

How to Select the Right Microcontrollers for an Application

# DAY 3 : The Modern MCU Selection Process

Sponsored by



# Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Group Chat’ by maximizing the chat widget in your dock.
- Submit questions for the lecturer using the Q&A widget. They will follow-up after the lecture portion concludes.

## Course Sessions

- The Microcontroller Industry Today
- MCU Selection Criteria
- **The Modern MCU Selection Process**
- Microcontroller Selection Use Cases
- Microcontroller Selection Best Practices

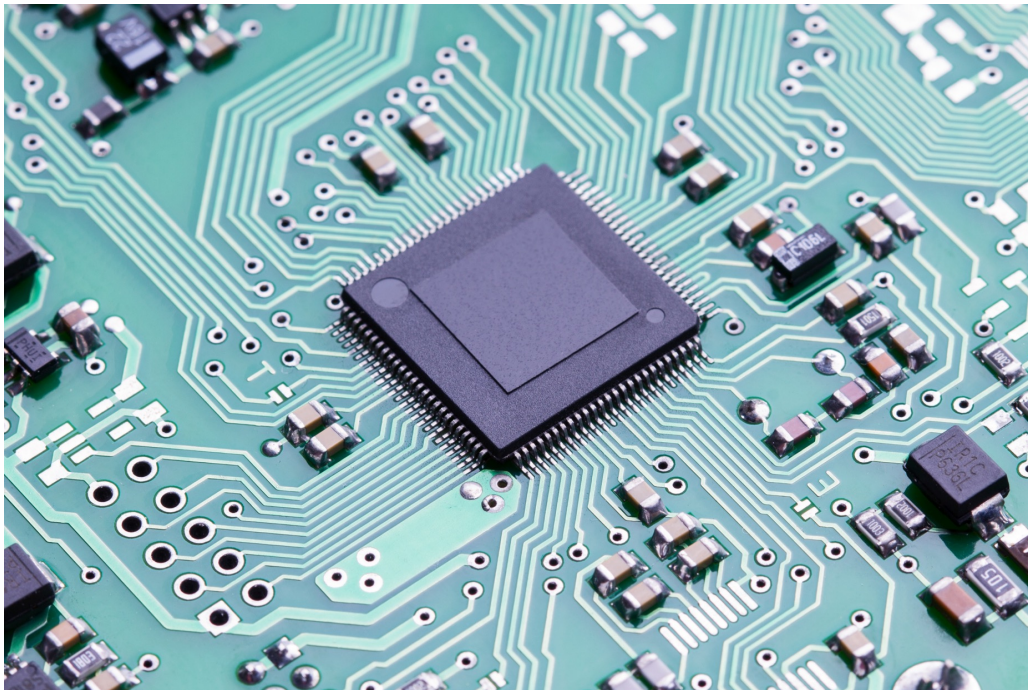
1

# The MCU Selection Process



# Microcontroller Selection

## Hardware



OR

## Software

```
506     return 0;
507 }
508
509 int int_board_io(st_board *bio, char *
510 {
511     init_menu_text(bio);
512     bcm2835_init();
513     bcm2835_gpio_fsel(PIN_SW_CANCEL,
514     bcm2835_gpio_set_pud(PIN_SW_CANCEL
515
516     bcm2835_gpio_fsel(PIN_SW_ENTER,
517     bcm2835_gpio_set_pud(PIN_SW_ENTER
```

# Which is more important to you in the selection process?

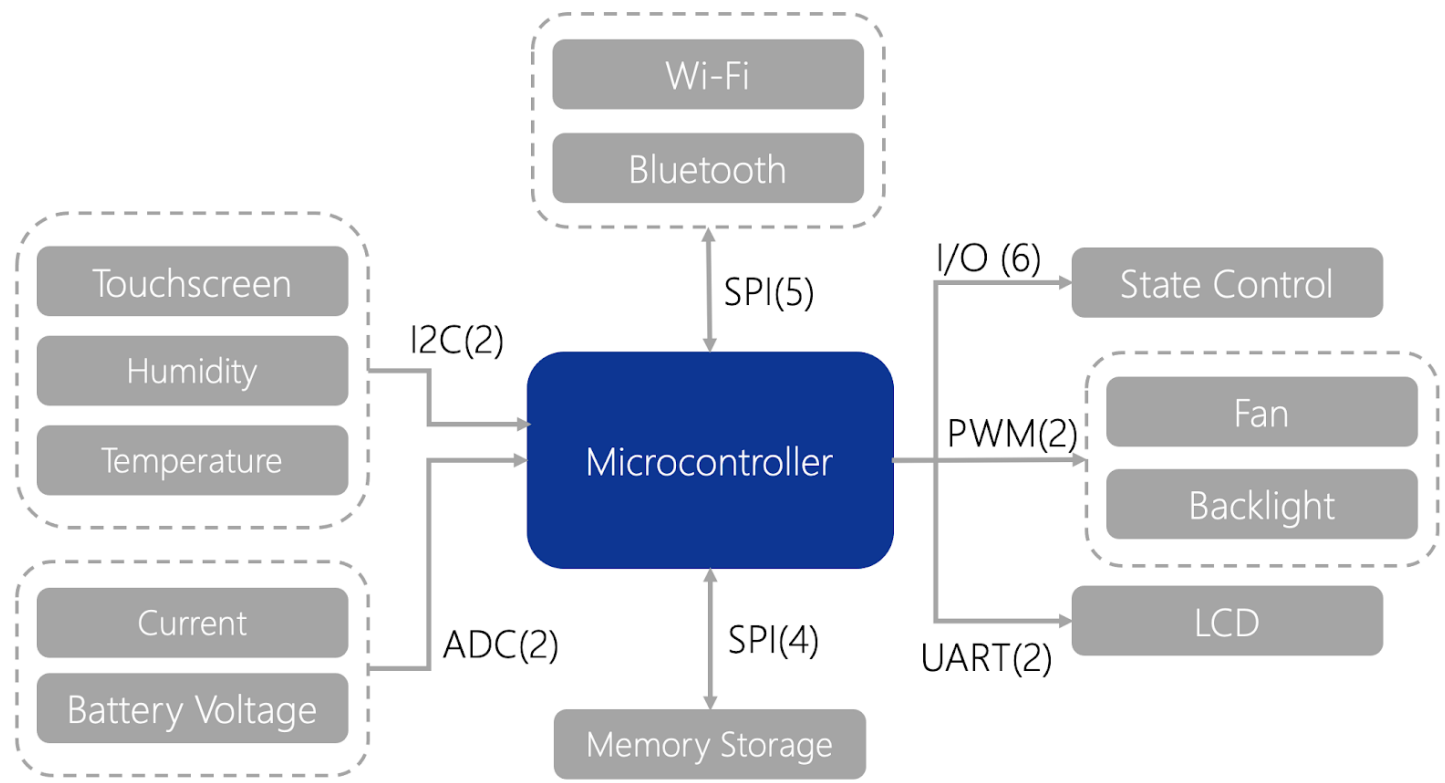
- Hardware
- Software
- Other

# 1

## The MCU Selection Process - Take 2

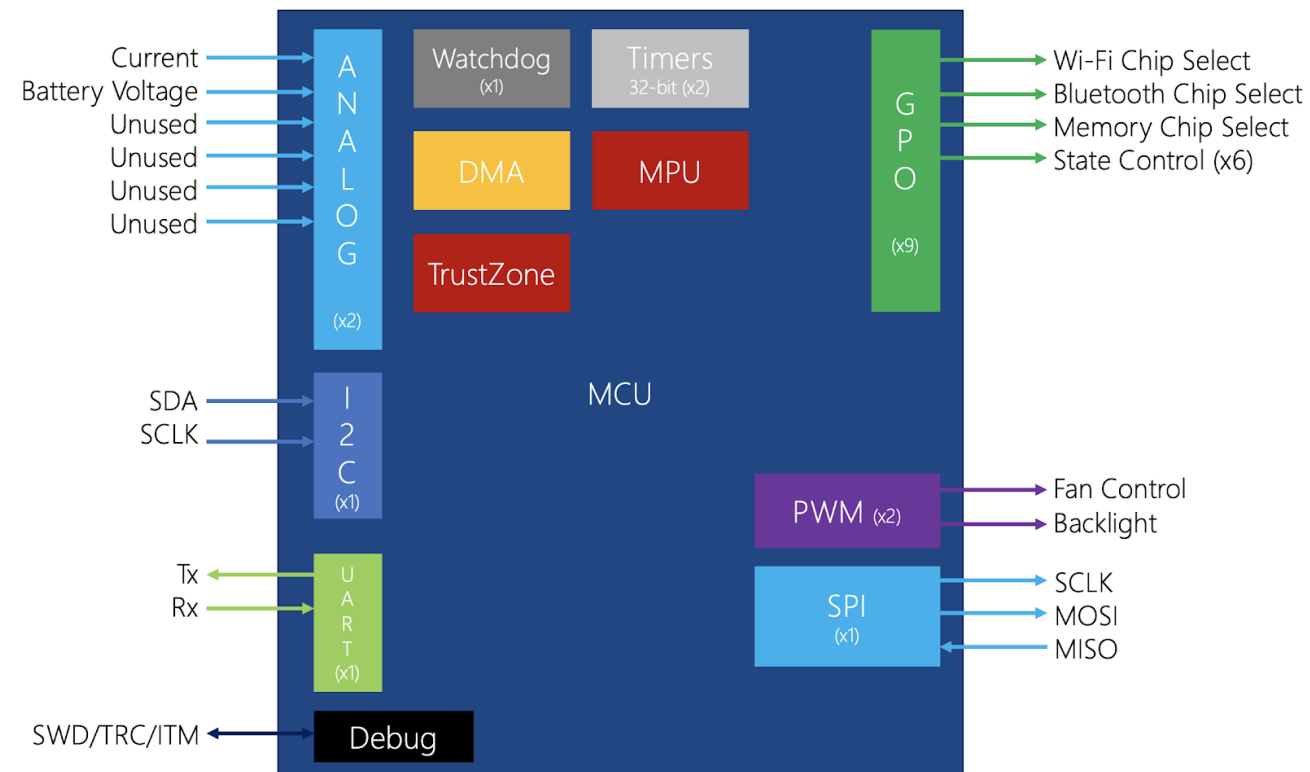
Selecting a modern microcontroller is more than just an electrical process, it's a systems process!

# Step #1 – Create a Hardware Block Diagram





# Step #1 – Create a Hardware Block Diagram



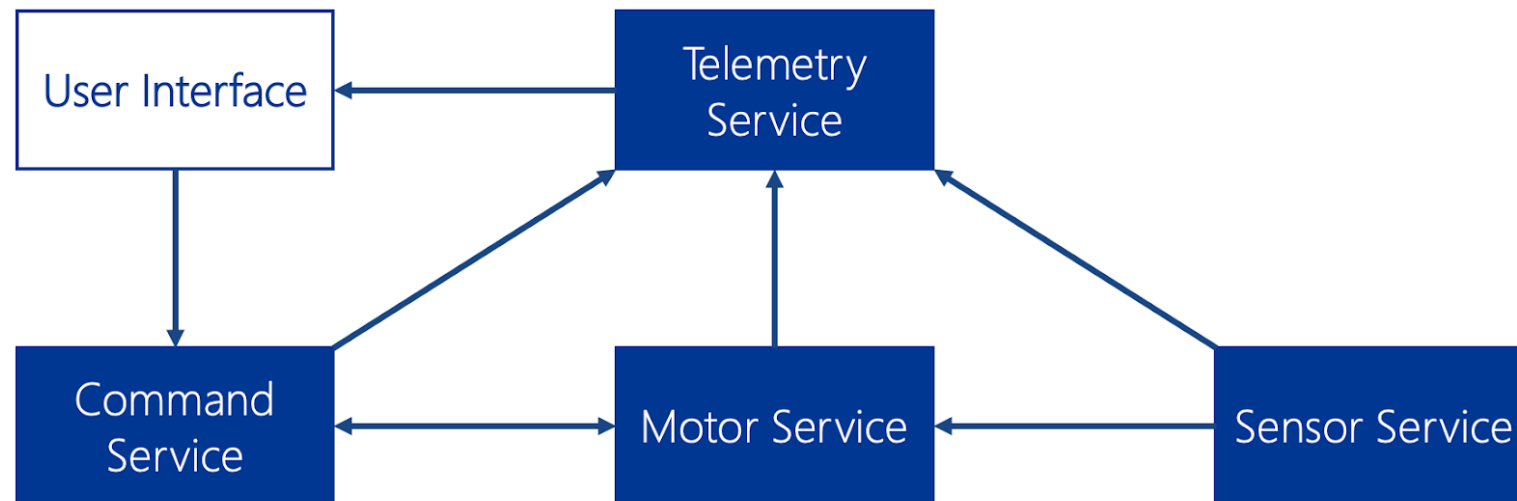
## Step #2 – Identify the Systems Data Assets

Data Asset	Asset Type	Data Size	Sample Rate	Processing
Analog	Sensor	32 Bytes	1 kHz	Digital Notch Filter
Digital	Sensor	128 Bytes	1 KHz	Running Average – 5 Sample
Firmware	IP	256 KBytes	-	See design
Keys	Keys	128 Bytes	-	Secure Storage
Device ID	Data	128 Bits	-	Secure Storage

## Step #3 – Perform a TMSA

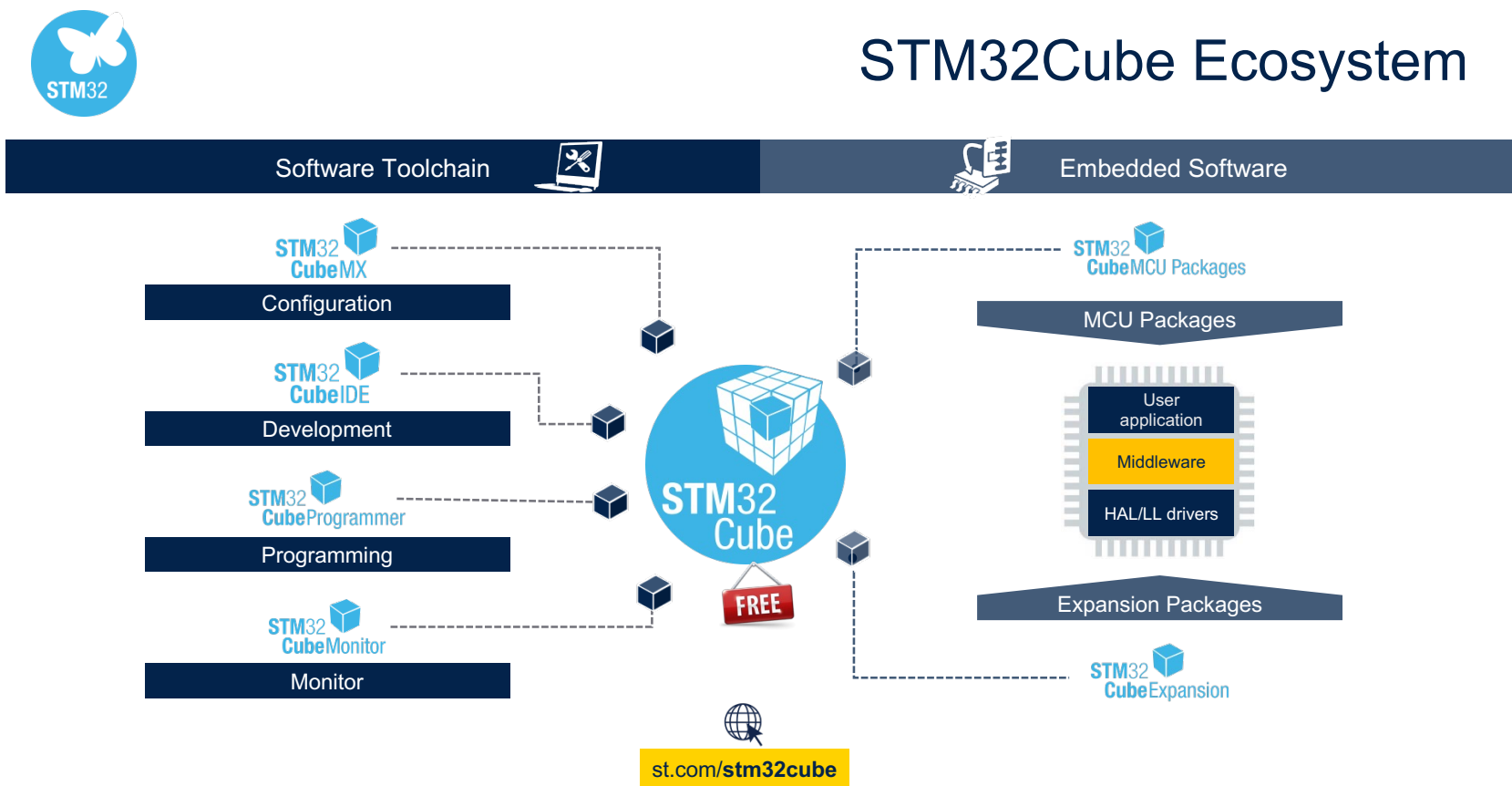
Security Objective	Countered Threats	Targeted Data Assets	Security Properties <sup>2</sup>	Design	Mfg	Inventory	End Use	Term
<b>Access Control<sup>1</sup></b>	Spoofing Malware	Configuration T. Firmware	C I, A	N/A Dig Sign	N/A Dig Sign	N/A N/A	Encryption Dig Sign	Dead <sup>4</sup> Dead <sup>4</sup>
<b>Secure Storage<sup>1</sup></b>	Tamper	HW ID T. Firmware User Data Configuration Keys	I I, A C, I C C, I	N/A Dig Sign N/A N/A N/A	eFuse Dig Sign N/A N/A SEF <sup>3</sup>	eFuse Dig Sign N/A N/A SEF <sup>3</sup>	eFuse Dig Sign Encryption Encryption SEF <sup>3</sup>	eFuse Dead <sup>4</sup> Dead <sup>4</sup> Dead <sup>4</sup> Dead <sup>4</sup>
<b>Firmware Auth</b>	Malware	T. Firmware	I, A	Dig Sign	Dig Sign	Dig Sign	Dig Sign	Dead <sup>4</sup>
<b>Comm<sup>1</sup></b>	MitM	User Data Keys	C, I C, I	N/A N/A	N/A SEF <sup>3</sup>	N/A SEF <sup>3</sup>	Encryption SEF <sup>3</sup>	Dead <sup>4</sup> Dead <sup>4</sup>
<b>Secure State</b>	Malware Tamper	T. Firmware HW ID T. Firmware User Data Configuration Keys	I I, A I, A C, I C C, I	Dig Sign N/A Dig Sign N/A N/A N/A	Dig Sign eFuse Dig Sign N/A N/A SEF <sup>3</sup>	Dig Sign eFuse Dig Sign Encryption Encryption SEF <sup>3</sup>	Dig Sign eFuse Dig Sign Encryption Encryption SEF <sup>3</sup>	Dead <sup>4</sup> eFuse Dead <sup>4</sup> Dead <sup>4</sup> Dead <sup>4</sup> Dead <sup>4</sup>

## Step #4 – Review the Software Model and Architecture





# Step #5 – Research Microcontroller Ecosystems

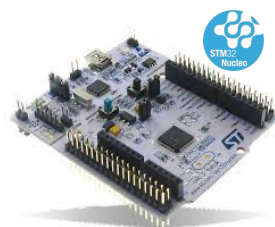


## Step #6 - Evaluate Development Boards



### STM32 Development Boards

For rapid evaluation and prototyping



#### Nucleo Boards

Flexible Prototyping

[st.com/stm32nucleo](https://st.com/stm32nucleo)



#### Discovery Kits

Key Feature Prototyping

[st.com/stm32discovery](https://st.com/stm32discovery)



#### Evaluation Boards

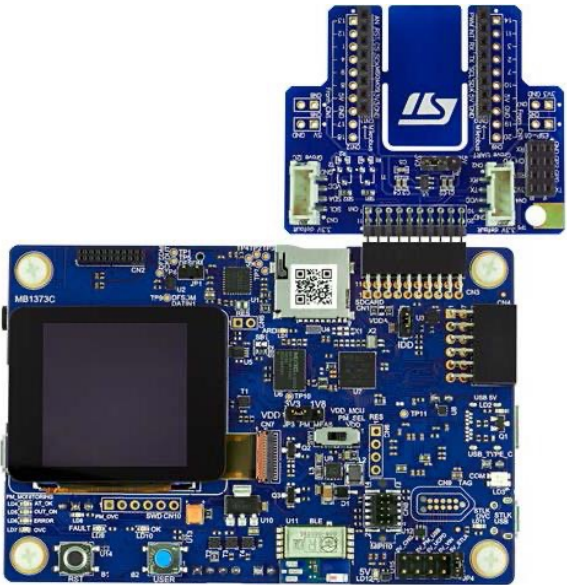
Full Feature Evaluation

[st.com/stm32evaltools](https://st.com/stm32evaltools)

Note: All ST boards integrate an in-circuit ST-Link debugger and programmer.

# Step #7 – Make the Final Selection

			Microcontroller #1						Microcontroller #2					
	Criteria	Weight	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Weighted Rating Total	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Weighted Rating Total
Hardware	32-bit Architecture	4	3	3	3	3	3	60	2	2	2	2	2	40
	Processor speed	4	2	2	2	2	2	40	1	1	1	1	1	20
	Instruction set	5	2	1	1	1	2	35	1	2	2	2	1	40
	Minimal interrupt latency	5	1	2	2	1	1	35	3	1	1	3	2	50
	Lowest energy consumption	5	1	1	1	1	1	25	2	2	2	2	2	50
	Part Availability	5	1	2	1	1	1	30	2	3	3	3	3	70
	Memory footprint / speed	4	3	3	3	3	3	60	2	2	2	2	2	40
Middleware	File system best meets system requirements	4	2	1	2	2	1	32	3	2	3	3	1	48
	TCP/IP stack best meets system requirements	4	2	1	2	2	1	32	3	2	3	3	1	48
	USB stack best meets system requirements	4	2	1	2	2	1	32	3	2	3	3	1	48
	Graphics stack best meets system requirements	4	2	1	2	2	1	32	3	2	3	3	1	48
	Middleware requires minimal integration effort	4	2	1	2	2	1	32	3	2	3	3	1	48
	Additional 3rd party tools integrated seamlessly	3	1	2	1	2	1	21	2	3	2	3	2	36
Engineer	Maximize professional growth potential	2	2	2	1	3	1	18	1	1	3	2	3	20
	Least amount of stress to implement	2	2	3	1	1	3	20	1	2	3	3	2	22
	Most fun / interesting	1	2	3	3	1	2	11	3	1	1	2	3	10
	Minimized labor intensity	3	1	2	3	1	3	30	2	3	1	2	1	27
	Least deadline constrained to get up to speed	2	2	1	2	1	3	18	3	2	3	2	1	22
	Most internal resources available	3	1	2	3	3	3	36	2	3	1	1	1	24
Security	Security Certified RTOS	5	2	2	1	3	1	45	3	3	2	1	2	55
	Supports Arm TrustZone	4	1	1	2	1	1	24	2	2	3	2	2	44
	Supports TF-M	5	1	1	1	2	2	35	2	2	2	3	3	60
	Secure OTA / Bootloader support	3	2	2	1	2	2	27	1	1	2	3	3	36
	Total	198	98	94	101	101	95	1852	104	113	109	116	102	2059
			Microcontroller #1						Microcontroller #2					



# Which is more important to you in the selection process?

- Hardware
- Software
- The combined ecosystem
- Other




3



# Tools for Finding Microcontrollers

How do we find the right options?

# Digikey



All Products ▾ microcontrollers 🔍

Hello, Jacob Beningo  
Account & Lists ▾ 

Products ▾ Manufacturers ▾ Resources ▾

Product Index > Integrated Circuits (ICs) > Embedded - Microcontrollers

## Embedded - Microcontrollers

Search Within 🔍 Results: 92,184

Manufacturer

Search Filter

Adafruit Industries LLC  
Advanced Micro Devices  
AMD  
Analog Devices Inc.  
Analog Devices Inc./Maxim Integrated  
Arduino  
Atmel  
Bridgetek Pte Ltd.  
Broadcom Limited  
Burr Brown

Series

Search Filter

-  
\*  
568xx  
56F8000  
56F8014  
56F836xx  
56F837xx  
56F8xx  
56F8xxx  
720/4500

Packaging

-  
Bag  
Box  
Bulk  
Cut Tape (CT)  
Digi-Reel®  
Strip  
Tape & Box (TB)  
Tape & Reel (TR)  
Tray  
Tube

Product Status

Active  
Discontinued at Digi-Key  
Last Time Buy  
Not For New Designs  
Obsolete  
Preliminary

Core Processor

Search Filter

12V1  
80C152  
80C186  
80C188  
80C196KC  
80C31  
80C32  
80C51  
80C52  
720

Core Size

Search Filter

4-Bit  
6-Bit  
8-Bit  
8/16-Bit  
16-Bit Dual-Core  
16-Bit  
16/32-Bit  
32-Bit 10-Core  
32-Bit 12-Core  
32-Bit 16-Core

Speed

Search Filter

30/20MHz  
40/20MHz  
40/30MHz  
60/30MHz  
350kHz  
500kHz  
625kHz  
1MHz  
1.2MHz  
1.6MHz

Stocking Options

☐ In Stock  
☐ Normally Stocking  
☐ New Product

Environmental Options

☐ RoHS Compliant  
☐ Non-RoHS Compliant

Media

☐ Datasheet  
☐ Photo  
☐ EDA/CAD Models

Marketplace Product

☐ Exclude

Apply All

92,184 Results

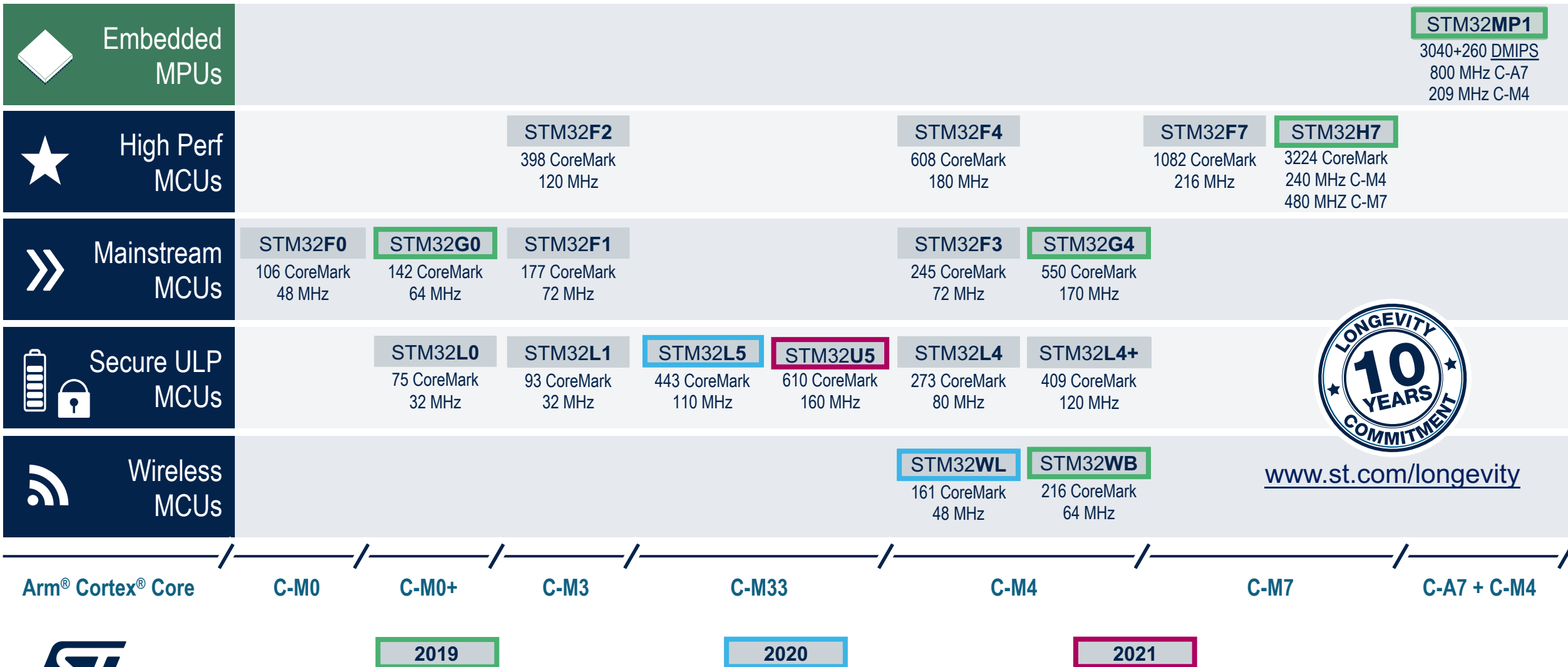
18

© 2022 Beningo Embedded Group, LLC. All Rights Reserved.



# STM32 MCU/MPU Portfolio

#1 GP MCUs, 9.4 billion shipped! (as of 2021)





## Criteria

MCU/MPU Filters

★

Commercial Part Number

PRODUCT INFO >

MEMORY >

TIMER >

ANALOG >

COMMUNICATION INTERFACE >

USB INTERFACE >

EXTERNAL MEMORY INTERFACE >

OTHER INTERFACE >

GRAPHICS >

SECURITY >

OTHER PERIPHERAL >

PHYSICAL >

**Voltage Min** From 1.62 to 2.4 (V)

1.62 2.4

**Voltage Max** From 1.95 to 3.6 (V)

1.95 3.6

**Current Lowest** From 0.0 to 140.0 (µA)

0.0 140.0

**Current Run** From 0.0 to 472.0 (µA)

0.0 472.0

**Current Standby** From 0.0 to 0.7 (µA)

0.0 0.7

**RX Current** From 0.0 to 7.9 (mA)

0.0 7.9

# Chip & Module Selection

3,458 part numbers and growing

MCU/MPU Selector

Board Selector

Example Selector

Cross Selector

MCU/MPU Selector Board Selector Example Selector Cross Selector

MCU/MPU Filters

★

Commercial Part Number

PRODUCT INFO >

MEMORY >

TIMER >

ANALOG >

COMMUNICATION INTERFACE >

USB INTERFACE >

EXTERNAL MEMORY INTERFACE >

OTHER INTERFACE >

GRAPHICS >

SECURITY >

OTHER PERIPHERAL >

PHYSICAL >

**Voltage Min** From 1.62 to 2.4 (V)

1.62 2.4

**Voltage Max** From 1.95 to 3.6 (V)

1.95 3.6

**Current Lowest** From 0.0 to 140.0 (µA)

0.0 140.0

**Current Run** From 0.0 to 472.0 (µA)

0.0 472.0

**Current Standby** From 0.0 to 0.7 (µA)

0.0 0.7

**RX Current** From 0.0 to 7.9 (mA)

0.0 7.9

Features Block Diagram Docs & Resources Datasheet Buy Start Project

STM32Cube

STM32U5 ultra-low-power MCU series with comprehensive STM32Cube ecosystem

MCU/MPUs List: 3458 items

Part No.	Marketing Status	Unit Price for 1000 (USD)	Board	Package	Flash	RAM
STM32C011D6Y3TR	Coming soon	NA		WLCSP 12 1.7x...	32 kBytes	6 kBytes
STM32C011D6Y6TR	Coming soon	NA		WLCSP 12 1.7x...	32 kBytes	6 kBytes
STM32C011F4P3	Coming soon	NA		TSSOP-20	16 kBytes	6 kBytes
STM32C011F4P6	Coming soon	NA		TSSOP-20	16 kBytes	6 kBytes
STM32C011F4U3	Coming soon	NA		UFOPFN 20 3x3...	16 kBytes	6 kBytes
STM32C011F4U6TR	Coming soon	NA		UFOPFN 20 3x3...	16 kBytes	6 kBytes
STM32C011F6P3	Coming soon	NA		TSSOP-20	32 kBytes	6 kBytes
STM32C011F6P6	Coming soon	NA		TSSOP-20	32 kBytes	6 kBytes
STM32C011F6U3	Coming soon	NA		UFOPFN 20 3x3...	32 kBytes	6 kBytes
STM32C011F6U6TR	Coming soon	NA		UFOPFN 20 3x3...	32 kBytes	6 kBytes
STM32C011J4M3	Coming soon	NA	STM32C0116-DK	SO-8	16 kBytes	6 kBytes
STM32C011J4M6	Coming soon	NA		SO-8	16 kBytes	6 kBytes
STM32C011J6M3	Coming soon	NA		SO-8	32 kBytes	6 kBytes
STM32C011J6M6	Coming soon	NA		SO-8	32 kBytes	6 kBytes
STM32C031C4T3	Coming soon	NA		LQFP 48 7x7x1...	16 kBytes	12 kBytes
STM32C031C4T6	Coming soon	NA		LQFP 48 7x7x1...	16 kBytes	12 kBytes







# STM32 MCU Finders

for Smartphones and PCs

## STM32 Mobile and PC MCU Finders

Mobile Version



PC Version



What tools do you use to find microcontrollers?

- Supplier tools
- Vendor tools
- Web tools / searches
- Other

# 4 Going Further

# Thank you for attending

Please consider the resources below:

- [www.beningo.com](http://www.beningo.com)
  - Blog, White Papers, Courses
  - Embedded Bytes Newsletter
    - <http://bit.ly/1BAHYXm>
  - Embedded Software Design
    - <https://bit.ly/3PZCtNO>



From [www.beningo.com](http://www.beningo.com) under

- Blog > CEC – How to Select the Right Microcontroller for an Application





**DesignNews**

# Thank You

Sponsored by



© 2022Beningo Embedded Group, LLC. All Rights Reserved.