href="#">EC-Master</a>	Factory Automation	Source	License	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
ASIX Electronics	<a href="#">AX58100 STM32F303RE Motor Control Demo Kit<sup>5</sup></a>	Factory Automation	Source	Free	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N
CMX	<a href="#">CMX-CANopen</a>	Automation, medical	Source	License	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	N	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Cypherbridge	<a href="#">uMODBUS</a>	Factory Automation	Source	License	Y <sup>2</sup>	N	N	N	N	N	Y <sup>3</sup>	Y <sup>3</sup>	N	N	N	N	N	N
eCosCentric	<a href="#">eCosPro-CAN</a>	Factory Automation	Source	License	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	N	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">CANopen</a>	Factory Automation	Source	License	N	N	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	N	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">eCosPro-ModbusTCP</a>	Factory Automation	Source	License	N	N	N	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N	N	Y	N <sup>1</sup>	N <sup>1</sup>
Embedded office	<a href="#">CANopen</a>	Factory Automation	Source	Free <sup>4</sup>	N	N	Y	Y	N	N	Y	N	N	N	N	N	N	N

1/ Please contact supplier

2/ MODBUS RTU

3/ MODBUS TCP

4/ Apache 2.0 license

5/ EtherCAT slave motor control solution based on ASIX AX58100 + STM32 and X-CUBE-MCSDK



# STM32 – industrial protocols (2/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
emotas	<u>CANopen</u>	Automation, medical	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	<u>I-CUBE-CANOPEN</u> MadeForSTM32 V2	Automation, medical	Source	License	N	Y	N	N	N	Y	N	N	Y	N	N	N	Y	Y
	<u>J1939</u>	Commercial vehicles	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	<u>EnergyBus</u>	Commercial vehicles	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	<u>EtherCAT<sup>1</sup></u>	Automation, medical	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
EUROS	<u>CANOpen</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N
	<u>PROFINET</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
	<u>Modbus</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
	<u>EtherCAT<sup>1</sup></u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
	<u>Ethernet</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
	<u>OPC UA Server/Client</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y
	<u>MQTT Client</u>	Automation	Binaries	License	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y

# STM32 – industrial protocols (3/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Hilscher	I-CUBE-NETX + PROFIBUS DP Slave <sup>(1)</sup>	Fieldbus Factory automation	Source + Binary <sup>(2)</sup>	License	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	
	I-CUBE-NETX + CANopen Slave <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	
	I-CUBE-NETX + DeviceNet Slave <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	
	I-CUBE-NETX + CC-Link Slave <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	
	I-CUBE-NETX + OPC UA Server <sup>(1)</sup>	IIoT	Source + Binary <sup>(2)</sup>	License	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	
	I-CUBE-NETX + MQTT Client <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	

1/ Requires external hardware (netX52 or netX90).

2/ source for STM32, binary for external hardware.

3/ Available on STM32Cube, so porting is very easy



# STM32 – industrial protocols (4/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Hilscher	<u>I-CUBE-NETX + PROFINET RT/IRT IO-Device</u> <sup>(1)</sup>	Industrial real-time Ethernet  Factory automation	Source + Binary <sup>(2)</sup>	License	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + EtherCAT Slave</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + Ethernet/IP Adapter</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + sercos Slave</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + POWERLINK Controlled Node</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + Varan Client</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>
	<u>I-CUBE-NETX + Open ModbusTCP</u> <sup>(1)</sup>				N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	Y	Y	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>	N <sup>3</sup>

1/ Requires external hardware (netX52 or netX90).

2/ source for STM32, binary for external hardware.



# STM32 – industrial protocols (5/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Kalycito	OPC UA	Factory automation	Open Source	Free	N	N	N	N	N	N <sup>2</sup>	Y	Y	Y	N	N	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
Matrikon	<u>Flex (OPC UA SDK)</u>	Factory automation	Source / Binaries	License	N	N	N	Y	N	N <sup>2</sup>	Y	Y	Y	N	N	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
MESCO	<u>HART Slave</u>	Process automation	Source	Lic. + Royal.	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>
MicroControl	<u>CANopen</u>	Automation, medical	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N <sup>2</sup>	N <sup>2</sup>
	<u>J1939</u>	Commercial vehicles	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N <sup>2</sup>	N <sup>2</sup>
	<u>EtherCAT<sup>1</sup></u>	Factory automation	Source	License	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>	Y <sup>1</sup>
	<u>PROFINET</u>	Factory automation	Source	License	N	N	Y	Y	N	N	Y	Y	Y	N	N	N	N	N
Micrium	µC/CAN	Factory automation	Open Source	Free	N	N	Y	Y	N	N	Y	N	N	N	N	N	N	N
	<u>µC/Modbus</u>	Factory automation	Open Source	Free	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	Y	Y	Y	N <sup>2</sup>	N <sup>2</sup>

1/ Requires external hardware.

2/ Please contact supplier.



# STM32 – industrial protocols (6/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
Mitsubishi	<a href="#">CC-Link IE TSN Remote Station SDK</a>	Factory automation	Source	License	N	N	N	N	N	N	Y	N	N	N	N	N	N	N
port	<a href="#">CANopen</a>	Factory automation	Source	License	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	N	N	Y	N <sup>2</sup>	N <sup>2</sup>
	<a href="#">EtherCAT<sup>1</sup></a>	Factory automation	Source	License	Y	Y	Y	Y	Y	N <sup>2</sup>	Y	Y	Y	N	N	Y	N <sup>2</sup>	N <sup>2</sup>
	<a href="#">PROFINET</a>	Factory automation	Source	License	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
	<a href="#">EtherNet/IP<sup>1</sup></a>	Factory automation	Source	License	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
	<a href="#">POWERLINK<sup>1</sup></a>	Factory automation	Source	License	N	N	N	Y	N	N	N	N	N	N	N	N	N	N
	<a href="#">I-CUBE-UGOAL</a> <a href="#">MadeForSTM32</a> <b>V2</b>	Factory automation	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SEGGER	<a href="#">emModbus</a>	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Systerel	S2OPC (OPC UA)	Factory automation	Open Source	Free	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	Y	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>





# STM32 – industrial protocols (7/8)

Provider	Solution name	Application	Model	Cost	Availability													
					F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
TEConcept	<u>IO-Link Device</u>	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	<u>IO-Link Master</u>	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TMGTE	<u>IO-Link Device</u>	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	<u>IO-Link Master</u>	Factory automation	Source	License	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	<u>Profibus DP</u>	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	<u>Profinet</u>	Factory automation	Source	License + royalties	N	N	N	Y	N	Y	Y	Y	Y	N	N	N	N	N
	<u>Ethernet/IP</u>	Factory automation	Source	License + royalties	N	N	N	Y	N	Y	Y	Y	Y	N	N	N	N	N
Rowebots	<u>UNISON Modbus</u>	Factory automation	Source	License	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y



# STM8 – industrial protocols

Provider	Solution name	Application	Model	Cost	Availability	
					STM8S / STM8AF	STM8L / STM8AL
SEGGER	<a href="#">emModbus</a>	Factory automation	Source	License	Y	Y
TEConcept	<a href="#">IO-Link Device</a>	Factory automation	Source	License	Y	Y
TMGTE	<a href="#">IO-Link Device</a>	Factory automation	Source	License	Y	Y



# Application field – motor control

- Control your 3-phase motor with top performance
  - STM32 microcontrollers offer the performance of the industry-standard Arm® Cortex®-M cores running either Vector control or FOC modes, widely used in high-performance drives for air conditioning, home appliances, drones, building and industrial automation, medical and e-bike applications. STM32 MC SDK (motor control software development kit) firmware (X-CUBE-MCSDK and X-CUBE-MCSDK-FUL) includes the Permanent-magnet synchronous motor (PMSM) firmware library (FOC control) and the STM32 Motor Control Workbench (to configure the FOC firmware library parameters), with its graphical user interface (GUI). STM32 Motor Control Workbench is PC software that reduces the design effort and time needed for the STM32 PMSM FOC firmware configuration. The user generates a project file through the GUI and initializes the library according to the application needs. Some of the variables of the algorithm being used can be monitored and changed in real time.

## Often-seen acronyms

BLDC	Brushless DC: permanent magnet motor with trapezoidal shaped B-EMF, FOC applicable
PMSM	Permanent magnet synchronous motor: with sinusoidal shaped B-EMF, FOC applicable
ACIM	AC induction motor: type of motor, FOC applicable
FOC	Field-oriented control: Mathematical technique used to achieve decoupled control of the flux and torque in a 3-phase motor.
HFI, MTPA	High Frequency Injection: algorithm for very low speed and fast acceleration (air con, fridge) and increased efficiency for low- or zero-speed, full torque applications (washing machines, factory automation) <ul style="list-style-type: none"><li>• “Maximum Torque Per Ampere” (MTPA): optimizes the motor torque for each load and increases the efficiency,</li><li>• “Feed Forward”: improves the current control at high speed.</li></ul>



# STM32 – motor control – PMSM

Provider	Solution name	Model	Cost	Availability													
				F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/ L4+	L5	U5
ST	STM32 Motor Control Software Development Kit (MCSDK) Software development kit including: • Motor control library (sensors, algorithms...), Single or Dual control •PMSM library for FOC control • Motor control application (implementation of library, high-level MC commands) • ST Motor Control Workbench software tool • Demo projects and utilities	<u>X-CUBE-MCSDK</u> Source code except CORDIC, MTPA,...	Free														
		<u>X-CUBE-MCSDK-FUL</u> Full source code (Registration/approval required)		Y <sup>1</sup>	Y	Y	N	Y	Y	Y	Y	Y <sup>2</sup>	N	N	Y	N	N

1/ Supports also STSPIN32F0

2/ Partially supported with examples



# STM32 – motor control - BLDC

Provider	Solution name	Model	Cost	Availability													
				F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
ST	<a href="#">Bipolar stepper motors driving</a>	Source	Free	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
ST	<a href="#">STSW-IHM040V1</a> STM32 6-step FW example (STM32F100) <a href="#">STSW-IHM043V1</a> STM32 6-step FW example (STM32F0)	Source	Free	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N
ST	<a href="#">X-CUBE-SPN7</a> Three-phase brushless DC motor driver	Source	Free	Y	N <sup>2</sup>	Y	N <sup>2</sup>	Y	N <sup>2</sup>	Y	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>	N <sup>2</sup>

1/ Can be ported

2/ Available on STM32Cube, so porting is very easy



# STM32 – motor control - stepper

Provider	Solution name	Model	Cost	Availability													
				F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4 /L4+	L5	U5
ST	<u>STSW-STM32018</u> Driving bipolar stepper motors using STM32F103 microcontroller	Source	Free	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
ST	<u>X-CUBE-SPN1</u> Stepper bipolar motor driver software expansion for STM32Cube	Source	Free	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
	<u>X-CUBE-SPN2</u> Two axes stepper motor driver software expansion for STM32Cube	Source	Free	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
	<u>X-CUBE-SPN3</u> High-power stepper motor driver software expansion for STM32Cube	Source	Free	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
	<u>X-CUBE-SPN4</u> Dual-brush DC motor driver software expansion for STM32Cube	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
	<u>X-CUBE-SPN5</u> Stepper bipolar motor driver software expansion for STM32Cube	Source	Free	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>

1/ Available on STM32Cube, so porting is very easy



# STM8 – motor control

Provider	Solution name	Model	Cost	Availability	
				STM8S / STM8AF	STM8L / STM8AL
ST	<u>STSW-STM8020</u> STM8S and STM8A BLDC and ACIM motor control firmware library <ul style="list-style-type: none"><li>• Scalar control of induction motor control</li><li>• Scalar control (6-step) of permanent magnet brushless motors (BLDC and PMSM)</li></ul>	Source	Free	Y	N
ST	<u>STSW-STM8042</u> STM8S motor control firmware library builder GUI	Binaries	Free	Y	N



# Application field – automotive

- More than hardware
  - In addition to microcontrollers dedicated to automotive equipment, ST proposes a set of firmware solutions

Often-seen acronyms	
J1939	Vehicle standard used for communication and diagnostics with vehicle components (e.g. agricultural machines).
J2602	USA variant of LIN
LIN	Local interconnect network: The LIN bus is a small and slow network system that is used as a cheap sub-network of a CAN bus to integrate intelligent sensor devices or actuators in today's cars. The LIN specification is enforced by the LIN-consortium, with the first exploited version being 1.1, released in 1999. Since then, the specification has evolved to version 2.1 and 2.2 to meet current networking needs. Bit rates vary within the range of 1 to 20 Kbit/s.
CAN	Controller-area network (CAN or CAN-bus): This is a standard vehicle bus designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. Possible bit rates from 125 Kbit/s up to 1 Mbit/s.
ASIL	ASIL is a risk classification scheme defined by the ISO 26262 - Functional Safety for Road Vehicles standard. This is an adaptation of the Safety Integrity Level used in IEC 61508 for the automotive industry.





# STM8 – automotive solutions

Provider	Solution name	Model	Cost	Availability	
				STM8AF	STM8AL
ST	<a href="#">J2602 Driver</a>	Source	Free	Y	N <sup>1</sup>
	<a href="#">LIN 2.1 Driver</a>	Source	Free	Y	Y
	<a href="#">STM8A-SafeASIL</a>	Document	Free	Y	N <sup>1</sup>
Simma Software	<a href="#">ssCAN</a>	Source	License	Y	N.A. <sup>3</sup>
	<a href="#">ssJ1939</a>	Source	License	Y	N.A. <sup>3</sup>
	<a href="#">ssI15765</a>	Source	License	Y	N.A. <sup>3</sup>
	<a href="#">ssI14229 (UDS)</a>	Source	License	Y	N.A. <sup>3</sup>
	<a href="#">ssNMEA2000</a>	Source	License	Y	N.A. <sup>3</sup>
Vector	<a href="#">CANbedded</a>	Source	License	Y	N.A. <sup>3</sup>
	<a href="#">CANbedded LIN</a>	Source	License	Y	N <sup>2</sup>
	<a href="#">CANbedded J1939</a>	Source	License	Y	N.A. <sup>3</sup>

1/ Please contact your ST sales office

2/ Please contact supplier

3/ No CAN in STM8AL series



# STM32 – CAN / LIN solutions

- Warning: STM32 devices are not qualified for automotive, and thus must not be used in automotive application.

Provider	Solution name	Model	Cost	Availability													
				F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4/L4+	L5	U5
IHR Gmbh	<a href="#">LIN 2.1 Driver</a>	Source	License	N <sup>1</sup>	N <sup>1</sup>	Y	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	Y <sup>2</sup>	Y <sup>3</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>	N <sup>1</sup>
Simma Software	<a href="#">ssCAN</a>	Source	License	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N.A. <sup>4</sup>	N.A. <sup>4</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">ssJ1939</a>	Source	License	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N.A. <sup>4</sup>	N.A. <sup>4</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">ssI15765</a>	Source	License	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N.A. <sup>4</sup>	N.A. <sup>4</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">ssI14229 (UDS)</a>	Source	License	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N.A. <sup>4</sup>	N.A. <sup>4</sup>	Y	N <sup>1</sup>	N <sup>1</sup>
	<a href="#">ssNMEA2000</a>	Source	License	Y	N <sup>1</sup>	Y	Y	Y	N <sup>1</sup>	Y	Y	N <sup>1</sup>	N.A. <sup>4</sup>	N.A. <sup>4</sup>	Y	N <sup>1</sup>	N <sup>1</sup>

1/ Please contact supplier

2/ slave only

3/ multi-master (4 channels)

4/ No CAN in STM32L0 and STM32L1 series

# Virtual machines & model-driven development

High-level languages are available in STM32 ecosystem,  
as well as model-driven development tools

- **Easier migration**

- ST and 3<sup>rd</sup> parties help customers migrate to these new environments



Environment	Meaning
Javascript	High Level Interpreted Language, typically used in HTML, internet and web related design
Python	High Level Language, interpreted or using a VM (Virtual Machine), popular within scientific community
.NET	C# object-oriented language and Microsoft Visual Studio development environment. This is Microsoft .NET Micro Framework for microcontrollers.
MATLAB/Simulink	Brands from MathWorks company, for software enabling model-driven approach



# STM32 – virtual machines and model-driven development

Provider	Description	Model	Cost	Availability															
				WB	WL	F0	G0	F1	F2	F3	G4	F4	F7	H7	L0	L1	L4 /L4+	L5	U5
ST	<a href="#">STM32 Peripheral blocks for Matlab/Simulink</a>	License	Free	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Mountaineer	<a href="#">Microsoft .NET Micro Framework</a>	Open source Apache 2.0	Free	N	N	N	N	Y	Y	N	N	Y	N	N	N	N	N	N	N
Espruino	<a href="#">Javascript</a>	Open source MPLv2	Free	N	N	N	N	Y	N	N	N	Y	N	N	N	N	Y	N	N
JerryScript	<a href="#">Javascript</a>	Open source Apache 2.0	Free	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N
Duktape	<a href="#">Javascript</a>	Open source MIT	Free	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N
Micropython	<a href="#">Python</a>	Open source MIT	Free	N	N	N	N	N	N	N	N	Y	Y	N	N	N	Y	N	N

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