Discover our embedded software solutions
- ST, third parties and open source -

STM32 and STM8 microcontrollers

April 2018

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A full portfolio and several models

- Extensive software ecosystem around the STM32 and STM8
- You will find your solution, fitting your requirements in terms of price, license and support

ST-designed software

- Built in-house, making the most of the STM32 and STM8
- Source code or binaries
- Supported by ST

Open source

- Proposed by community or third parties
- Source code, from BSD or GPL licenses to commercial products
- Supported by open-source community or third parties

Third parties

- Generic solutions proposed by many companies, portable to/from other platforms
- Source code or binaries
- Supported by third parties

A large community of third parties… and growing !

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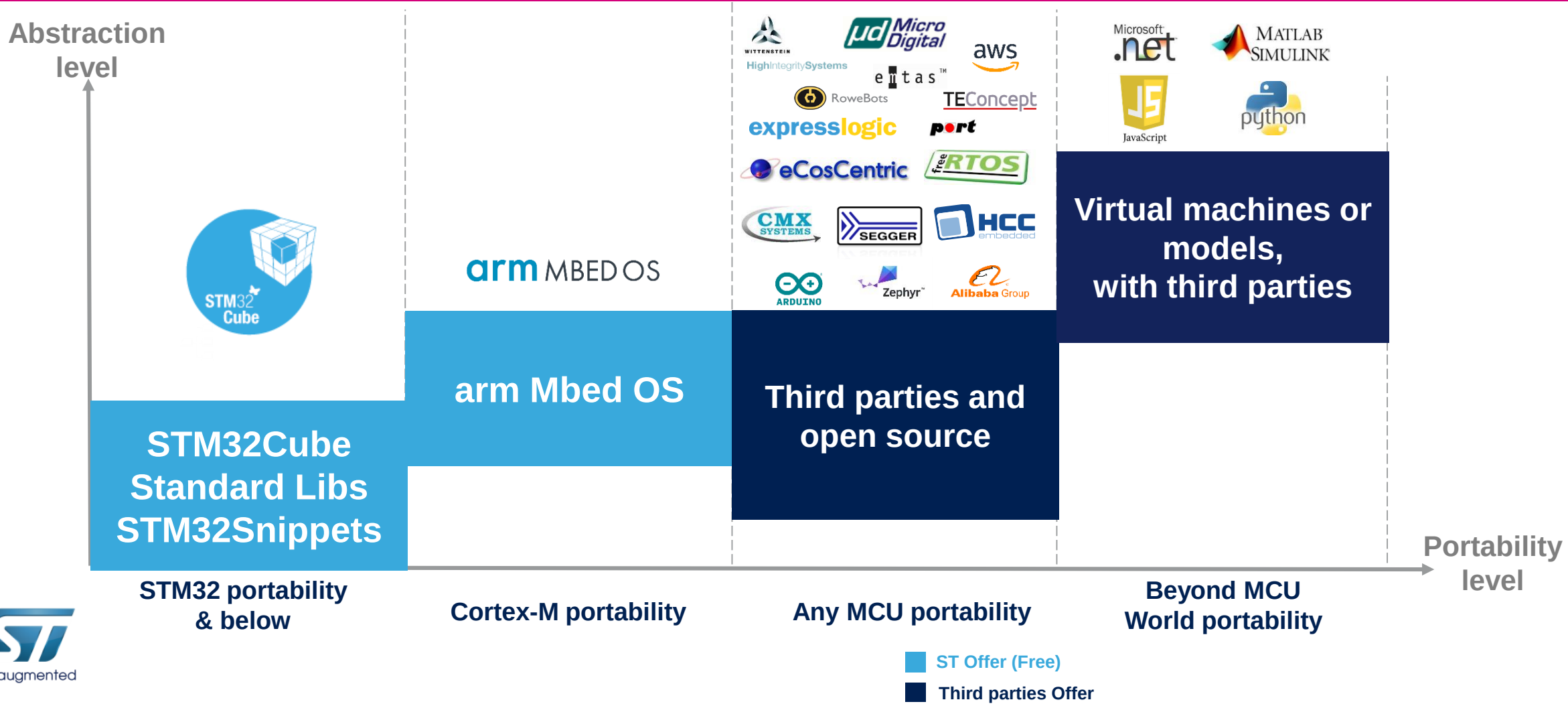
STM32 Embedded Software Offer - Overview

Several solutions mixing levels of Portability and Abstraction



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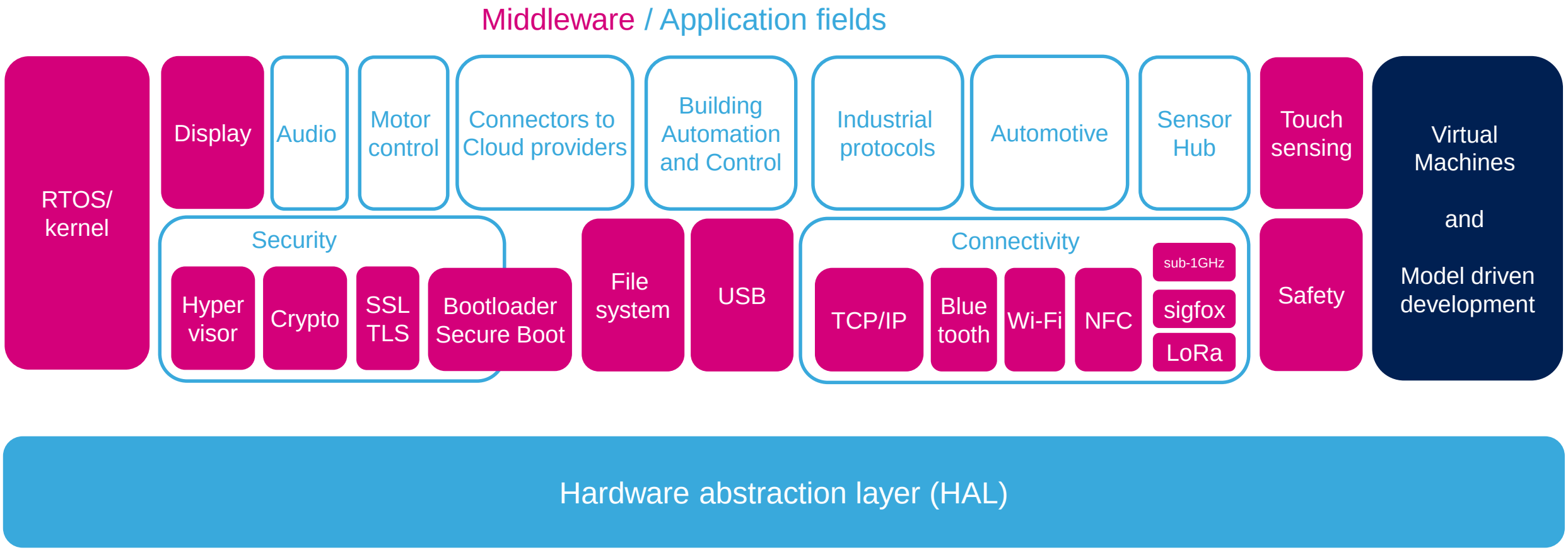
Solutions at all levels



Select the area of interest for more details

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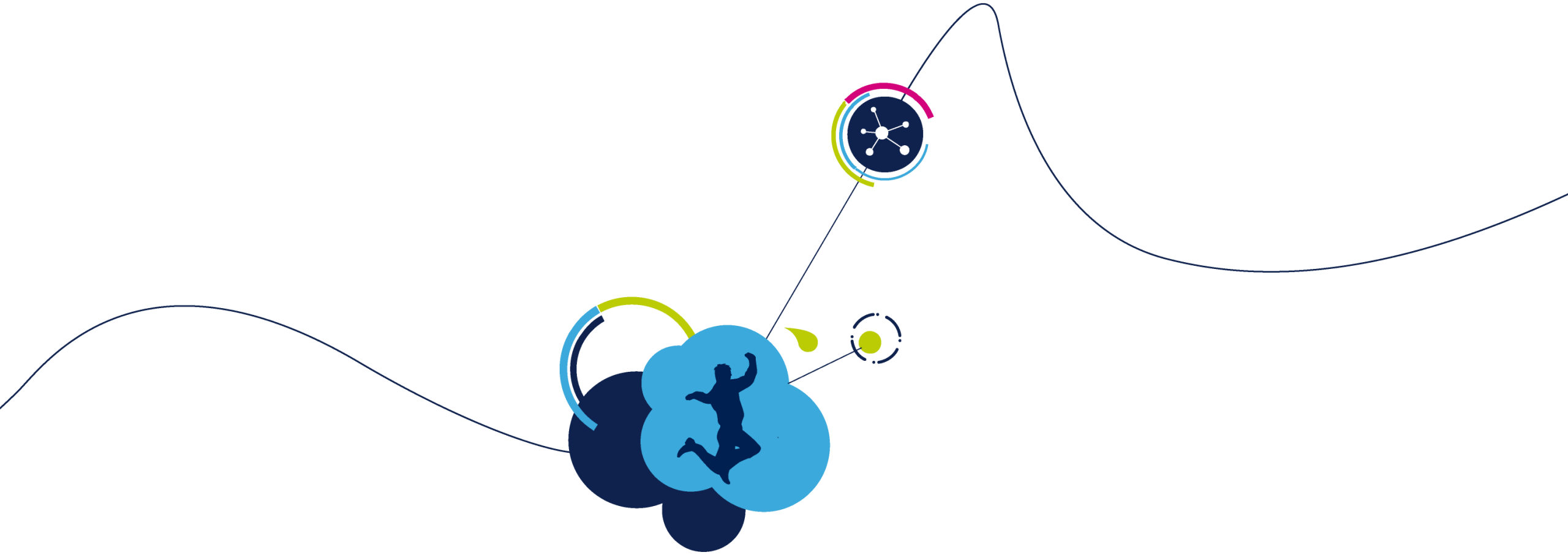

Hardware abstraction layer (HAL)

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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

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STM32 - Hardware abstraction layer

Provider	Solution name	Model	Cost	Availability										
				F0	F1	F2	F3		F4	F7	H7	L0	L1	L4 /L4+
							F30x	F37x						
ST	STM32Snippets	Source	Free	Y	N.A.							Y	N.A.	
ST	Standard peripheral library	Source	Free	Y	Y	Y	Y	Y	Y	N[1]	N[1]	N[1]	Y	N[1]
ST	STM32Cube - HAL Hardware Abstraction Layer	Open Source	Free (BSD)	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y
ST	STM32Cube – LL Low-Layer	Open Source	Free (BSD)	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y

N.A.: Not applicable. No plan to make it available
1/ Not plan to make it available

More details about hardware abstraction layer solutions: STM32 Embedded Software overview

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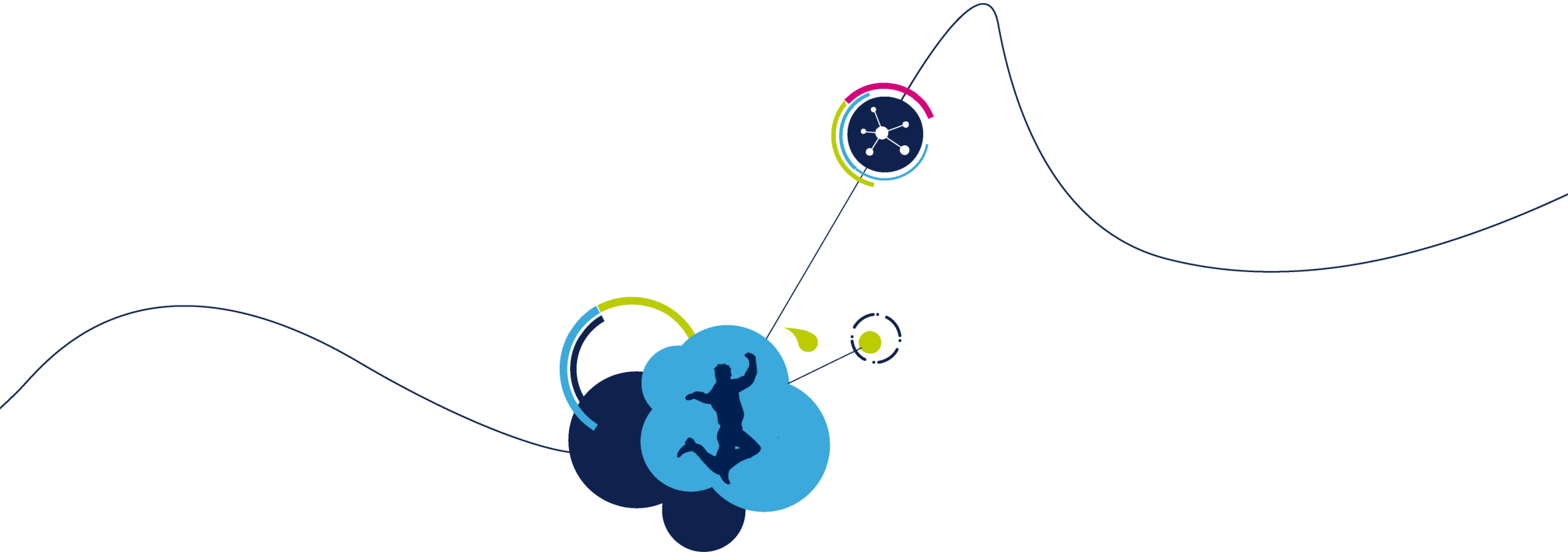
STM8 - Hardware abstraction layer

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



Middleware and application fields

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Middleware and Application fields

Middleware stacks fill the gap between hardware and your application.
ST and third parties bring the required solutions.

ST also proposes application software bricks to speed up customer development.

- **All standard middleware covered**
  - RTOS/kernel
  - File system
  - USB
  - Security (hypervisor, crypto, SSL/TLS, secure boot)
  - Connectivity (TCP/IP, Bluetooth, Wi-Fi, NFC, Cloud connectors…)
  - Safety
  - Industrial protocols
  - Audio
  - Motor Control
  - …

Middleware – RTOS / kernel

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.

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

STM32 – RTOS / kernel (1/3)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4 /L4+
Alibaba	Rhino RTOS	Open Source (Apache 2.0)	Free	N	N	N	N	Y	Y	N	Y	N	Y
arm	Mbed OS[5]	Open Source (Apache 2.0)	Free	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
AWS	FreeRTOS kernel	Source[3]	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AVIX-RT	AVIX	Binaries	License	N	Y	Y	Y	Y	Y	N	N	Y	N
Chibios	ChibiOS/RT ChibiOS/NIL	Open source (GPL3) or Source	Free or License	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
CMX	CMX-RTX	Source	License	N	Y	Y	Y	Y	Y	N	N	Y	N
CMX	CMX-Tiny+	Source	License	Y	Y	Y	Y	Y	Y	N	Y	Y	N
eCosCentric	eCosPro	Modified GNU GPL or Source[1]	Free or License	N	Y	Y	Y	Y	Y	N[4]	N	Y	Y
eForce	µC3/Compact	Source	License	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Emcraft	uCLinux	Open Source (GPL)[2]	Free[2]	N	N	N	N	Y	Y	N[4]	N	N	N
EUROS	EUROS	Binaries or source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ eCos is an open-source kernel, a subset of eCosPro. eCosPro comes with TCP/IP stack, FAT, jFFS2, RAM and ROM FS
2/ uCLinux is open source, but this company proposes some ports on STM32.
3/ FreeRTOS kernel license is MIT from V10, previous versions are under a modified GPL license
4/ Please contact supplier
5/ Mbed OS is Thread certified

STM32 – RTOS / kernel (2/3)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Express Logic	ThreadX[6]	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Green Hills	µ-velOSity	Source	License	Y	Y	Y	Y	Y	Y	N[2]	Y	Y	Y
HCC	eTaskSync	Source	License	Y	Y	Y	Y	Y	Y	N[2]	Y	Y	Y
Keil / arm	MDK-ARM	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mentor	Nucleus Kernel	Source	License	N	Y	Y	Y	Y	Y	N[2]	N	Y	Y
Micrium	µC-OS	Source	License	Y	Y	Y	Y	Y	Y	N[2]	Y	Y	Y
Micro Digital	SMX	Source	License	Y	Y	Y	Y	Y	Y	N[2]	Y	Y	Y
NuttX	NuttX	Open Source[4]	Free	Y	Y	Y	Y	Y	Y	N	N	Y	Y
Quadros	RTXC Rtos	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rowebots	Unison	Source[1]	License	N	Y	Y	Y	Y	Y	Y	N	Y	Y
SEGGER	embOS software expansion for STM32Cube	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sciopta	SCIOPTA 61508[3]	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ An open-source version with less features is also available
2/ Please contact supplier
3/ Safety certified RTOS for systems requiring certification
4/ BSD license
5/ The license will become MIT, once FreeRTOS V10 will be integrated in STM32Cube (planned for 2018)
6/ ThreadX is part of the X-WARE IoT platform, which is Thread certified

STM32 – RTOS / kernel (3/3)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	STM32Cube – FreeRTOS kernel	Open source (modified GPL)[5]	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wittenstein - High Integrity Systems	OpenRTOS[1]	Source	License	Y	Y	Y	Y	Y	Y	N[4]	Y	Y	Y
Wittenstein - High Integrity Systems	SafeRTOS[2]	Source	License	Y	Y	Y	N[4]	Y	Y	N[4]	N[4]	Y	Y
Wittenstein - High Integrity Systems	SafeRTOS CORE[3]	Source	License	Y	Y	Y	N[4]	Y	Y	N[4]	N[4]	Y	Y
Zephyr	Zephyr kernel	Open Source	Free[6]	Y	Y	N	Y	Y	N	N	N	N	Y

1/ OpenRTOS is FreeRTOS with commercial support
2/ Safety certified RTOS for systems requiring certification
3/ SafeRTOS version without full safety certification/documentation
4/ Available on customer request. Please contact supplier
5/ FreeRTOS kernel license is MIT from V10, previous versions are under a modified GPL license. Included in STM32Cube MCU packages (\Middlewares\Third_Party folder).
6/ Apache 2.0 license

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STM8 – RTOS / kernel

Provider	Solution name	Model	Cost	Availability	
				STM8S STM8AF	STM8L STM8AL
AtomThreads	AtomThreads RTOS	Open source (BSD)	Free	Y	N[1]
Chibios	ChibiOS/RT	Open source (GPL3) or Source	Free or License	Y	Y
CMX	CMX-Tiny+	Source	License	Y	N[1]
SEGGER	embOS	Source	License	Y	Y

1/ Contact supplier

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Middleware – Hypervisor

An hypervisor allows application and task isolation, enabling independent secure domains inside the same MCU chip. The hypervisor runs in privileged mode, and manage all access to security-critical peripherals

- **Many solutions**
  - Through third parties

STM32 – Hypervisor

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
arm	Mbed uVisor	Source	Free	N	N	N	N	Y[1]	N	N	N	N	N
Prove & Run	ProvenCore-M	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ supported on STM32F429I-DISCO

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Middleware – Crypto

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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Cypherbridge	uVPN SDK IKEv1/IKEv2/IPsec	Source	License	N	N	N	N	Y	Y	N[1]	N	N	N
EUROS	SSL/TLS SSL v3, TLS 1.0, 1,1. 1.2	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
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	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HCC	Verifiable Encryption manager AES, 3DES, DSS, EDH, MD5, RSA, SHA1, SHA256	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rowebots	UNISON SSL/TLS Stack 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	Y	Y	Y	Y	Y	Y	N	Y	Y
SEGGER	emSecure signatures	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SEGGER	emLib AES and emLib DES	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SEGGER	emFile encryption	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ please contact supplier

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STM32 – Crypto (2/2)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	STM32 Cryptographic library[1, 2] AES, DES, 3DES, ARC4, MD5, SHA1, SHA2, RSA sig, ECC Key gen, ECDSA, ...	Binaries	Free	N	Y	Y	Y	Y	N	N	N	Y	N
ST	X-CUBE-CRYPTOLIB	Binaries	Free	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
wolfSSL	wolfCrypt[1], part of wolfSSL MD2, MD4, MD5, SHA-1, SHA-256, SHA-384, SHA-512, BLAKE2b, RIPEMD-160, Poly1305 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	N	Y	N	Y	Y	Y	Y	Y	Y

1/ Can benefit from hardware acceleration when available.
2/ Subject to trade regulations. See website.

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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				
				F107	F2	F4	F7	H7
arm	Mbed TLS[1]	Open source	Free	Y	Y	Y	Y	Y
CypherBridge	Embedded TLS SDK (uSSL™)	Source	License	N	Y	Y	Y	N[2]
HCC	Verifiable SSL/TLS	Source	License	Y	Y	Y	Y	N[2]
Oryx Emb.	CycloneSSL	Open source (GPL2) or Source	Free or license	Y	Y	Y	Y	Y
SEGGER	emSSL	Source	License	Y	Y	Y	Y	N[2]
ST	STM32Cube – Mbed TLS[3]	Open source	Free	Y	Y	Y	Y	Y
wolfSSL	Embedded SSL Library	Open source (GPL2) or Source	Free or license	N	Y	Y	Y	N[2]

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)

STM32 – SSL/TLS solution details

Provider	Solution name	Details
arm	Mbed TLS	SSL version 3, TLS version 1.0, 1.1, 1.2, More…
CypherBridge	Embedded TLS SDK (uSSL™)	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	Verifiable SSL/TLS	TLS 1.0, 1.1, 1.2 (RFC 5246), 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 Emb.	CycloneSSL	Server and/or client operation, Supports TLS 1.0, 1.1, 1.2 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	emSSL	TLS 1.0, 1.1 and 1.2. More…
ST	STM32Cube - TLS	SSL version 3, TLS version 1.0, 1.1, 1.2, More…
wolfSSL	Embedded SSL Library	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) More…

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 flash memory (also called In-Application Programming)

ST also proposes a solution for Secure Boot and Secure Firmware Update

STM32 – Bootloader / Secure Boot

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Cypherbridge	uLoadXL SDK	Source	License	N	N	Y	N	Y	Y	N[1]	N	N	N
eCosCentric	RedBoot	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
EUROS	Bootloader	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Feaser	OpenBLT	Open source (GPL3) or Source	Free or Licence	N[1]	Y	Y	Y	Y	N[1]	N[1]	N[1]	N[1]	N[1]
HCC	Bootloaders	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Simma Software	ssBL-target, ssBL-PC	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N[1]	N[1]	Y
ST	X-CUBE-IAP-USART[3]	Source	Free	N[2]	Y	N[2]	N[2]	N[2]	N[2]	N[2]	Y	N[2]	Y
ST	X-CUBE-IAP-SD[3]	Source	Free	Y	N[2]	N[2]	N[2]	N[2]	N[2]	N[2]	N[2]	N[2]	Y
ST	X-CUBE-SBSFU[4]	Source	Free	N	N	N	N	N	N	N	N	N	Y

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1/ Please contact supplier
2/ Available on STM32Cube, so porting is very easy
3/ In-application programming example
4/ Secure Boot + Secure Firmware Update solution, with example

STM32 – Bootloader / Secure Boot details

Provider	Solution name	Details
Cypherbridge	uLoadXL SDK	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	RedBoot	Debug and bootstrap firmware
Feaser	OpenBLT	UART, CAN, TCP/IP, USB, SD-CARD External flash and serial EEPROM
HCC	Bootloaders	Serial, USB Device, USB Host , FAT Fail-saferty, AES encryption
Simma Software	ssBL-target, ssBL-PC	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	ssBL-target, ssBL-PC	Source	License	Y	N[1]

1/ Please contact supplier

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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, such as FAT and JFFS2

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

STM32 – File system (1/2)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
AWS	FreeRTOS+™ FAT SL[3]	Source	Free	Y	Y	Y	Y	Y	Y	N[4]	Y	Y	Y
arm	Mbed LittleFileSystem, FATFileSystem	Open source	Free	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
ChaN	FatFS	Open source (BSD)	Free	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]	Y[2]
CMX	CMX-FFS	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Cypherbridge	uFile	Source	License	N	N	Y	N	Y	Y	N[4]	N	N	N
EmCraft	JFFS2, YaFFS, FAT, NFS, etc..	Open source (GPL)	Free	N	N	Y	N	Y	Y	N[4]	N	N	N
eCosCentric	eCosPro-YAFFS[1], MMFS, JFFS2	Source	License	N	Y	Y	Y	Y	Y	N[4]	N	Y	Y
eForce	µC3-FileSystem	Source	License	Y	Y	Y	Y	Y	Y	N[4]	Y	Y	Y
Express Logic	FileX + LevelX	Source	License	Y	Y	Y	Y	Y	Y	N[4]	Y	Y	Y
EUROS	FMS, FAT, SafeFAT	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HCC	FAT FS: FAT, THIN, SafeFAT Flash FS: SafeFlash, TINY Flash Translation Layer: SafeFTL	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

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1/ Free for non-commercial use
2/ FatFS ported on STM32 available on demos
3/ For STM32 users, the license is the same as FreeRTOS kernel (MIT)
4/ Please contact supplier

STM32 – File system (2/2)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Wittenstein - High Integrity Systems	CONNECT File System	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Green Hills	µ-velOSity File System	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
Keil / arm	MDK-ARM Flash	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Mentor Embedded	Nucleus Storage	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
Micrium	µC/FS	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Micro Digital	smxFS	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Quadros	RTXCfatfile	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Rowebots	Unison FAT File System	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
SEGGER	emFile	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
ST	STM32Cube - FatFS[2]	Open source (BSD)	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Please contact supplier
2/ Included in STM32Cube MCU packages (\Middlewares\Third_Party folder)

STM8 – File system

Provider	Solution name	Model	Cost	Availability	
				STM8S STM8AF	STM8L STM8AL
ChaN	Petit FatFS	Open source (BSD)	Free	N[1]	Y[2]
HCC	FAT THIN	Source	License	Y	Y
SEGGER	emFile	Source	License	Y	Y

1/ Could be very easily ported.
2/ Petit FatFS ported on STM8 available in demos

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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

STM32 – USB solutions (1/2)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Chibios	ChibiOS/HAL	Open source (GPL3) or Source	Free or License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
CMX	CMX-USB Device, Host	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	N
eCosCentric	eCosPro-Host, Device	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
EUROS	USB Host & Device	Binaries	License	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EmCraft	Linux USB Host	Open source (GPL)	Free	N	N	Y	N	Y	N	N[1]	N	N	N
Express Logic	USBX	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
HCC	HCC-USB Host, Device	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Keil / arm	MDK-ARM USB	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Mentor Embedded	Nucleus USB	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	Y	Y
Micrium	USB Host, USB Device	Source	License	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y

1/ Please contact supplier

STM32 – USB solutions (2/2)

Provider	Solution name	Model	Cost	Availability										
				F0	F1		F2	F3	F4	F7	H7	L0	L1	L4/L4+
					Others	F105 F107								
Micro Digital	smxUSB	Source	License	Y	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
Quadros	RTXCusb	Source	License	N[1]	Y	Y	Y	Y	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]
Rowebots	Unison USB System	Source	License	N	Y	Y	Y	Y	Y	N	N[1]	Y	N	Y
SEGGER	emUSB Device, emUSB Host	Source	License	Y	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
ST	USB FS device library	Source	Free	Y	Y	N	N	Y	N	N	N[1]	N	Y	N
ST	USB FS&HS Host&Device lib	Source	Free	N	N	Y	Y	N	Y	N	N[1]	N	N	N
ST	STM32Cube – USB Host&Device[4]	Source	Free	Y[2]	Y[2]		Y	Y[2]	Y	Y	N[1]	Y[2]	Y[2]	Y[2]
Thesycon	Embedded USB Device	Source	License	N[1]	N[1]		Y	N[1]	Y	Y	N[1]	N[1]	N[1]	N[1]
Zephyr	USB device stack	Source	Free[3]	Y	Y		N	Y	Y	N	N	N	N	Y

1/ Available on customer request. Please contact supplier
2/ Device only
3/ Apache 2.0 license
4/ Included in STM32Cube MCU packages (\Middlewares\Third_Party folder)

STM32 – USB solutions details (1/2)

Provider	Solution name	Details
Chibios	ChibiOS/HAL	Device: HID, MS, CDC
CMX	CMX-USB Device, Host	Device: HID, MS, CDC (ACM, ECM, RNDIS), Audio, Midi, MTP, PHDC Host: HID, MS, CDC (ACM, ECM, RNDIS, OBEX), Audio, Midi, Printer, HUB
eCosCentric	eCosPro-Host, Device	Device: MS, CDC (ACM, ECM, EEM, RNDIS) Host: MS, CDC (ACM, ECM, EEM, RNDIS), Hub
EUROS	USB Host & Device Stack	Device: HID, MS, CDC (ACM, ECM) Host: HID, MS, CDC (ACM, ECM), HUB
Express Logic	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
EmCraft	Linux USB Host	Host: HID, MS, CDC (ACM, ECM), HUB
HCC	HCC-USB	Device: HID, MS, CDC (ACM, ECM, EEM, RNDIS), Audio, Video, MIDI, PTP, MTP, PictBridge, DFU, PHDC Host: HID, MS, CDC (ACM, ECM, EEM, NCM, OBEX, FTDI), Audio, Video, PTP, MTP, iPod, HUB
Keil / arm	MDK-ARM USB	Device: HID, MS, CDC (ACM), Audio Host: HID, MS
Mentor Embedded	Nucleus USB	Device: HID, MS, CDC (ACM, ECM) Host: HID, MS, CDC (ACM, ECM), HUB

STM32 – USB solutions details (2/2)

Provider	Solution name	Details
Micrium	USB Host, USB Device	Device: HID, MS, CDC (ACM), Audio, PHDC (Medical) Host: HID, MS, CDC (ACM), Audio, Printer, PHDC (Medical)
Micro Digital	smxUSB	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	RTXCusb	Device: MS, CDC (ACM, ECM, RNDIS) Host: HID, MS, CDC (ACM), HUB
Rowebots	Unison USB System	Device: MS, CDC (ACM) Host: MS, CDC (ACM), HUB, others on demand (inc . PHDC)
SEGGER	emUSB Device, emUSB Host	Device: HID, MS, CDC (ACM), RNDIS, Printer, MTP Host: HID, MS, CDC (ACM), HUB
ST	USB FS device library	Device: HID, MS, CDC (ACM), Audio, DFU
ST	USB FS&HS Host&Device	Device: HID, MS, CDC (ACM), Audio, DFU Host: HID, MS
ST	STM32Cube – USB Host&Device	Device: HID, MS, CDC (ACM), Audio, DFU Host: HID, MS, CDC (ACM), Audio, MTP
Thesycon	Embedded USB Device	Device: Audio, CCID, Mass Storage, network, HID, CDC (ACM)
Zephyr	USB device stack	Device: CDC (ACM), DFU

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				
				F107	F2	F4	F7	H7
AWS	FreeRTOS+™ TCP[2]	Source	Free	Y	Y	Y	Y	N[1]
AWS	FreeRTOS+™ UDP[2]	Source	Free	Y	Y	Y	Y	N[1]
CMX	CMX-TCP/IP	Source	License	Y	Y	Y	Y	N[1]
CMX	CMX-MicroNet	Source	License	Y	Y	Y	Y	N[1]
Cypherbridge	Embedded SSH SDK (uSSH™)	Source	License	N	Y	Y	Y	N[1]
EUROS	TCP/IP stack	Binaries	License	Y	Y	Y	Y	Y
Express Logic	NetX and NetX Duo IPv4/IPv6 and NetX Secure SSL/TLS/DTLS	Source	License	Y	Y	Y	Y	N[1]
eCosCentric	SecureSockets, SecureShell eCosPro stacks	Source	License	Y	Y	Y	Y	N[1]
eForce	µNet3	Source	License	Y	Y	Y	Y	N[1]
EmCraft	Linux TCP/IP stack	Open source (GPL)	Free	N	Y	Y	Y	N[1]
GreenHills	µ-velOSity TCP/IP v4/v6	Source	License	Y	Y	Y	Y	N[1]
Wittenstein - High Integrity Systems	CONNECT TCP	Source	License	Y	Y	Y	Y	N[1]

1/ Please contact supplier
2/ The license is the same as FreeRTOS kernel (MIT)

STM32 – TCP/IP solutions (2/2)

Provider	Solution name	Model	Cost	Availability				
				F107	F2	F4	F7	H7
HCC	MISRA HCC-TCP/IP v4/v6	Source	License	Y	Y	Y	Y	N[1]
Interniche	NicheStack	Source	License	Y	Y	Y	N[1]	N[3]
Interniche	embTCP v4/v6	Source	License	Y	Y	Y	N[1]	N[3]
Keil / arm	MDK-ARM TCPNET	Source	License	Y	Y	Y	N[1]	N[3]
Mentor Embedded	Nucleus Network	Source	License	Y	Y	Y	Y	N[3]
Micrium	µC/TCP-IP	Source	License	Y	Y	Y	Y	N[3]
Micro Digital	smxNS and smxNS6 (Dual IPv6/v4)	Source	License	Y	Y	Y	Y	N[3]
Oryx Emb.	CycloneTCP	Open source (GPL2) or source	Free or license	Y	Y	Y	Y	Y
Quadros	RTXC Quadnet	Source	License	Y	Y	Y	Y	N[3]
Rowebots	Unison TCP-IP/v4-v6	Source	License	N	Y	Y	Y	N[3]
SEGGER	embOS/IP	Source	License	Y	Y	Y	Y	Y
SICS	LwIP	Open source (BSD)	Free	Y[1]	Y[1]	Y[1]	N	N
ST	STM32Cube – LwIP[2]	Open source (BSD)	Free	Y	Y	Y	Y	Y
Zephyr	Zephyr Networking	Source	Free[4]	Y	N	Y	N	N

1/ A port to STM32 was implemented by ST
2/ 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)
3/ Please contact supplier
4/ Apache 2.0 license

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STM32 – TCP/IP solution details (1/2)

Provider	Solution name	Details
AWS	FreeRTOS+™ TCP	ARP, DHCP, DNS, LLMNR, NBNS, UDP
AWS	FreeRTOS+™ UDP	ARP, DHCP and DNS
CMX	CMX-TCP/IP	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	CMX-MicroNet	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	Embedded SSH SDK (uSSH™)	SSH 2.0, Configurable DSS and RSA asymmetric session, Configurable crypto with 3DES AES and blowfish support, SCP, SFTP
EUROS	TCP/IP stack	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
Express Logic	NetX and NetX Duo 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	SecureSockets	SSH2
eCosCentric	SecureShell	SSL/TLS
eCosCentric	eCosPro stacks	PPP, ARP, ICMP, UDP, TCP, IPv4, IPv6, DHCP, BOOTP, SMTP, TFTP, FTP(c+s), HTTP, SNMP, NTP, mDNS, Bonjour
eForce	µNet3	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	Linux TCP/IP stack	PPP, DNS, NAT, SSH (cs), DHCP (cs), SNMP (cs), Telnet (cs), FTP (cs), HTTP (cs)
HCC	MISRA HCC-TCP/IP v4/v6	ARP, ICMP, IPv4, IPv6, UDP, TCP, DNS, DHCP(c), FTP(s), SMTP, TFTP(s), HTTP(s)
Wittenstein - High Integrity Systems	CONNECT TCP	TCP, UDP, ARP, ICMP, IPv4, DNS, DHCP, FTP, TFTP, HTTP, LLMNR, NBNS, Auto-IP, standard sockets or callback interface

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

STM32 – TCP/IP solution details (2/2)

Provider	Solution name	Details
Green Hills	µ-velOSity TCP/IP v4/v6	ARP, ICMP, IGMP, IPv4, IPv6, IPv4/6, UDP, TCP, DNS, DHCP(c),
Interniche	NicheStack	SLIP, 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(s), RTP/RTCP, SSH
Interniche	embTCP v4/v6	ARP, TCP/IP v4, IPv4/v6 HTTP, FTP Telnet ICMP, UDP, TCP. DNS, DHCP
Keil / arm	MDK-ARM TCPNET	SLIP, PPP, ARP, IPv4, ICMP, UDP, TCP, DNS, DHCP(c), FTP(s), SMTP, SNMP, Telnet(s), TFTP(s), HTTP(s)
SICS	LwIP	PPP, ARP, ICMP, IPv4, UDP, TCP, DHCP(c), IPv6
Mentor Embedded	Nucleus Kernel	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	µC/TCP-IP (and µC/SSL)	ARP, ICMP, IPv4, UDP, TCP, DNS, DHCP(c), FTP(cs), SMTP, POP3(c), SNTP, Telnet(s), SSL/TLS, TFTP, HTTP(s)
Micro Digital	smxNS and smxNS6 (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 Emb.	CycloneTCP	ARP, IPv4, ICMP, IGMP, IPv6, ICMPv6, MLD, NDP, SLAAC, UDP, TCP, DNS, DHCP(c), DHCPv6(c), SMTP(c), FTP(cs), HTTP(s),
Quadros	RTXC Quadnet	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), UPnP, Prioritized Packets Handling
Rowebots	Unison TCP-IP/v4-v6	PPP, ARP, ICMP, IGMP, IPv4, IPv6, IPv4/6, 6LowPan, IPSec, UDP, TCP, DNS, DHCP(cs), SMTP(c), SNMP, Telnet(s), TFTP(cs), HTTP(cs), NAT
SEGGER	embOS/IP	PPP, PPPoE, ARP, ICMP, IGMP, IPv4, UDP, TCP, DNS, DHCP(cs), FTP(cs), SMTP(c), SNTP(c), Telnet(s), TFTP(cs), HTTP(s), PTP IEEE 1588
SICS	Contiki/uIP6	IPv6, 6LoWPAN
ST	STM32Cube - LwIP	PPP, ARP, ICMP, IPv4, UDP, TCP, DHCP(c), IPv6
Zephyr	Zephyr Networking	IPv4, IPv6 (dual stack support), ICMPv4, ICMPv6, UDP, TCP, HTTP, MQTT, CoAP, LWM2W, RPL, DNS/ 6LoWPAN

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

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Middleware – Bluetooth

Bluetooth is a wireless communication technology for exchanging data over short distances, typically used in the mobile world between phones and accessories.

- **Solutions with STM32 + Bluetooth transceiver**
  - Several solutions are available, using STM32 with ST's SPBTLE-RF 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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
arm	Mbed BLE[4]	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Alpwise	OpenSynergy Blue SDK	Binaries or Source	License + royalties	N[2]	Y	Y	N[2]	Y	Y	N[2]	N[2]	N[2]	Y
Alpwise	BlueWiseLE® bluetooth 5 Link Layer stack	Binaries or Source	License + royalties	Y	Y	Y	Y	Y	Y	Y[1]	Y	Y	Y
A&W	PhoneLink	Binaries or Source	License and/or royalties	N	Y	Y	N	Y	Y	Y[1]	N	N	N
Clarinox	ClarinoxBlue	Binaries or Source	License and/or royalties	Y[1]	Y[1]	Y[1]	Y[1]	Y	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]
EUROS	BLE stack[6]	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rowebots	UNISON Bluetooth System	Source	License	N	Y	Y	Y	Y	Y	Y[1]	N	Y	Y
SEARAN	dotStack	Binaries or Source	License and/or royalties	Y	Y	Y	Y	Y	Y	Y[1]	Y	Y	Y
ST	X-CUBE-BLE1	Binaries and Source	Free	N[3]	N[3]	N[3]	N[3]	Y	N[3]	N[3]	Y	N[3]	Y
ST	I-CUBE-nRF51DRV	Binaries and Source	Free	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	Y	N[3]	N[3]
ST	STM32CubeL4-BLE[5]	Source	Free	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	N[3]	Y
Zephyr	Bluetooth	Source	Free[7]	N	Y	N	Y	Y	N	N	N	N	Y

1/ Available on customer request. Please contact supplier
2/ Available on specific conditions. Please contact supplier
3/ Available on STM32Cube so porting is very easy
4/ Support BLE, Heart Rate Service, iBeacon on various ST boards including DISCO-L475VG-IOT01A, X-NUCLEO-IDB05A1 with STM32 Nucleo boards
5/ point to point and HeartRate profile example running on running on B-L475E-IOT01A with ST SPBTLE-RF
6/ SmartBond™ DA14681 Bluetooth® low energy SoC adapted to the EUROS RTOS
7/ Apache 2.0 license

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STM32 – Bluetooth solution details

Provider	Solution name	Details
arm	Mbed BLE	More...
Alpwise	OpenSynergy Blue SDK	BT 5.x BLE Dual-Mode Host Stack and Profiles (compliant with version v4.2 and as well as all earlier specification versions including v2.1+EDR, v3.0+High Speed and v4.0, and v4.1) classic profiles: HSP, HFP, MAP, PBAP, AVRCP, A2DP, VDP, SAP, OPP, FTP, BIP, BPP, GPP, CTN, HCRP, HID, PAN, HDP LE profiles: ATT and GATT, SPP-like, alert notification, battery service, device information service, proximity/FindMe, ID over GATT, Health thermometer profile, haert rate profile, transport discovery profile, internet protocol support (IPv6 w/6LoWPAN)
Alpwise	BlueWiseLE® bluetooth 5 Link Layer stack	BT4.2 BLE Single Mode Host Stack Supported profiles over GAP, GATT: Blood Pressure, Phone Alert, HID over Gatt, iBeacon, Proximity, Alert Notification, Find me, Pulse Oximeter, Running Speed & Candence Health Thermometer, Time, Heart Rate, Network Availability, Location & Navigation, Cycling Speed & Cadence, Cycling power, Glucose Meter, Weight Scale, and additional proprietary profiles, Data Exchange (Serial port over BLE), Cable Replacement, FOTA (Firmware update Over The Air), Voice over BLE…
A&W	PhoneLink	BT2.1+EDR, BT4.0 Supported Profiles : HFP, HSP, PBAP, A2DP, AVRCP, HID, OBEX, FTP, OPP, SPP, PAN, MAP and more
Clarinox	ClarinoxBlue	BT4.0 + EDR + LE Supported profiles: A2DP, AVCTP, AVDTP, AVRCP, DI, DUN, FTP, GAVDP, GAP, HFP, HSP, HCI, IOP, L2CAP, MAP, OBEX, OPP, PAN, PBAP, RFCOMM, SDAP, SDP, SPP, GAP, ATT, GATT
SEARAN	dotStack	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
ST	X-CUBE-BLE1	BT4.0, BT4.1 All profiles supported
ST	I-CUBE-nRF51DRV	BT4.0, BT4.1 All profiles supported
Zephyr	Bluetooth	BT5.0, GAP, GATT, BR/EDR,

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Middleware – 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 ST's SPWF01SA, SPWF04SA modules or other modules (Espressif ESP8266, Inventek ISM43362-M3G-L44)

STM32 – Wi-Fi™ solutions

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
arm	Mbed Wifi[6]	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ST	STM32CubeL4/L4+–WiFi[2]	Source	Free	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	Y
ST	STM32CubeF4 – WiFi[3]	Source	Free	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	N[1]	N[1]	N[1]
ST	STM32CubeF7 – WiFi[4]	Source	Free	N[1]	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	N[1]	N[1]
ST	X-CUBE-WIFI1[5]	Source	Free	N[1]	Y	N[1]	N[1]	Y	N[1]	N[1]	Y	N[1]	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/ Middleware and examples for ST's SPWF01SA and SPWF04SA modules
6/ Support ST boards including DISCO-L475VG-IOT01A, DISCO-F413ZH

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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 and ST25R3915
    - 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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-NFC1	Source	Free	Y	Y	N[1]	Y	Y	N[1]	N[1]	Y	Y	Y
ST	X-CUBE-NFC2	Source	Free	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	Y	N[1]	N[1]
ST	X-CUBE-NFC3	Source	Free	N[1]	Y	N[1]	N[1]	Y	N[1]	N[1]	N[1]	N[1]	N[1]
ST	X-CUBE-NFC4	Source	Free	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	Y	N[1]	N[1]
ST	X-CUBE-NFC5	Source	Free	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	N[1]	N[1]	Y

- 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
- 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

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Middleware – LoRa®

LoRa® is a type of wireless telecommunication network designed to allow long range communications at a very low bit-rate and enabling long-life battery operated sensors. LoRaWAN™ defines the communication and security protocol that ensures the interoperability with the LoRa® network

Solutions with STM32 + LoRa® radio

- Semtech SX1276MB1MAS, SX1276MB1LAS and SX1272MB2DAS LoRa® radio expansion boards
- Murata CMWX1ZZABZ-091 LoRa® module
- USI WM-SG-SM-42 LoRa® module
- RiSiNGHF® RHF0M003 modem for LoRa®
- CMWX1ZZABZ-xxx module for sigfox

STM32 – LoRa® solution

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	I-CUBE-LRWAN[2]	Source	Free	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	Y	Y	Y
arm	MbedOS LoRa[3]	Source	Free	N	N	N	N	N	N	N	Y	N	N
StackForce	LoRaWAN stack	Source/Object	License/Royalties	N	N	N	N	N	N	N	Y	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-LRWAN3
3/ Available on DISCO-L072CZ-LRWAN1

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Middleware – Sigfox™

Sigfox™ is a long range wireless area network allowing low-power sensors to benefit from a planetary network, enabling end devices with low BOM cost

Solutions with STM32 + radio

- Murata CMWX1ZZABZ-xxx module

STM32 – Sigfox™ solution

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-SFOX	Source	Free	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	Y[2]	N[1]	N[1]

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

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Middleware – sub-1GHz

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 STM32 + radio

- SPIRIT1

STM32 – sub-1GHz solution

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-SUBG1[2]	Source	Free	N[1]	N[1]	N[1]	N[1]	Y	N[1]	N[1]	Y	Y	N[1]
StackForce	emb6 - 6LoWPAN based IoT stack[3]	Source/Object	Free / License	N	N	N	N	N	N	N	Y	N	N
StackForce	WM-Bus stack[3]	Source/Binaries	License	N	N	N	N	N	N	N	Y	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

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Middleware – Safety

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

- **Ready for certification offers on STM32**
  - Through third parties or directly from ST

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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-CLASSB	Source	Free	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
ST	STM32-CLASSB-SPL	Source	Free	Y	Y	Y[3]	Y	Y[3]	N	N	N	Y[3]	N
ST	X-CUBE-STL	Document	Free	Y	Y	Y	Y	Y	Y	N[1]	Y	Y	Y
MESCO	Safety Design Package	Source	Lic. + Royal.	N	N[2]	N[2]	N[2]	N[2]	N[2]	N[2]	N	Y	N[2]

1/ Porting ongoing
2/ Can be ported
3/ Derived package only (not certified)

STM8 – Safety solutions

Provider	Solution name	Model	Cost	Availability		
				STM8S	STM8AF	STM8L STM8AL
ST	STM8-SafeCLASSB	Source	Free	Y	Y	Y
ST	STM8A-SafeASIL	Document	Free	N	Y	N

Middleware – Display

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 – Display solutions (1/2)

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	Embedded GUI library	Source	Free	N	Y	Y	Y	Y	N	N	N	Y	N
ST	STemWin	Binaries	Free	N	Y	Y	Y	Y	Y	Y	N	Y	N
ST	STM32Cube - STemWin	Binaries	Free	N	Y	Y	Y	Y	Y	Y	N	Y	Y
ST	ST Java UI	Binaries	Free	Y	Y	Y	N	Y	Y	Y	Y	Y	N
Altia	Altia Design and Deep screen	Source	License	Y	Y	Y	Y	Y	Y	Y	N[1]	Y	N
Crank	Storyboard	Binaries	License	N	N[1]	N[1]	Y	Y	Y	Y	N	N[1]	N
Draupner	TouchGFX	Binaries /Source	License	N	N	N	N	Y	Y	Y	N	N	Y
eCosCentric	eCosPro-PEG	Source	License	N[1]	Y	Y	Y	Y	N[1]	N[1]	N[1]	N[1]	N[1]
EUROS	eGUI	Binaries	License	N[1]	Y	Y	Y	Y	Y	Y	N[1]	Y	N
Express Logic	GUIX	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

1/ Available on customer request. Please contact supplier

STM32 – Display solutions (2/2)

Provider	Solution name	Model	Cost	Availability								
				F0	F1	F2	F3	F4	F7	L0	L1	L4/L4+
Korulab	Koru	Binaries	License	N	N	N	N	Y	Y	N	N	N
Micrium	µC/GUI	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	N
Micro Digital	PEG	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rowebots	emWin GUI	Source	License	N	Y	Y	Y	Y	Y	N	N[1]	N
SEGGER	emWin	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	N
Tara Systems	Embedded Wizard	Binaries / Source	License	N	N	N	N	Y	Y	N	N	Y

1/ Available on customer request. Please contact supplier

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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									
					F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	STM32 Touch Sensing Library	CT	Source	Free	Y	N	N	Y	N	N	N	N	Y	N
ST	STM32Cube – Touch Sensing	CT	Source	Free	Y	N	N	Y	N	N	N	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	Y[1]	Y[1]

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

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STM32 – Instrumentation

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
AWS	FREERTOS+™ CLI[1]	Source	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

- Enabling your FreeRTOS application to process command line input

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

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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

AWS, Azure, Watson

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, …)

paho

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

STM32 ODE Functions packs

AWS, Azure, Watson…

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

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STM32 - Connectors to cloud providers

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-CLD-GEN[1]	Source	Free	N	N	N	N	Y	Y	N	N	N	Y
ST	X-CUBE-AWS	Source	Free	N	N	N	N	Y	Y	N	N	N	Y
ST	X-CUBE-AZURE	Source	Free	N	N	N	N	Y	Y	N	N	N	Y
ST	X-CUBE-WATSON	Source	Free	N	N	N	N	Y	Y	N	N	N	Y
ST	FP-CLD-AWS1	Source	Free	N	N	N	N	Y	N	N	N	N	N
ST	FP-CLD-AZURE1	Source	Free	N	N	N	N	Y	N	N	N	N	Y
ST	FP-CLD-WASTON1	Source	Free	N	N	N	N	Y	N	N	N	N	N
AWS	Amazon FreeRTOS[2]	Source	Free[3]	N	N	N	N	N	N	N	N	N	Y
Cypherbridge	uMQTT Toolkit	Source	License	N	N	N	N	Y	Y	N	N	N	N
Express Logic	X-WARE IoT Platform	Source	License	Y	Y	Y	Y	Y	Y	N	N	N	N

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/ “Connect to AWS Iot” and “Connect to AWS Greengrass” packages are available for STM32L4/L4+Discovery kit IoT node
3/ MIT license

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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.
AAC, MP3, 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										
				F0	F1	F105 F107	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	ADPCM Vocoder, Speex Vocoder	Source	Free	N	Y	N[1]	N[1]	N[1]	N[1]	N	N	N	N[1]	N[1]
ST	G711, G726, G726A Vocoders	Source	Free	N	N[1]	N[1]	Y[3]	N[1]	Y[3]	N	N	N	N[1]	N[1]
ST	Audio Engine MP3 Decoder With Channel Mixer, Equalizer and Loud	Binaries	Free	N	N[1]	Y	Y	N[1]	Y	Y	Y	N	N[1]	N[1]
ST	Audio Engine MP3 Codec With Channel Mixer, Equalizer and Loud	Binaries	Free	N	N[1]	Y	Y	N[1]	Y	N	N	N	N[1]	N[1]
ST	Audio Engine WMA Decoder With Channel Mixer, Equalizer and Loud	Binaries	Free	N	N[1]	Y	Y	N[1]	Y	Y	N	N	N[1]	N[1]
ST	Audio Engine AAC Decoder AAC-LC, HE-AAC+ v1, HE-AAC+ v2	Binaries	Free	N	N[1]	Y[3]	Y[3]	N[1]	Y[3]	N[1]	N[1]	N	N[1]	N[1]
ST	Audio Engine AC3 Decoder	Binaries	Free	N	N	N	N	N	N[2]	N[1]	N[1]	N	N	N
ST	Audio Engine Post Processing Smart volume control, Equalizer, Sample rate converters, Stereo widening	Binaries	Free	N	N	N	N	N[1]	Y	N[1]	N[1]	N	N	N
ST	Apple iAP Streaming Library (iPod/iPhone/iPad)[2]	Source	Free	N	N	Y	Y	Y	Y	N[1]	N[1]	N	Y	N
ST	USB audio class and stream synchro. (feedback pipe, external PLL, …)	Binaries	Free	Y	N	Y	Y	N[1]	Y	Y	N	Y	N	N
ST	Source Rate Converter[3]	Binaries	Free	N	Y	Y	Y	N[1]	Y	Y	N	N	N[1]	N

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1/ The library will run immediately on these targets, even if not ported officially.
2/ Only available by request to local sales for companies being a licensee of Apple MFi (Made for iPod) program.
3/ Available on demand. Ask your local ST Sales office.

STM32 – Audio solutions

Provider	Solution name	Model	Cost	Availability										
				F0	F1	F105 F107	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	X-CUBE-AUDIO[3]	Source	Free	N	N	N	N	N	Y	Y	N	N	N	N
ST	X-CUBE-AVS[4]	Source	Free	N	N	N	N	N	N	Y	N	N	N	N
DSPConcept	Audio Weaver Algorithms	Binaries	License	N	N	N	N	N	Y	Y	Y	N	N	N
Craftwork	Remote Speakers (DLNA Media Renderer)	Binaries	License	N	N	N	N[1]	N	Y	N[1]	N[1]	N	N	N
Sensory	Voice recognition[2]	Binaries	License	N	N	N	N	N	Y	N[1]	N[1]	N	N	N
Vestec	Voice recognition[2]	Binaries	License	N	N	N	N	N	Y	N[1]	N[1]	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)
4/ Framework for the Alexa Voice Service (AVS)

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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

Figures of merit on STM32F4 target

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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 for one user.
	Sweet Spot Mode 1	4.2 MHz				
	Sweet Spot Mode 2 (Ambi)	4.7 MHz	7956 Bytes	6968 Bytes	7680 Bytes	

Figures of merit on STM32F4 target

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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 standardised (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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
CSLab	BACnet stack embedded	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
prizm.io	BACnet Stack	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ST	DALI[2]	Source	Free	N	Y	N	N	N	N	N	N	Y	N
CSLab	BACnet stack embedded	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Andrea Informatique	DLMS / COSEM	Binaries	License	N[3]	Y	Y	N[3]	Y	N[3]	N[3]	N[3]	Y	N[3]
ST	DMX-512[2]	Source	Free	N[1]	Y	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]
prizm.io	DMX-512 Stack	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TAPKO	KAIstack KNX	Binaries / source	License + royalties	Y	Y	Y	Y	Y	Y	Y	Y[3]	Y[3]	Y[3]
Weinzierl	KNX	Source	License	Y	Y	N[1]	N[1]	N[1]	N	N	N[1]	Y	N[1]

1/ Can be ported
2/ Provided on demand to sales office, supporting DALI slave only.
3/ Please contact supplier

STM8 – Building Automation and Control

Provider	Solution name	Application	Model	Cost	Availability	
					STM8S / STM8AF	STM8L / STM8AL
ST	DALI	Lighting	Source	Free	Y	N[1]
TAPKO	KAIstack KNX	Building automation	Binaries / source	License	N	Y

1/ Can be easily ported

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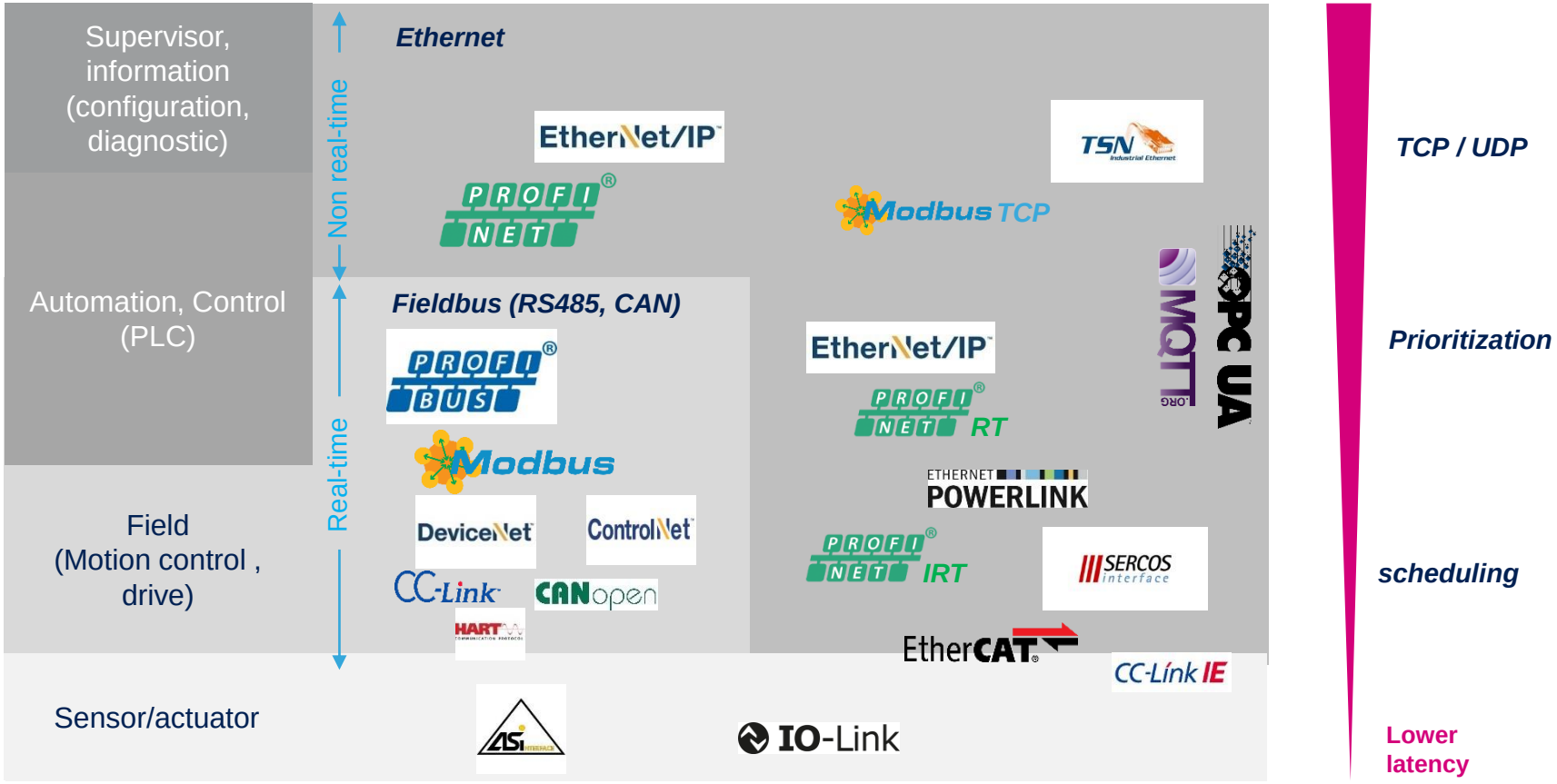
Application field – Industrial protocols

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	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
CMX	CMX-CANopen	Automation, medical	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	N	N[1]
eCosCentric	eCosPro-CAN	Factory Automation	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	N	Y
	CANopen	Factory Automation	Source	License	N	Y	Y	Y	Y	Y	N[1]	N	N	Y
	eCosPro-ModbusTCP	Factory Automation	Source	License	N	N	Y	Y	Y	Y	N[1]	N	N	Y
emtas	CANopen	Automation, medical	Source	License	Y	Y	Y	N	Y	Y	Y	N	N	Y
	J1939	Commercial vehicles	Source	License	Y	Y	Y	N	Y	Y	Y	N	N	Y
	EnergyBus	Commercial vehicles	Source	License	Y	Y	Y	N	Y	Y	Y	N	N	Y
	EtherCAT[2]	Automation, medical	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Please contact supplier.
2/ Requires external hardware.

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STM32 – Industrial protocols (2/8)

Provider	Solution name	Application	Model	Cost	Availability									
					F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
EUROS	CANOpen	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	PROFINET	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Modbus	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	EtherCAT[1]	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Ethernet	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	OPC UA Server/Client	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	MQTT Client	Automation	Binaries	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Requires external hardware.

STM32 – Industrial protocols (3/8)

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

1/ Requires external hardware (netX52).
2/ source for STM32, binary for external hardware.

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STM32 – Industrial protocols (4/8)

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

1/ Requires external hardware (netX52).
2/ source for STM32, binary for external hardware.

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STM32 – Industrial protocols (5/8)

Provider	Solution name	Application	Model	Cost	Availability									
					F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
HMS	IXXAT® CANopen	Automation, medical	Source	License	N	Y	Y	Y	Y	Y	Y	N	N	Y[1]
	IXXAT® SAE J1939	Transportation	Source	License	N	Y	Y	Y	Y	Y	Y	N	N	Y[1]
	EtherNet/IP Adapter	Factory automation	Source	License	N	Y[1]	Y	N	Y	Y	Y	N	N	Y[1]
	EtherNet/IP Scanner	Factory automation	Source	License	N	Y[1]	Y	N	Y	Y	Y	N	N	Y[1]
	IXXAT® IEEE1588	Factory automation	Source	License	N	Y[1]	Y	N	Y	Y	Y	N	N	Y[1]
	IXXAT® Safety over EtherCAT	Automation	Source	License	N	Y[1]	Y	N	Y	Y	Y	N	N	Y[1]
	IXXAT® CIP Safety (EtherNet/IP, sercos)	Automation	Source	License	N	Y[1]	Y	N	Y	Y	Y	N	N	Y[1]

1/ Please contact supplier

STM32 – Industrial protocols (6/8)

Provider	Solution name	Application	Model	Cost	Availability									
					F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Matrikon	OPC UA Server	Factory automation	Source / Binaries	License	N	N	Y	N	Y	Y	Y	N	N	N
MESCO	HART Slave	Process automation	Source	Lic. + Royal.	Y	Y	Y	Y	Y	N[2]	N[2]	Y	Y	N[2]
MicroControl	CANopen	Automation, medical	Source	License	Y	Y	Y	Y	Y	Y	Y	N	N	Y
	J1939	Commercial vehicles	Source	License	Y	Y	Y	Y	Y	Y	Y	N	N	Y
	EtherCAT[1]	Factory automation	Source	License	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]	Y[1]
	PROFINET	Factory automation	Source	License	N	Y	Y	N	Y	Y	Y	N	N	N
Micrium	µC/Modbus	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Requires external hardware.
2/ Please contact supplier.

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STM32 – Industrial protocols (7/8)

Provider	Solution name	Application	Model	Cost	Availability									
					F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
Port	CANopen	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	N	N	Y
	EtherCAT[2]	Factory automation	Source	License	Y[1]	Y	Y	Y	Y	Y[1]	Y[1]	N	N	Y[1]
	PROFINET	Factory automation	Source	License	N	N	N	N	Y	Y	Y	N	N	N
	EtherNet/IP[2]	Factory automation	Source	License	N	N	N	N	Y	Y	Y	N	N	N
	POWERLINK	Factory automation	Source	License	N	N	Y[1]	N	N	N	N	N	N	N
SEGGER	emModbus	Factory automation	Source	License	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

1/ Requires external hardware.
2/ Please contact supplier.

STM32 – Industrial protocols (8/8)

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

1/ Can be ported

STM8 – Industrial protocols

Provider	Solution name	Application	Model	Cost	Availability	
					STM8S / STM8AF	STM8L / STM8AL
SEGGER	emModbus	Factory automation	Source	License	Y	Y
TEConcept	IO-Link Device	Factory automation	Source	License	Y	Y
TMGTE	IO-Link Device	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) • “Maximum Torque Per Ampere” (MTPA): optimizes the motor torque for each load and increases the efficiency, • “Feed Forward”: improves the current control at high speed.

STM32 – Motor control – PMSM

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/ L4+
ST	STM32 Motor Control Software Development Kit (MCSDK) v5.0.0 Software development kit including: • Motor control library (sensors, algorithms…), Single or Dual control • Motor control application (implementation of library, high-level MC commands) • HFI (next release v5.1, 18Q2) • PFC (next release v5.1, 18Q2) • ST Motor Control Workbench software tool • Demo projects and utilities	X-CUBE-MCSDK Source code except CORDIC, MTPA,… X-CUBE-MCSDK-FUL Full source code (Registration/approbation required)	Free	Y	18Q2	18Q4	Y	Y	18Q3	18Q4	N	N	18Q3

STM32 – Motor control - BLDC

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
ST	Bipolar stepper motors driving	Sources	Free	N[1]	Y	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]
ST	STSW-IHM040V1 STM32 6-step FW example (STM32F100) STSW-IHM043V1 STM32 6-step FW example (STM32F0)	Source	Free	Y	Y	N	N	N	N	N	N	N	N
ST	X-CUBE-SPN7 Three-phase brushless DC motor driver	Source	Free	Y	Y	N	Y	Y	N	N	N	N	N

1/ Can be ported

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STM32 – Motor control - Stepper

Provider	Solution name	Model	Cost	Availability									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4 /L4+
ST	STSW-STM32018 Driving bipolar stepper motors using STM32F103 microcontroller	Source	Free	N	Y	N	N	N	N	N	N	N	N
ST	X-CUBE-SPN1 Stepper bipolar motor driver software expansion forSTM32Cube	Source	Free	Y	N	N	Y	Y	N	N	Y	N	N
ST	X-CUBE-SPN2 Two axes stepper motor driver software expansion for STM32Cube	Source	Free	Y	N	N	Y	Y	N	N	N	N	N
ST	X-CUBE-SPN3 High-power stepper motor driver software expansion for STM32Cube	Source	Free	Y	N	N	Y	Y	N	N	Y	N	N
ST	X-CUBE-SPN4 Dual-brush DC motor driver software expansion for STM32Cube	Source	Free	N	N	N	N	Y	N	N	Y	N	N
ST	X-CUBE-SPN5 Stepper bipolar motor driver software expansion for STM32Cube	Source	Free	N	N	N	Y	Y	N	N	Y	N	N

STM8 – Motor control

Provider	Solution name	Model	Cost	Availability	
				STM8S / STM8AF	STM8L / STM8AL
ST	STSW-STM8020 STM8S and STM8A BLDC and ACIM motor control firmware library • Scalar control of induction motor control • Scalar control (6-step) of permanent magnet brushless motors (BLDC and PMSM)	Source	Free	Y	N
ST	STSW-STM8042 STM8S motor control firmware library builder GUI	Binaries	Free	Y	N

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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	J2602 Driver	Source	Free	Y	N[1]
	LIN 2.1 Driver	Source	Free	Y	Y
	STM8A-SafeASIL	Document	Free	Y	N[1]
Simma Software	ssCAN	Source	License	Y	N.A.[3]
	ssJ1939	Source	License	Y	N.A.[3]
	ssI15765	Source	License	Y	N.A.[3]
	ssI14229 (UDS)	Source	License	Y	N.A.[3]
	ssNMEA2000	Source	License	Y	N.A.[3]
Vector	CANbedded	Source	License	Y	N.A.[3]
	CANbedded LIN	Source	License	Y	N[2]
	CANbedded J1939	Source	License	Y	N.A.[3]

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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	F1	F2	F3	F4	F7	H7	L0	L1	L4/L4+
IHR Gmbh	LIN 2.1 Driver	Source	License	N[1]	Y	N[1]	N[1]	Y[2]	Y[3]	N[1]	N[1]	N[1]	N[1]
Simma Software	ssCAN	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N.A.[4]	N.A.[4]	Y
	ssJ1939	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N.A.[4]	N.A.[4]	Y
	ssI15765	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N.A.[4]	N.A.[4]	Y
	ssI14229 (UDS)	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N.A.[4]	N.A.[4]	Y
	ssNMEA2000	Source	License	Y	Y	Y	Y	Y	Y	N[1]	N.A.[4]	N.A.[4]	Y

1/ Please contact supplier
2/ slave only
3/ multi-master (4 channels)
4/ No CAN in STM32L0 an d STM32L1 series

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Sensor Hub

- **Sensor hub solution for Android & Windows 8 mobile devices**
  - Sensor hub framework including 9-axis sensor fusion, gesture recognition, context awareness and pedestrian dead reckoning on STM32

- **Power-efficient implementations**
  - Optimized algorithms with smart scheduling allowing power-efficient sensor data acquisition, data batching and motion processing on STM32

Definitions	
Motion sensors	Components able to sense various motions including accelerations (accelerometers = A), rotations (gyroscopes = G) and Earth magnetic field (magnetometers = M).
Sensor hub	Microcontroller collecting and processing the motion sensors raw data (data fusion) for an upstream device (usually a mobile application processor).
9-axis sensor fusion	Processing that “fuse” the raw data collected from the AGM sensors in order to compute the device orientation. Fusing each other sensor data allow to increase the orientation accuracy and to correct each sensor inherent noise, drift or sensitivity to external environment. Sensor data calibration is included as well in the fusion process.
Gestures recognition	Processing that allows the sensor hub to sense various gestures like shaking, taping, flipping, twisting, …
Context awareness	Processing that allows the sensor hub to detect the system user’s activity like device facing up, device facing down, user standing, user walking, user running, …
PDR	Pedestrian dead reckoning allowing the sensor hub to determine the system user’s trajectory based one the sensors data only (no GPS, no Wi-Fi, …). The trajectory will be represented in 2D or 3D (if pressure sensor is used) environment.

STM32 – Sensor Hub solutions

Solutions with Partners. Ask your local ST Sales office.

Virtual Machines & Model-driven development

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

- **Easier migration**
  - ST and 3rd 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									
				F0	F1	F2	F3	F4	F7	H7	L0	L1	L4 /L4+
ST	STM32 Peripheral blocks for Matlab/Simulink	License	Free	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mountaineer	Microsoft .NET Micro Framework	Open source Apache 2.0	Free	N	Y	Y	N	Y	N	N	N	N	N
Espruino	Javascript	Open source MPLv2	Free	N	Y	N	N	Y	N	N	N	N	Y
JerryScript	Javascript	Open source Apache 2.0	Free	N	N	N	N	Y	N	N	N	N	N
Duktape	Javascript	Open source MIT	Free	N	N	N	N	Y	N	N	N	N	Y
Micropython	Python	Open source MIT	Free	N	N	N	N	Y	Y	N	N	N	Y

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