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Capital
Markets
Day 2022

Microcontrollers & Digital ICs Group

Remi El-Ouazzane

President, Microcontrollers & Digital ICs Group

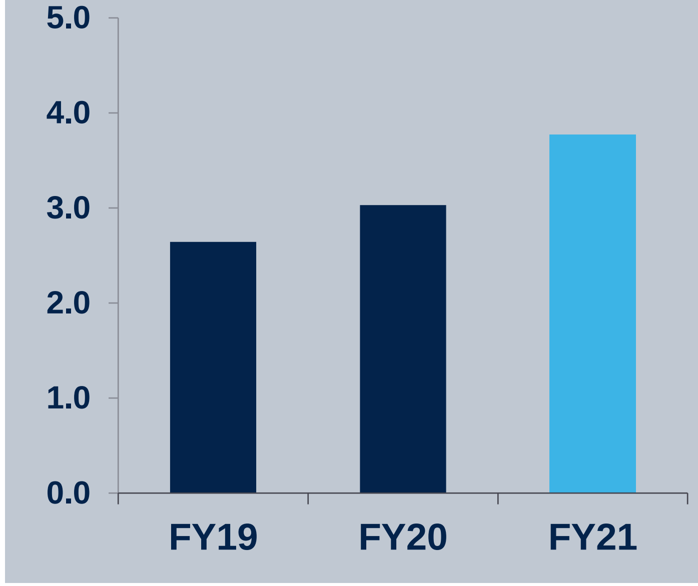
30% of ST FY21 Revenues

Revenue overview - MDG

MDG Group Revenue $B

2021

$3.77B

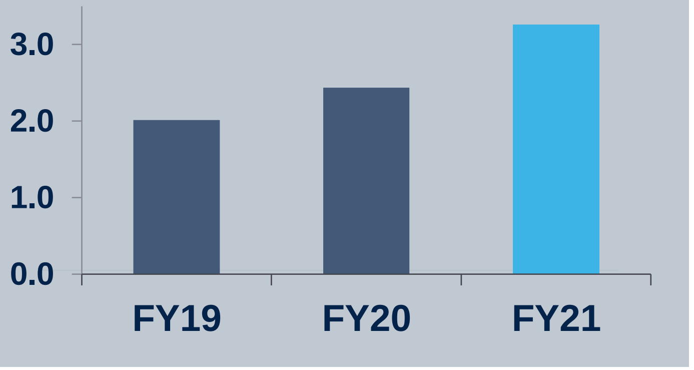


MDG Sub-Group Revenue $B

Microcontrollers and Memory Sub-Group

2021

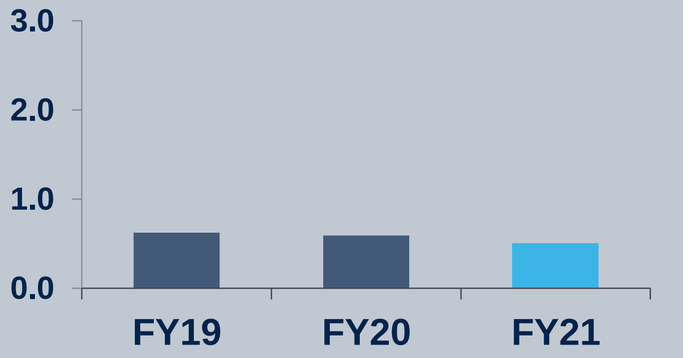
$3.26B



RF Communications Sub-Group

2021

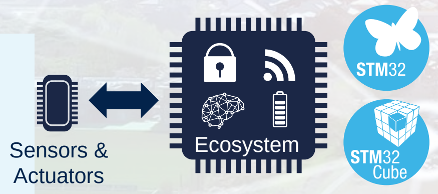
$0.51B



Era of the cloud-connected intelligent edge

From: Internet of Things
To: Cloud-connected, Autonomous Things

Our Goal:
Making these Things more **Secure**, more **Connected**, and more **Intelligent**



STM32 | STM32Cube

The edge computing platform of Autonomous Things

GHz Wireless Infrastructure and Edge RF Front-Ends

To efficiently connect Autonomous Things to and from the Cloud

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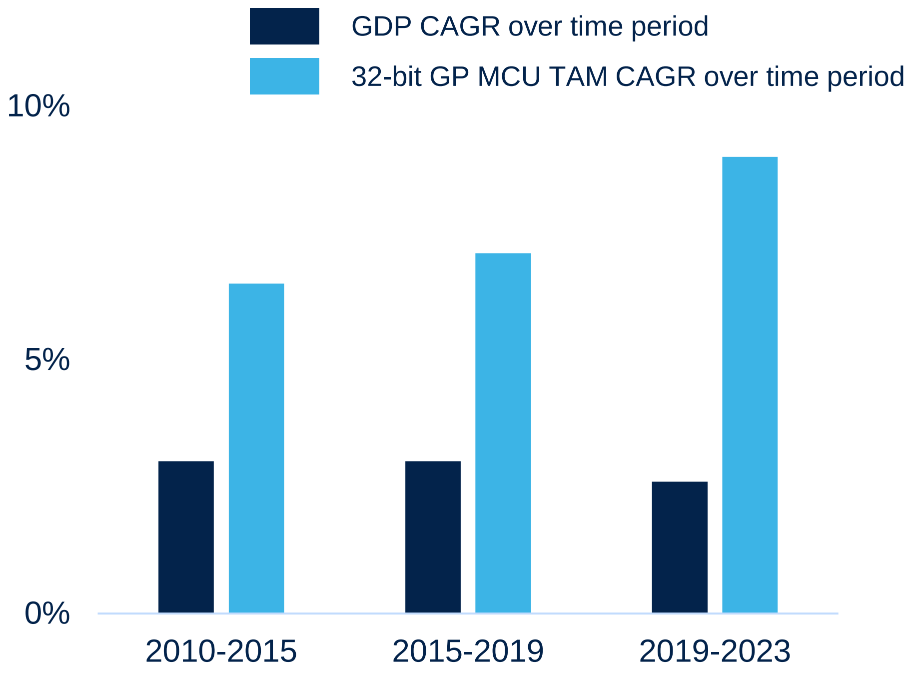
STM32

32-bit GP MCU: Accelerating the world’s digitalization

Digitalization + Cloud-Connection = Increasingly faster growth of 32-bit GP MCU market versus GDP



Sources: World Bank, IMF, Omdia

Growing pervasion of 32-bit GP MCU

Robot mower: from **4** in 2013 to **12** in 2019

Industrial circuit breaker: from **0** in 2012 to **2** in 2022

Power tools: **1** in 2015 to **3** in 2022

Drones: from **1** in 2014 to **7** in 2018

2013

€ 3,400

Main control, HMI
Motor control
Obstacle detection
Sensor control

2019

€ 5,000

Advanced User Interface
Main control
2x Motor control
Obstacle detection
7x Sensor control

Husqvarna

STM32: the leading 32-bit MCU for Industrial

ST market share: 23% - #1

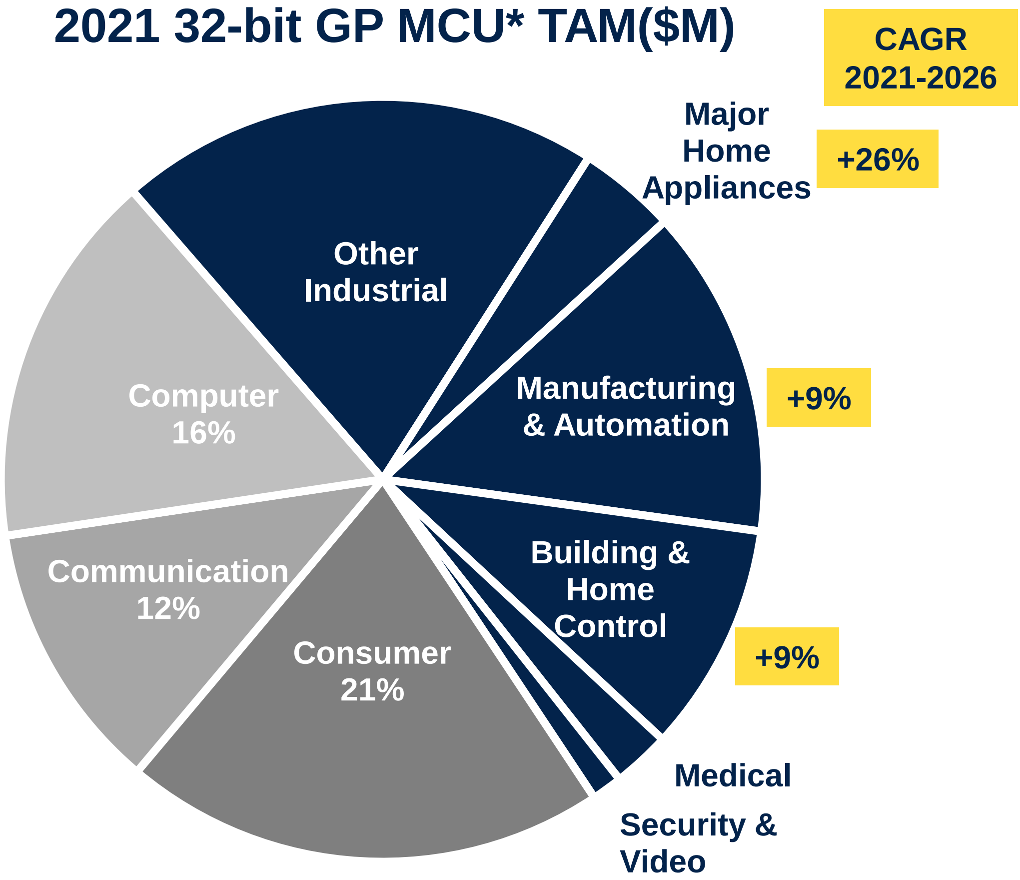
of 2021 General Purpose MCU* TAM

2017	2018-2020	2021
Competitor A	Competitor A	#1
B	#2	A
#3	Competitor B	Competitor B

Organic growth driving ST market share gains

2021-2026 Industrial market growth drivers

- Home appliances - Energy efficiency & cloudification
- Factory automation - AI based predictive maintenance
- Power tools - Wireless connectivity
- Automotive electrification - Infrastructure development
- Building - Smarter, safer and more energy efficient



2021 32-bit GP MCU* TAM($M)

Industrial growing from 52% of TAM in 2021 to 65% in 2026

Sources: Omdia, WSTS

* Excluding Automotive and Smartcard MCU

Developer-first strategy: STM32Cube

TouchGFX · aws · ARDUINO · CRANK · AMETEK · SIERRA WIRELESS · EmCraft systems · SEGGER · PROVENRUN · STM32 Cube.AI · KEIL Tools by ARM · Fieldscale · Embedded Wizard · emotas · Microsoft Azure · sensory · DSP CONCEPTS

Applicative Reference Implementations

Extension Libraries and AI toolkit

HDK | **Embedded SDK** | **Development tool kit** | **Development resources**

ALTAIR · hilscher · IAR SYSTEMS · BIRICHA DIGITAL · emtrion · OSMIC Software · STACKFORCE · ORYX EMBEDDED · Witekio · wolfSSL · Linaro · bootlin · QUECTEL · Qt · KUDELSKI IoT THINGS · port · twilio

2M* Unique Developers

2M* HDK shipped

8M* SDK & tool kits Downloads

10k/y X-Cube.AI Downloads

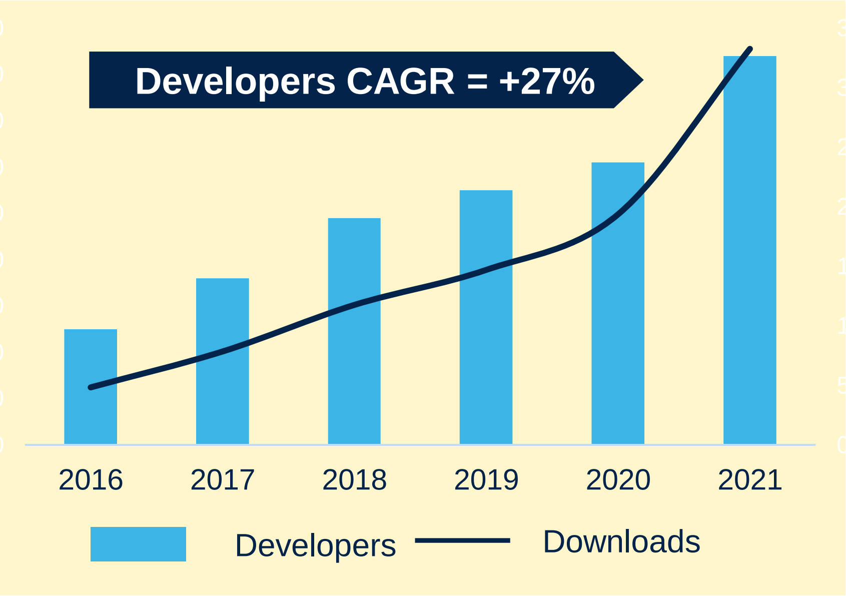
> 120 HDK references

> 150 Cube Expansions

> 150 MOOC hours

> 100 Partners

* Cumulative over 5 years



Next growth drivers for the STM32

1 Increase existing GP MCU socket value with Security, Wireless Connectivity, AI, and ST adjacencies (Analog, MEMS, Power)

2 Capture new higher value MPU sockets

STM32

Capitalize on our 100,000+ STM32 customer base

ABB
APATOR TELEMETRIA
GROUPE ATLANTIC
DAIKIN
ENGINEERING TOMORROW Danfoss
DELTA
EATON Powering Business Worldwide
elvie
enel
FISHER & PAYKEL TECHNOLOGIES
GEBERIT
Haier
Husqvarna
INOVANCE
LEDGER
LEDVANCE
legrand
LG
makita
Microsoft
Midea | Welling
Miele
Nidec All for dreams
Milwaukee
Panasonic
PHILIP MORRIS INTERNATIONAL
ResMed
SAMSUNG
Schneider Electric
GROUPE SEB
SICK Sensor Intelligence.
SIEMENS
SOMFY
SPACEX
STIEBEL ELTRON
SUNGROW Clean power for all
VIESSMANN
wacom
wilo
xylem Let's Solve Water
ZIEHL-ABEGG

1

Democratizing Edge to Cloud Security

STM32 STSECURE

Building turn-key secure solutions for IoT nodes

Scalable Security

 SESIP psacertified™ Level 3	 COMMON CRITERIA Level 5+

Highest security certifications

MCU only or MCU+Secure Element

Certified by major Cloud vendors

Ready for IoT

STM32U5 / STSAFE-A110

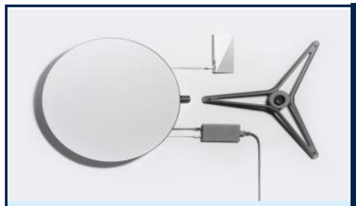
Discovery kit for IoT nodes with STM32U5

Milwaukee

From portable device

Milwaukee Tools
Battery

SPACEX



SpaceX-StarLink
Router & antenna

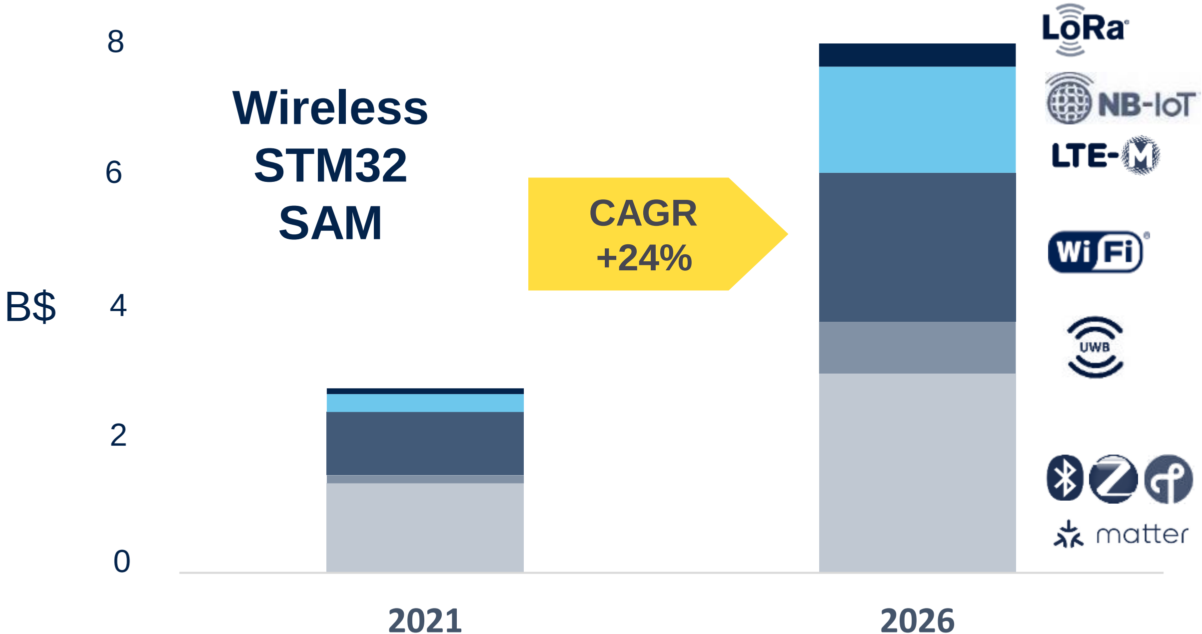
To Highly Secure

1

The Cloudification of the STM32 customer base

Wireless Connectivity growth drivers

- Network Effect
- Cloud connectivity for new use cases
- Diversity of wireless technologies



Source: ABI

Connecting 100 000+ STM32 customers

Broadest wireless protocol offering	NB-IoT, LoRa, UWB, LTE-M, matter, WiFi
Seamless Software migration	STM32 Cube
Built-in Security	STM32 Trust
Cloud Native	STM32 CubeExpansion

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1

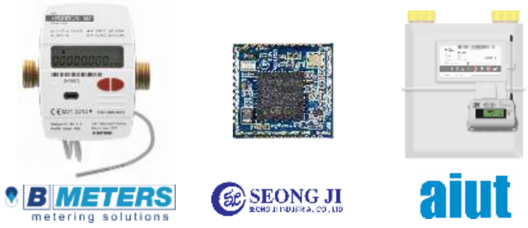
Accelerating momentum in wireless connectivity

Seamless Software Migration

STM32Cube is the Foundation

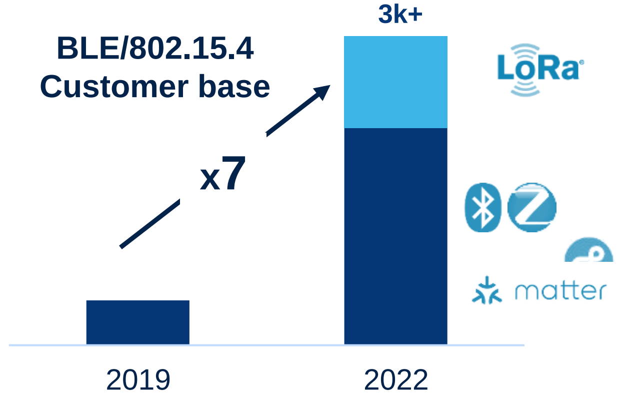
Broad range of Industrial Wins

They made the switch !

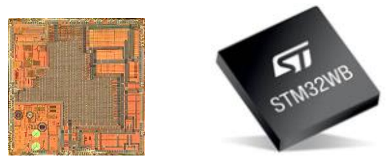


Building customer trust

>$100M*, 42% Industrial



World 1st true open dual-core BLE/802.15.4/Matter MCU



*ST 2022 forecast

- 1st time >$100M of BLE/802.15.4 revenue
- Industrial applications estimate as % of revenues

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1

Making AI at the edge a reality

Introducing ST's game-changing Neural MCU

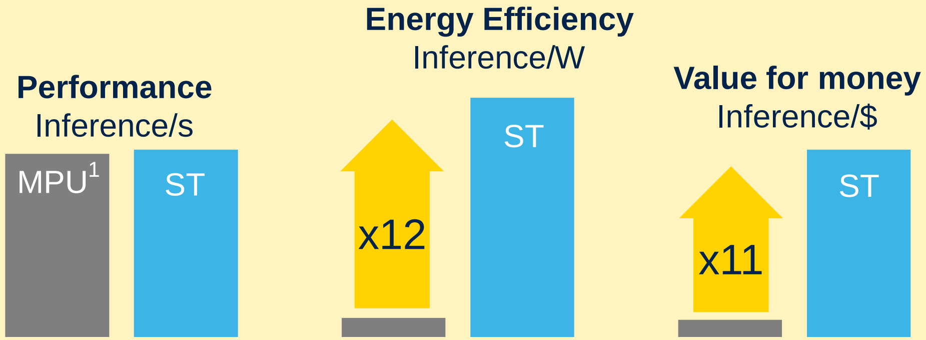
NEW

STM32**N6**

First MCU with **ST Neural-ART NPU** Accelerator

State of the art Inference/W and Inference/$

Powered by STM32 Cube.AI



> "The new STM32N6 Neural MCU is dramatically lowering the AI technology implementation price point. This breakthrough supports our roadmap of new generation intelligent sensors allowing rapidly growing adoption in Smart Cities"

LACROIX

Vincent SABOT,
Executive Managing Director, LACROIX - City activity

Accelerating Development of Edge AI Solutions

CARTESIAM Edge AI Productivity Lab

No AI experts required
Up to 95% shorter development cycle
Fit small footprints, MCU & ISPU
Accretive royalty model

NANOEDGE AI STUDIO

Anomaly detection sensor

OXYtronic

STM32F4

12 months from concept to market

Multi sensor capability

Extreme flexibility

Broad deployment planned

Predictive maintenance

ALTEN

AIRBUS

STM32F4

30% increase in cutting tool life

Preventing operational failure

Extending to all drilling & cutting tools

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[1] Comparison with competitor quad-core microprocessor with AI hardware acceleration

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1

Maximizing ST attach rate in industrial applications

Typical industrial application

AC-DC

DC-DC

Control Unit

STM32

Gate Driver

MOSFET/ IGBT

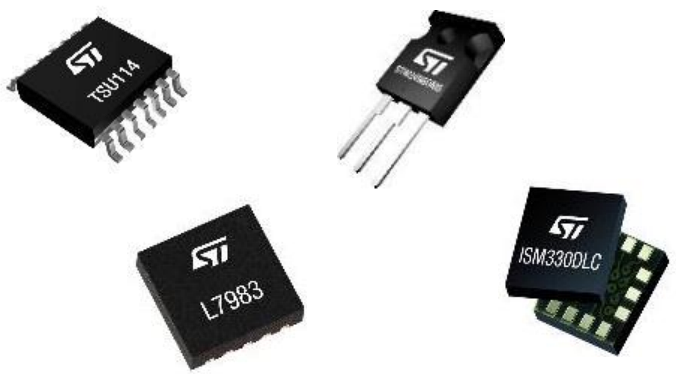
Signal conditioning

Sensors

Connectivity

+

ST analog, power, sensors, …



Driving ST Growth

Photovoltaics

Factory automation

Metering

HVAC 2 kW

Photovoltaics	STM32 $17.1	Attach $131 x8
Factory automation	STM32 $8.8	Attach $16.9 x2
Metering	STM32 $1.8	Attach $6.2 x3
HVAC 2 kW	STM32 $2.4	Attach $12.4 x5

Actual implementation based on selected customer products

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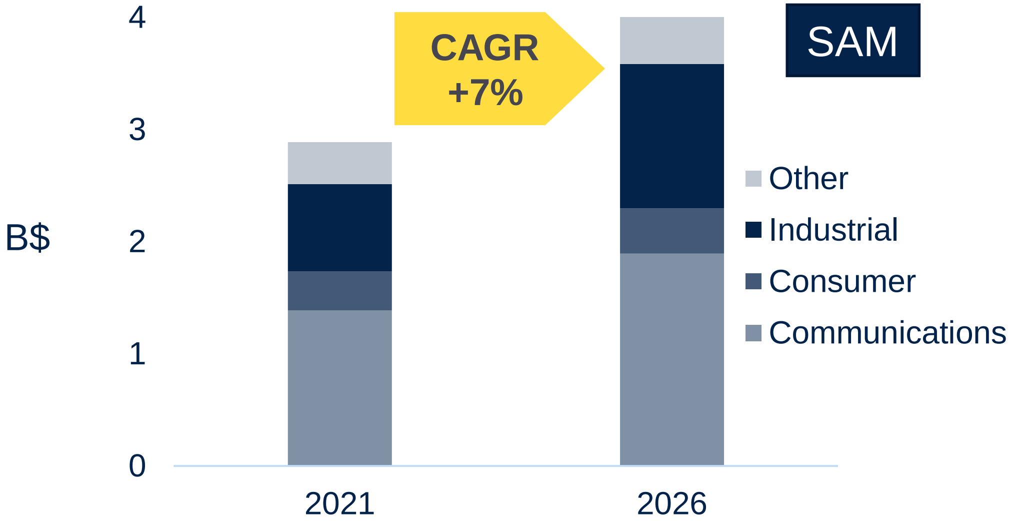
2 STM32 MPU: Building on STM32 industrial success

The natural evolution of STM32 MCU portfolio



Source: WSTS, IC Insights, ST

Expanding our 100K+ MCU customer base in embedded processing

Differentiate in Open Source Software

OpenSTLinux = Reference 32-bit platform in OSS community

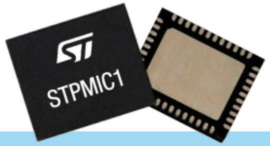
Leverage STM32Cube

Full re-use of selection, configuration and development tools of the STM32 MCUs

Natural continuity for our 100 000+ MCU customers

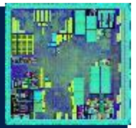
2

STM32MP: General purpose MPUs for the Industrial Market



Power management IC for STM32 MPUs

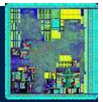
24 STM32MP1 product lines



STM32MP15x

- Single and dual A7 core
- Real Time domain with Cortex M4
- Industrial interfaces (Ethernet, CAN,..)
- GPU + display interfaces

NEW



STM32MP13x

- Single A7 core
- Dual Ethernet
- Sub $3
- PCI security
- Ramping soon at OEMs

150+ Customers
10M+ units*
3x YoY growth since 2020

Smart home & building	**Point-of-Sales**
SOM makers**	**Factory Automation**

Digital power & energy management

CyberPower
DELTA
DH electronics
enel
ENGICAM
&vo OCTAVO SYSTEMS
PHYTEC
PIVOTAL COMMWARE®
STIEBEL ELTRON
VIESSMANN

> “We are adopting ST’s new STM32MP135 because it offers the perfect cost/performance balance while meeting the strong security requirements of our next generation product family”
>
> **World leader in payment services**

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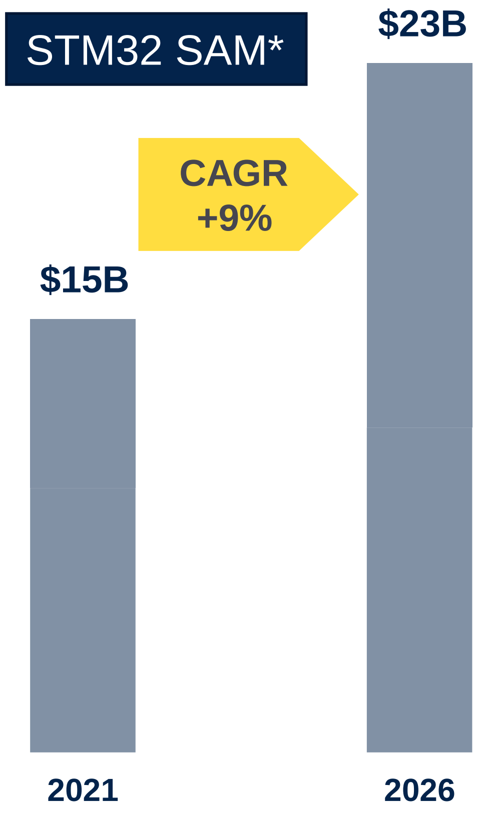
*cumulative since launch
**System on Module

Growing STM32 revenue faster than the SAM



*GP MCU + Wireless MCU + Embedded-MPU

SAM expansion from $15B to $23B

1 **GP MCU** revenue to grow in line with SAM in units and more than SAM in $, leveraging added value

1 **Wireless MCU** revenue to grow faster than SAM thanks to portfolio expansion, customer base & ease of SW migration

2 Double digit **MPU revenue** growth - growing faster than SAM thanks to enriched and accelerated product line introductions

Source: WSTS, ABI, ST

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GHz Wireless

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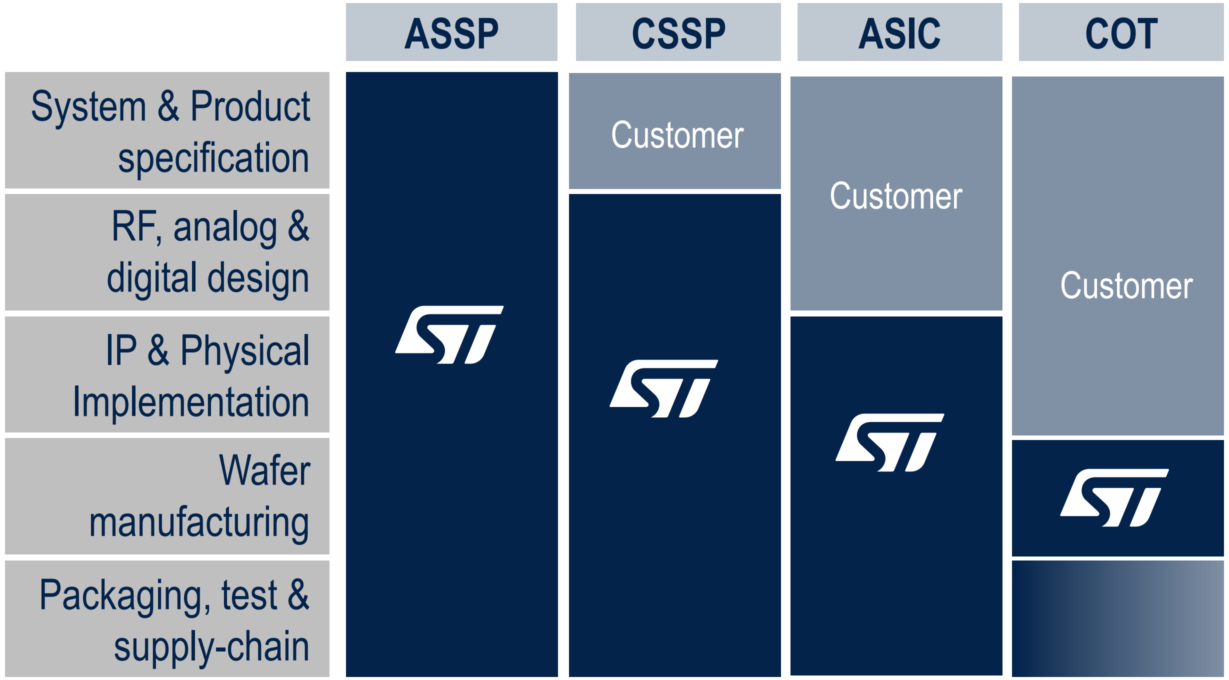
Addressing GHz wireless growth opportunities with RF

RF Front-Ends (LPPD, PA, LNA, SW, Filters) & Beamformer

Infrastructure	Edge*

*excluding Smartphone

Diverse business models

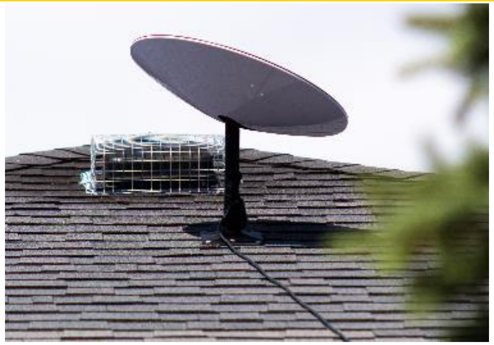


	ASSP	CSSP	ASIC	COT
System & Product specification	ST	Customer	Customer	Customer
RF, analog & digital design		ST		
IP & Physical Implementation			ST	
Wafer manufacturing				ST
Packaging, test & supply-chain				

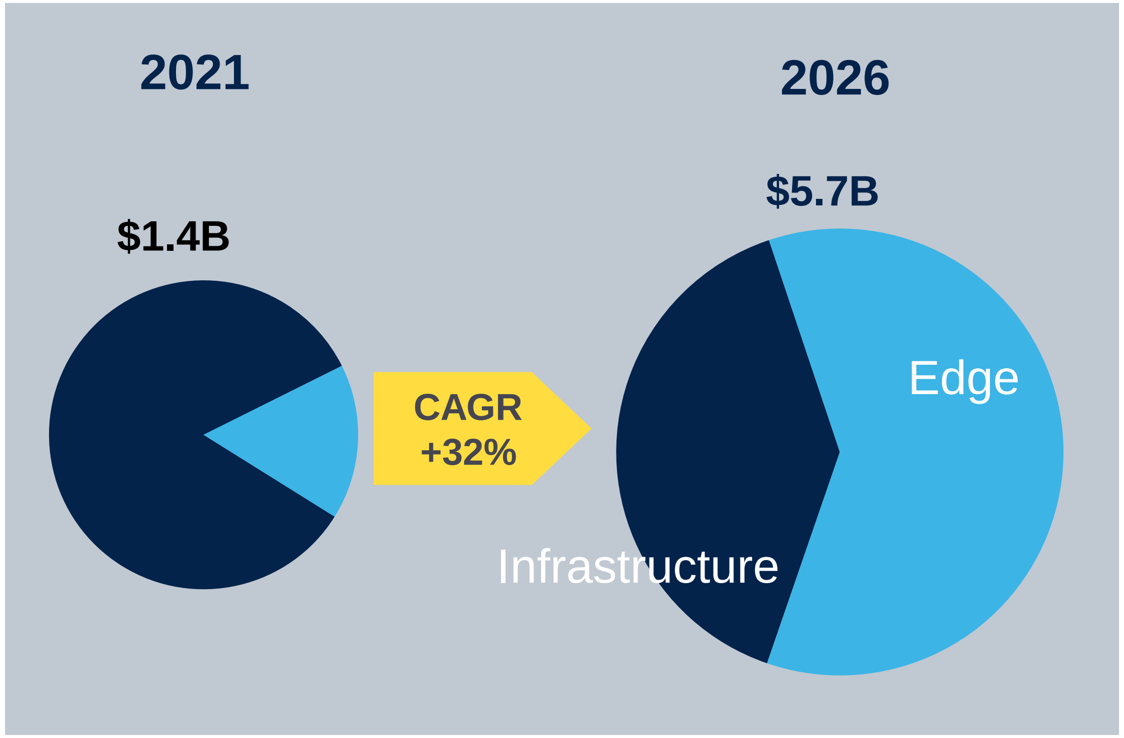
Fast growing GHz wireless market

GHz Wireless growth drivers

- **LEO satellite communication** gaining traction as an alternative for broadband internet access
- **5G mMIMO** deployment globally
- **Wi-Fi 6** & **Cellular-IoT** growing fast



GHz wireless SAM*

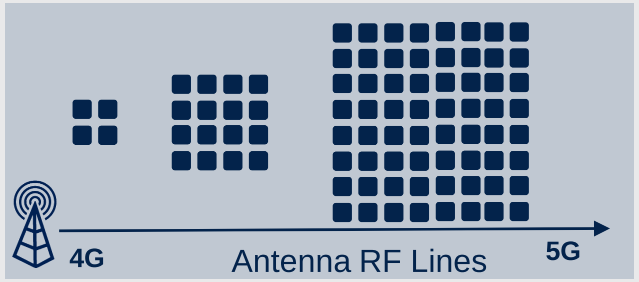


Source: ST

*SAM
- Infrastructure: RF Front-End & Beamformer for 5G BTS mMIMO, mmWave & Small Cells, LEO Satellites
- Edge: RF Front-End & Beamformer for LEO Satellite User Terminals, C-IoT, Wi-Fi 6 (excl. Smartphones)

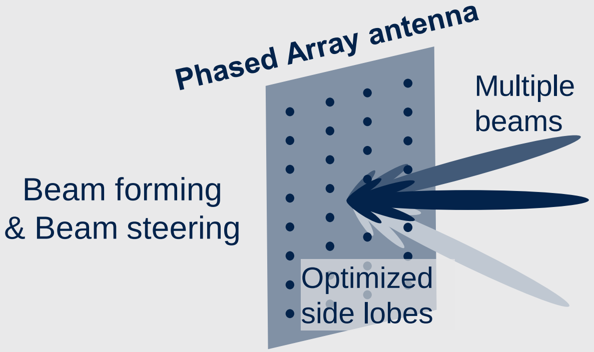
Key technology drivers of the GHz wireless market

Multiplication of RF chains



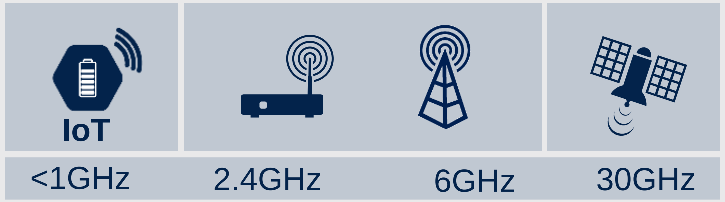
- Driven by **Massive MIMO & Phase Array Antenna**
- **Number of RF chains dramatically increases** from traditional Base Station

Adapting key RF FE KPIs



- Fundamental importance of **Noise Figure** for receiver sensitivity
- New transmitted peak power paradigm allows **highest power efficiency**

Wide frequency span



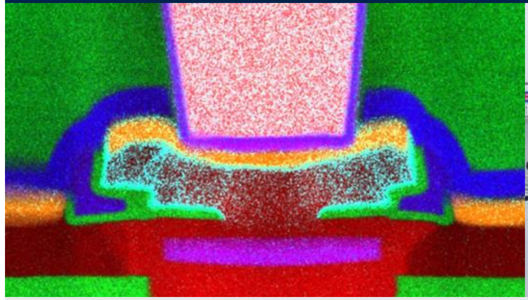
- **Higher throughput** calls for more bandwidth,
- **Available bands** are many & broadly scattered
- From **SubGHz to mmWave**

This requires **new core technologies** optimized for these new targets and **consumer-like volume**

Building GHz wireless products on ST technology leadership

BiCMOS

200mm wafers for high-volume 130nm SiGe (B9MW)
300mm wafers for leading-edge 55nm SiGe (B55X)



LNA$_{20GHz}$ NF	-0.2dB	(B55X vs best available foundry)
LNA$_{20GHz}$ Gain	+6dB	(B55X vs best available foundry)
Fmax*Ft	x1.9	(B55X vs best available foundry)

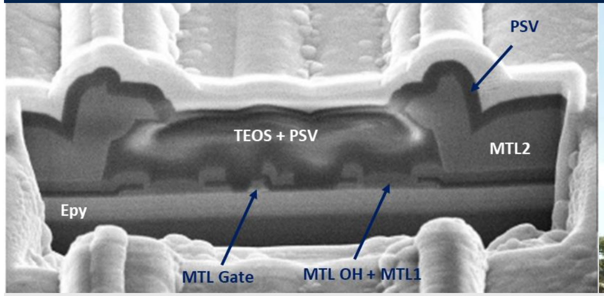
Major B55X product tape out in H2’22

Best Noise Figure (NF) on the market for beamformers

“ST's BiCMOS technology benefits in term of Noise Figure performance proved fundamental for SpaceX system performance.”
Mark Juncosa, SpaceX VP of Engineering

GaN-on-Si

Cost-effective GaN for RF volume markets
150mm – 200mm CMOS-like manufacturing



Power Density	x5 vs LDMOS* (on par with best available GaN)
Drain Efficiency	>75% (on par with best available GaN)
PA Efficiency	+10% vs LDMOS

Qualification in progress

Optimal solution for 5G mMIMO PA

Partners from RF to Light

“GaN-on-Silicon is a highly competitive technology versus LDMOS and GaN-on-SiC in key markets and its near-term availability makes it an attractive choice.”
Steve Daly, Macom CEO

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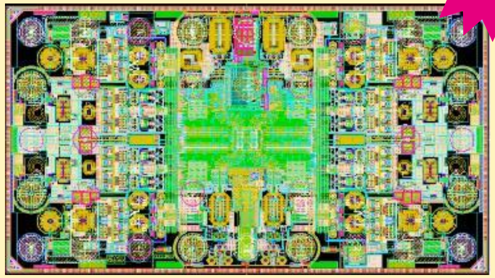
* Lateral Drain Extended Metal Oxide Semiconductor

ST products for GHz wireless market

LEO SAT User Terminal

Sampling now

NEW



FE Ku Band CSSP
12-15GHz

2023

- Increase frequency to Ka band
- Porting to B55X for even better NF
- Cost-down through 300mm volume

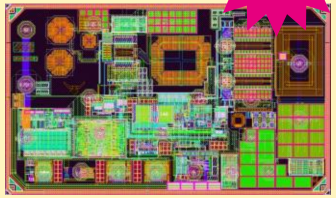
Best NF

Best sensitivity

High-volume

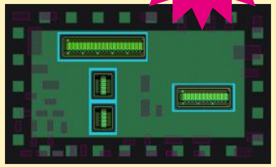
5G Tx line-up

NEW



STFETxx LPPD
1.8-5GHz

NEW



GAN PAM
3.4-3.8GHz

- Portfolio extension to new bands / power
- Complete integration in a SIP
- Cost-down with 200mm GaN-on-Si volume

Perfect technologies to cover the full Tx line-up

Right cost & Power Added Efficiency (PAE)

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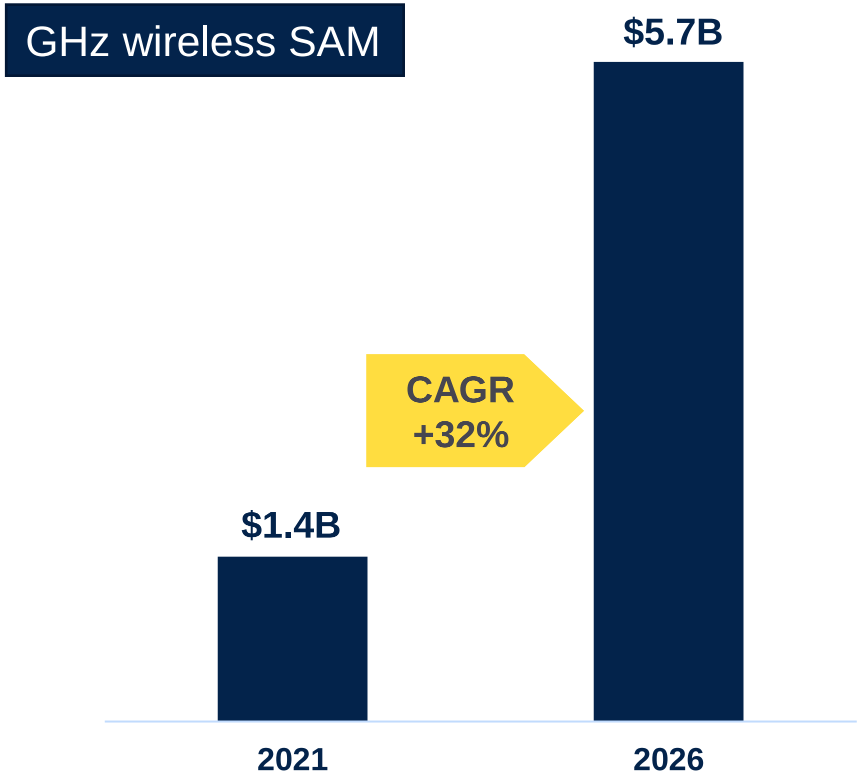
Growing revenue faster than the GHz wireless market



Leverage ST **technology leadership** in core technologies: BiCMOS & GaN-On-Si, Beamformers, Front-End modules Volume-ready packaging & test

Capitalize on leadership for **LEO Satellite Communication**

- 500M ICs delivered to date

Expand in **5G mMIMO and mmW** with breakthrough GaN-on-Si PA technology

- Sampling lead customer in H2 2022

Expand engagements on **Cellular-IOT and Wi-Fi 6** FEMs & RF switches

- Multiple engagements currently ongoing

Source: ST

Supporting ST $20B+ revenue ambition

Two strong pillars of growth

STM32 and GHz Wireless RF Front-End & Beamformer

STM32: Leveraging our established customer base and STM32Cube ecosystem to expand the SAM of the franchise

GHz Wireless: leveraging ST technology innovation and leadership to build new product lines in fast growing markets

Strong potential for **incremental revenue** over next 5 years, accretive to company operating margin targets

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Our technology starts with You

Find out more at www.st.com

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