FIBER NETWORK COUNCIL APAC

2023 Innovation Panorama

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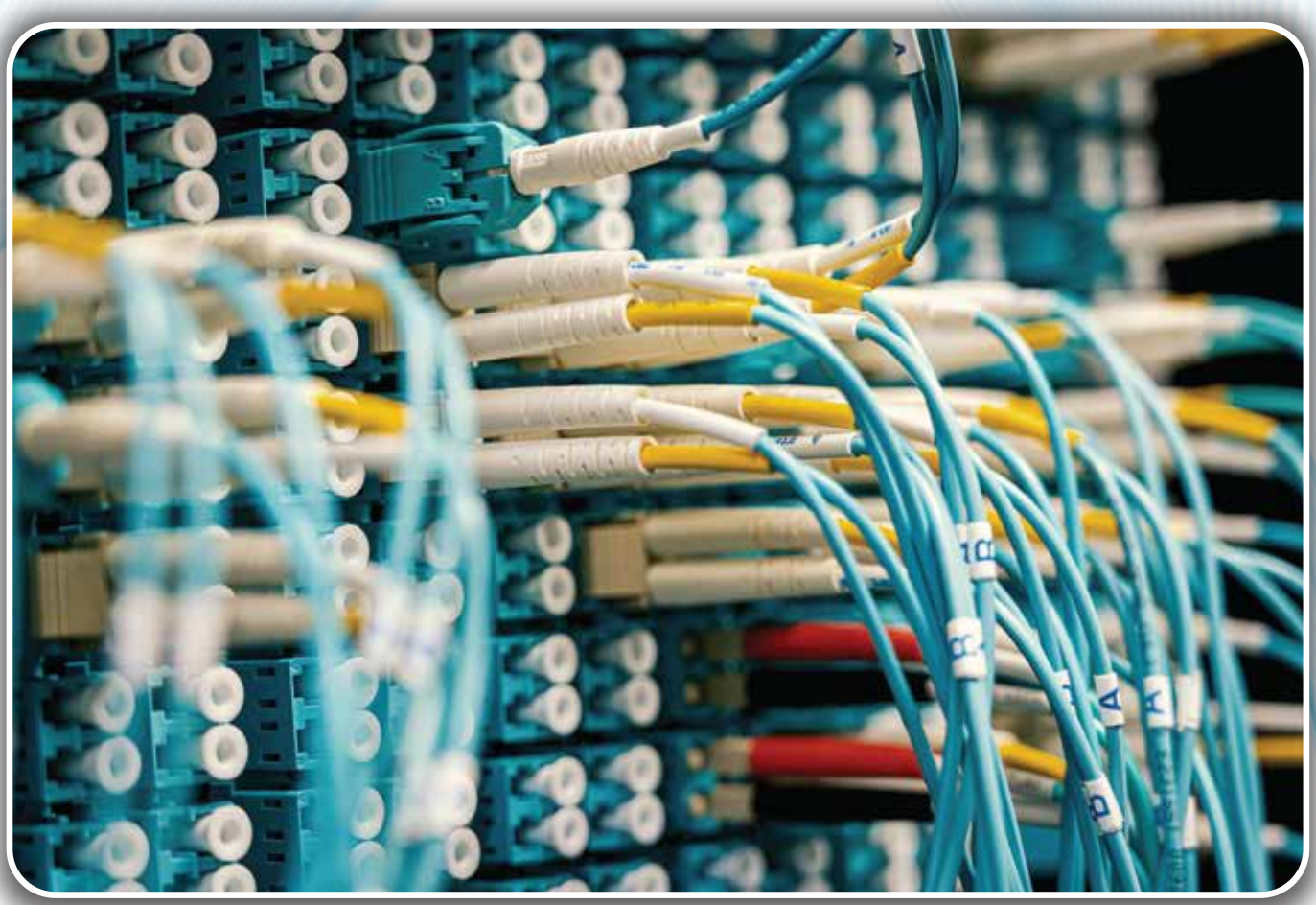
FTTH/B Market Panorama APAC

21 countries analysis



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STUDY BACKGROUND

Important Definitions

Premise :	A house or building, that could be connected by an FTTH/FTTHB network
Homes Passed :	The potential number of Premises which a Service Provider has capability to connect to an FTTH/FTTB network in a service area with minimal additional installation
Sockets :	The In-Home connection point of a single fibre service provider inside a premises. It is possible to have multiple sockets if the location is serviced by multiple FTTH network operators
Subscribers :	The number of Premises which are connected to a network and are already subscribers
Take Up rate :	Subscribers – as a proportion of Homes Passed
Coverage rate :	Homes passed – as a proportion of Total Households
Penetration rate :	Subscribers – as a proportion of Total Households

Methodology

* Mission on behalf of the FTTH Council Asia Pacific

* Provide a complete summary of the FTTH/B status in 21 countries in Asia-Pacific at June 2023

ACTIONS

Scope

* Analysis of **21 countries***
* **Data per player** for FTTH/B and other fibre-based architectures
* Distinction between architecture: FTTH/B vs FTTx (FTTN/C+VDSL, FTTLA+Docsis 3.x)
* Key parameters study: technical, financial, business models, figures

Bottom-up methodology

* Desk research
* **Direct contacts** with leading players and IDATE partners within countries
* Information exchange with the FTTH Council APAC members

Results

* Both quantitative and qualitative data
* Market status in the country
* Strategic approach of involved players

GENERAL OVERVIEW AND MAIN TRENDS

FTTH/B Market Panorama in Asia Pacific

Key Figures as at June 2023

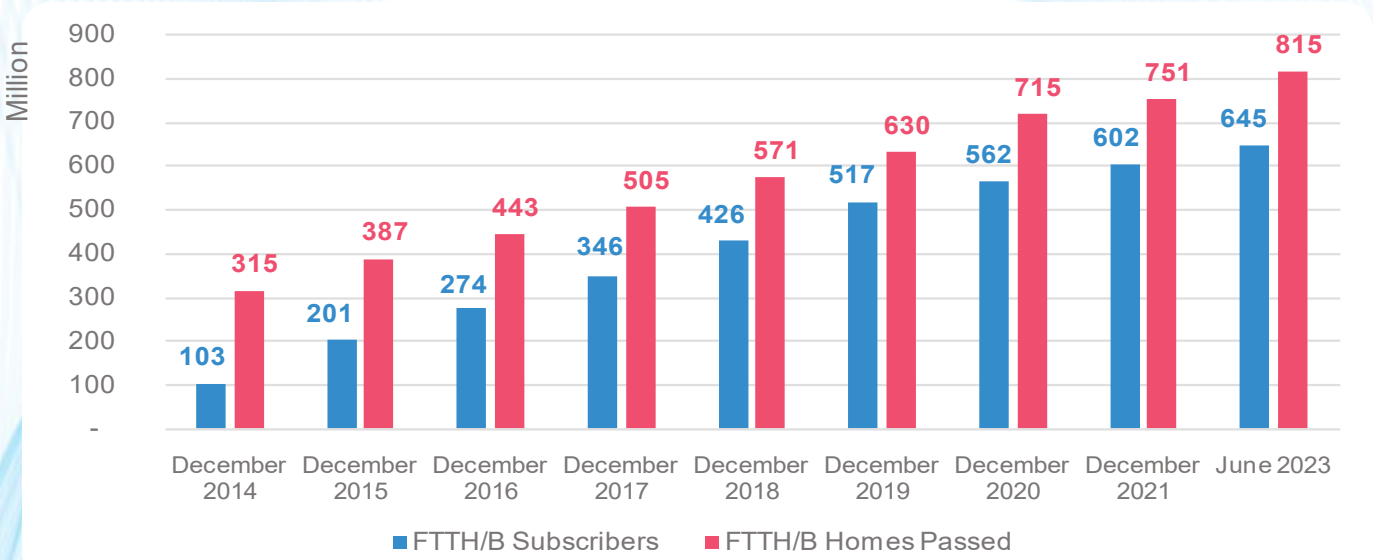
As at June 2023, in APAC-21(*):

645 million FTTH/B subscribers (+7.1% vs 2021)

815 million FTTH/B Homes Passed (+7.9% vs 2021)

FTTH/B market evolution in Asia Pacific (APAC-21)

In terms of Homes Passed and Subscribers (2014 - 2023)

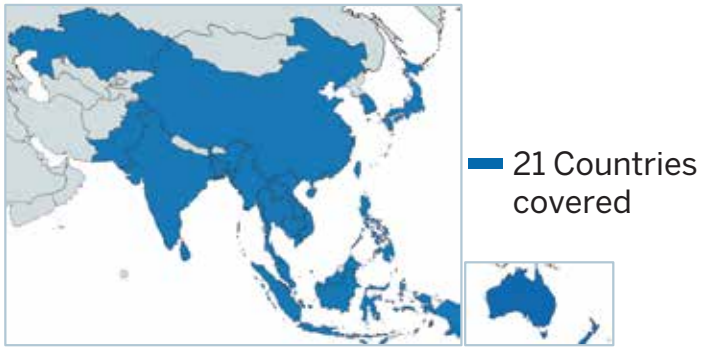


Trends from 2014 to 2023 :

Subscribers' evolution **X 6.3**

Homes Passed evolution **X2.6**

Detailed FTTH/B Market Panorama scope



21 Countries covered

APAC - 21 = Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Laos, Malaysia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam

Coverage rate 69.9% (+ 4% vs 2021)

Coverage rate 69.9% (+ 4% vs 2021)

A fall in the take-up rate explained by a **strong acceleration of fibre deployment compared with subscription.** Several countries have made significant progress since December 2021 such as : **Australia, Malaysia, India, Indonesia, Philippines and Thailand.**

FTTH/B Market Panorama in APAC

FTTH/B markets – Coverage - June 2023

Market category
In terms of coverage rate*

Mature & Dynamic markets


China


Hong Kong


Japan


Malaysia


New Zealand


Philippines


Taiwan


Thailand


Singapore


South Korea


Vietnam

FTTH/B coverage > 80%

Medium and growing markets


Australia


Indonesia


Kazakhstan


Sri Lanka

FTTH/B Coverage 30% > 80%

High Potential markets with significant announcements and/or progress


India


Laos


Pakistan

FTTH/B Coverage < 30%

(*) Excluding countries with non available data

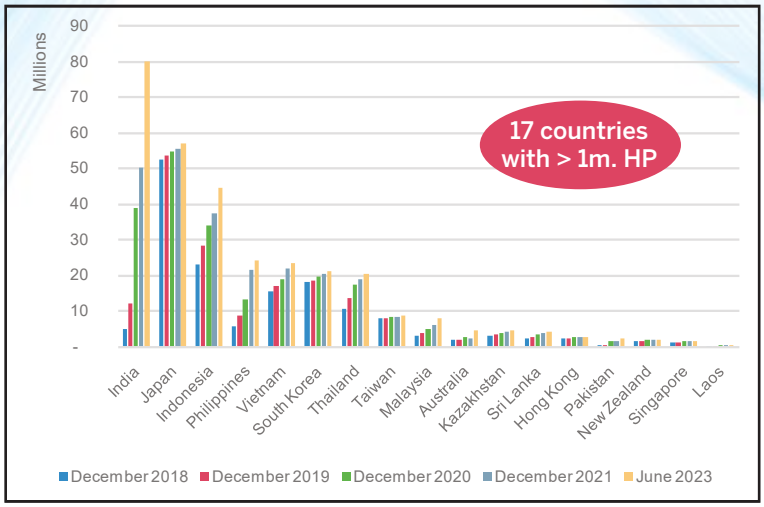
APAC : FTTH/B STATUS AND LEADING COUNTRIES

FTTH/B Homes Passed

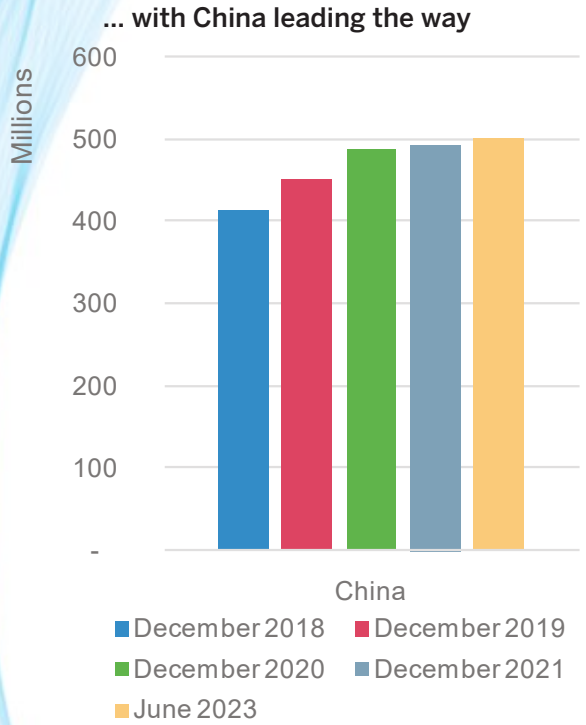
Significant growth in Australia and India

APAC Ranking* - FTTH/B Homes Passed over time (in million)

Data comparison between Dec.2018 and June 2023 **

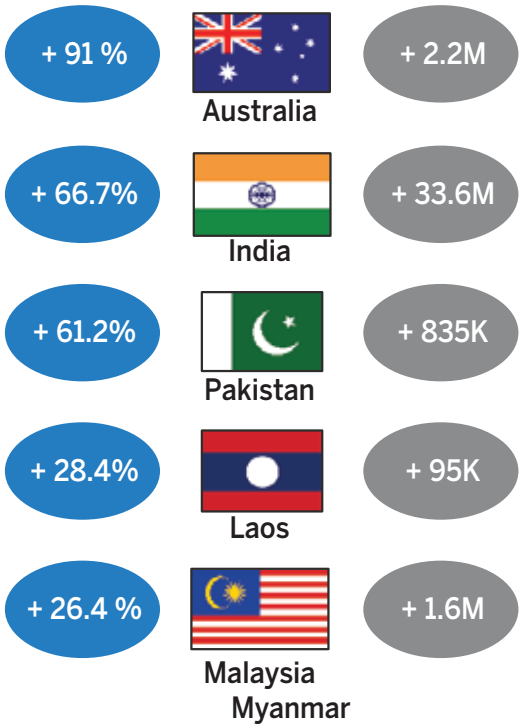


... with China leading the way



Top 5 growth rates – Homes Passed (in %)

Data from Dec. 2021 to June 2023



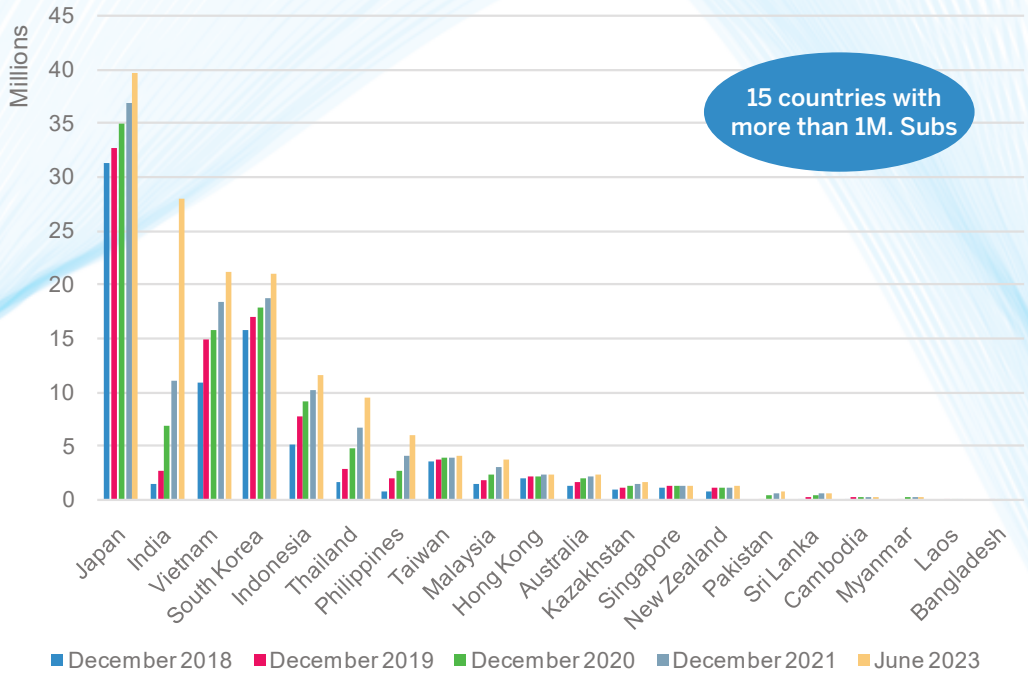
FIBER NETWORK COUNCIL APAC

FTTH/B Subscribers

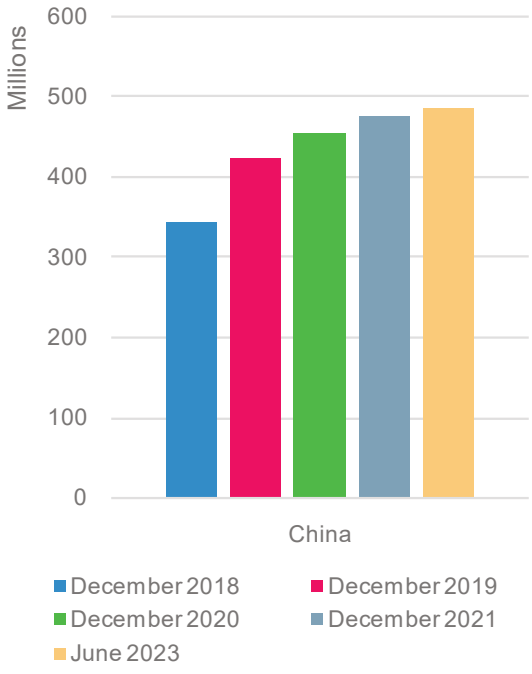
India : strong growth for subscribers

APAC Ranking* - FTTH/B Subscribers over time (in million)

Data comparison between Dec.2018 and June 2023 **



... with China leading the way



Top 5 growth rates – Subscribers (in %)

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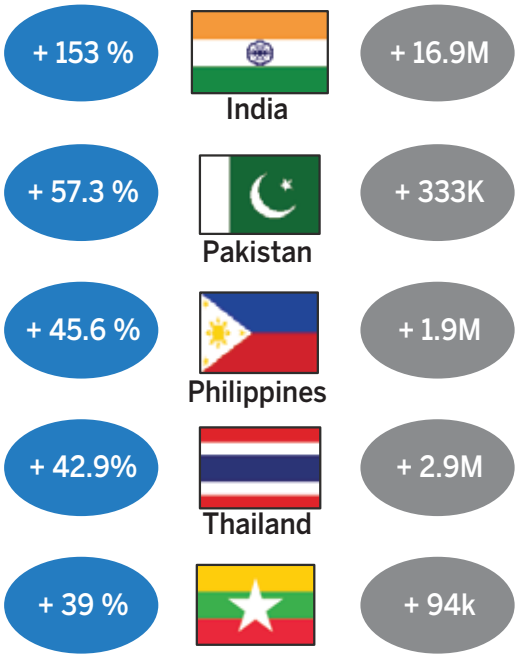
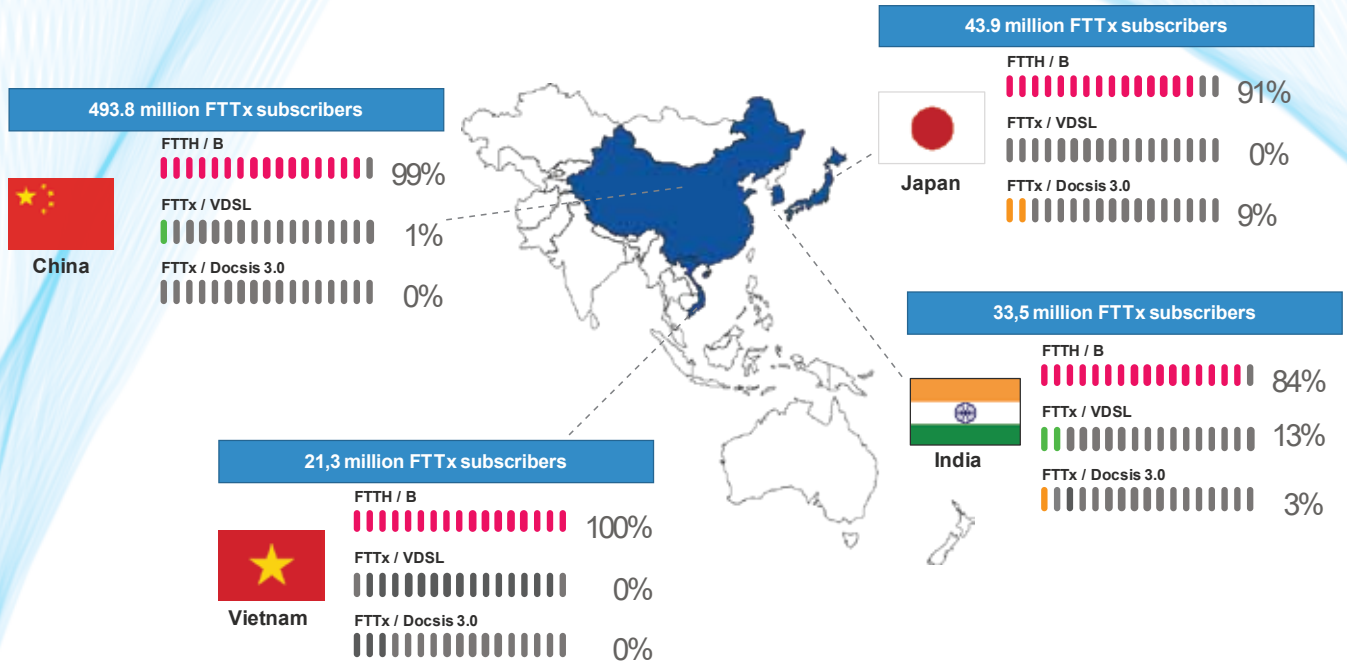


FTTH/B Subscribers

Major Asian countries are moving forward with FTTH/B deployments



FTTH/B Take-up rates*

Summary map

FTTH/B take-up map – June 2023

(Subscribers / Homes Passed)

Some countries can experience **a lower Take-up rates** rate due to strong acceleration of fiber deployment compared with subscription.

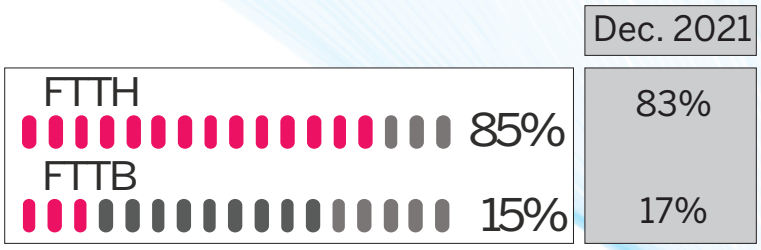
The following countries have made significant progress in terms of homes passed since December 2021 and deserve a special mention :

- **Australia**
- **India**
- **Indonesia**
- **Malaysia**
- **Philippines**
- **Thailand**

FTTH/B Technical Trends

FTTH vs FTTB

APAC has concentrated its consolidating its efforts to deploy full fiber solution the end user. More countries are migrating legacy networks towards full FTTH solutions.



* Fiber is now deployed inside MDU (Risers)

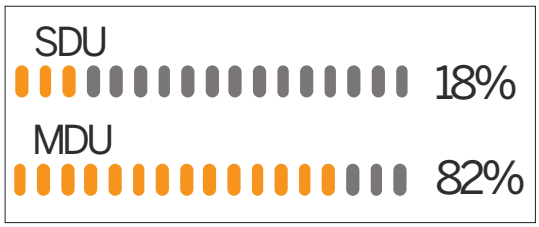
PON vs Ethernet P2P

APAC-21 countries are concentrated in the deployment of PON technologies. Now its observed the announcement of new XGPON projects to reach 10G services.

* FTTH GPON maintained as the norm in APAC countries
* 10 GPON now being massively deployed

SDU vs MDU

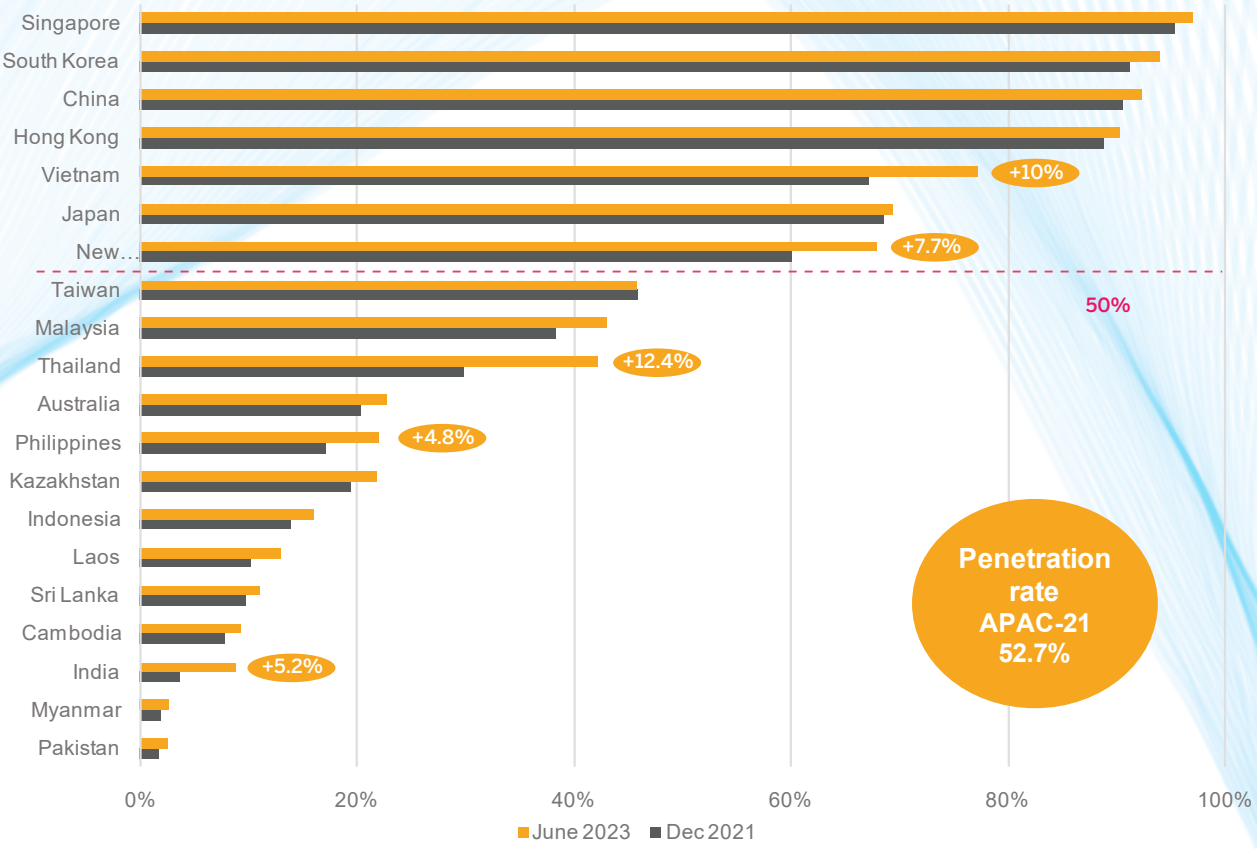
Countries in APAC tend to have a highly concentrated population, thus explaining the predominance of MDU architecture in the region



FTTH/B Ranking

APAC ranking as at June 2023

Penetration rates* of APAC-21 countries – June 2023 (FTTH/B Subscriptions / Households)



(*)Some countries can experience a lower penetration rates rate due to historical data readjustments

- Includes countries of +200k Households in which FTTH/B subscribers represent at least 1% of total households
- **Vietnam, Thailand, New Zealand, India, and Philippines** made significant progress since 2021.
- The migration from legacy networks towards full fiber networks is now accelerating in countries like Vietnam, Indonesia and Philippines.

KEY CONCLUSIONS

APAC : FTTH/B Panorama

Keys conclusions

815 million homes passed by full-fiber infrastructure in the total region, with 645 million FTTH subscriptions

Homes Passed - Subscription

Singapore, South Korea and China are still the three main leaders in APAC in terms penetration rates. China remains the largest FTTH/B market in APAC. China is home to approximately 76% of total FTTH/B subscribers in Asia-Pacific.

Leading countries

Several countries have made significant progress in terms of homes passed since December 2021 such as : Australia, India, Indonesia, Malaysia, Philippines and Thailand

Significant progress

The effort is now made on fiber adoption among Fixed Broadband subscribers in countries where coverage is almost complete nationwide (Singapore, Taiwan, Japan, Hong Kong).

Take-up

FTTH/B technologies are predominant in most Asian countries. Fiber is still in its nascent phase in several densely populated countries of the region, such as India, Bangladesh or Malaysia. The transition towards fiber is often challenged by the predominance of copper networks.

Technology

5G Mini Panorama APAC

Key facts

5G reaches more than early adopters in advanced countries, touches less advanced markets with technology improvements

- **5G** was launched in 2018 by a small number of players, with deployments really kicking off in 2019 and 2020. Many MNOs switched to 5G in 2019 following the introduction of 5G-enabled smartphones and devices. South Korea was the first country to benefit from full 5G. 2020 was the year of 5G confirmation with many commercial launches, trials and deployments. As of mid-2023, 15 countries are enjoying commercial 5G services in the APAC region*.
- **Technologically, most of the current commercial 5G networks are Non-Stand-Alone (NSA) networks. Some SA networks emerge.** The idea of the players is to shorten time-to-market and enable data and bandwidth-intensive services (video streaming, AR/VR, immersive media). The NSA architecture enables new spectrum to be used and maximizes the installed 4G infrastructure.
- **Most commercial 5G networks use mid-band frequencies at 3.5 GHz; some use millimeter wave or low frequency. Dynamic spectrum sharing is being introduced to take advantage of low frequencies.**
- **5G adoption is faster than previous generations.** Adoption continues to grow at a rapid pace in advanced markets: consumer interest increases and becomes more demanding where 5G is touching beyond early adopters, coverage is expanding, and the range of compatible smartphones is widening. Some markets have seen rapid adoption: players have launched plans with attractive pricing. Other players have promoted plans with added value (content, quality of service, higher speeds).
- **Subscriber uptake is particularly impressive in China and in South Korea.** These two countries are expected to have 30% and 42% 5G share of connections (5G subscriptions/total mobile subscriptions) by the end of December 2023, respectively.
- **Asia-Pacific will account for the lion's share of 5G subscriptions and revenue.** The volume effect is in full swing in China and comes to India: Bharti launched commercial services late 2022; more Indian players are expected to launch services in 2023. It will push Asia-Pacific 5G subscriptions to exceed 1 billion in 2023. By mid-2023, China accounts for the majority of Asian 5G subscriptions. This share will decline over the next five years.
- **5G supports a variety of use cases, but eMBB services will drive 5G growth over the next few years.** In the longer term, the share of other use cases will increase. Previous mobile technologies did not have the potential to generate as much global growth in verticals as 5G. 5G doesn't just give people faster speeds to browse the internet. It is expected to help or drive the next industrial (r)evolution and connect billions of objects.

Countries under study: Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Laos, Malaysia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam,

5G APAC Panorama

5G commercial launches in APAC

5G networks are gaining momentum

APAC 5G markets scope

15 countries with commercial availability

Commercial availability

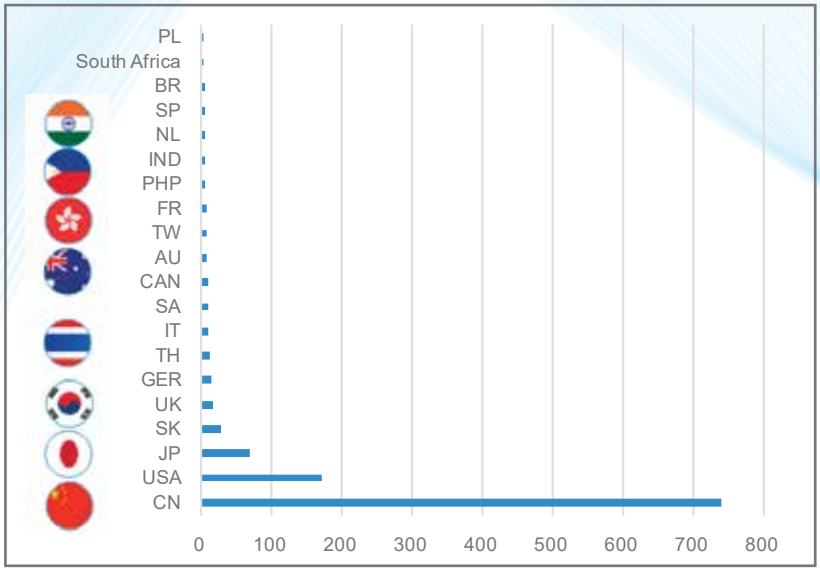
Commercial availability	Expected 5G launches
Asia-Pacific: • Australia • China • Hong Kong • India • Indonesia • Japan • Laos • Malaysia • New Zealand • Philippines • Singapore • South Korea • Sri Lanka • Taiwan • Thailand	**Asia-Pacific:** **2023:** • Bangladesh • Cambodia • Kazakhstan • Vietnam **2024 and later:** • Myanmar • Pakistan

Subscriber numbers

China is leading the game by far – Three national players forming the Top 3

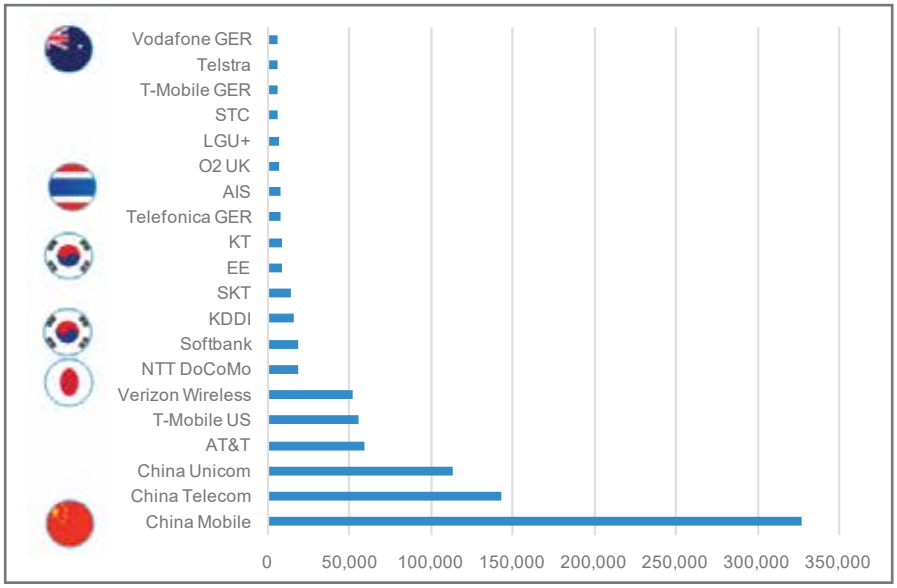
- South Korea and Japan follow China and the USA
  - **3 times more subscribers in China** than in the USA
- India steps in

Top leading countries by subscriber numbers (000, YE2021e)



Note: Number of subscribers for China have been reassessed early 2022 to identify 5G users. Official figures do not always collect 5G users but 5G device holders or 5G price plans holders

Top leading players by number of subscribers (000, December 2022)



Note: Number of subscribers for China have been reassessed early 2022 to identify 5G users. Official figures do not always collect 5G users but 5G device holders or 5G price plans holders

China, Japan, South Korea: major 5G deployments in APAC (1/3)

China's figures are impressive: 2.73 million 5G base stations have been deployed

> All prefecture level cities, all county and urban areas...

> 87% of townships covered

Overview of 5G coverage progress by country (coverage, number of base stations, number of people covered)

Country	Operator	Launch date	Coverage
CHINA 	China Mobile	November 2019	**December 2021:** 730,000 base stations deployed **June 2022:** 1 million base stations deployed **July 2023:** 1.7 million 5G base stations deployed (85% of population covered)
	China Telecom	November 2019	**December 2021:** 690,000 base stations deployed **June 2022:** 870,000 base stations deployed **May 2023:** more than 1 million base stations deployed
	China Unicom	November 2019	**December 2021:** 690,000 base stations deployed **June 2022:** 870,000 base stations deployed, 200,000 DAS **May 2023:** 1 million base stations deployed
	China Broadnet	June 2022	**October 2022:** nationwide coverage reached **April 2023:** 680.000 700 MHz base stations deployed, 31 provinces with full coverage

China, Japan, South Korea: major 5G deployments in APAC (2/3)

While 5G NSA coverage reached 90% in June 2022, SA coverage starts in Japan

> In the first half 2022, the government set a goal for 95% of the country population to be covered with 5G in 2024

Softbank announced it has already been reached in the first half 2022

> The MIC is considering auctioning 5G spectrum in the years to come

Overview of 5G coverage progress by country (coverage, number of base stations, number of people covered)

Country	Operator	Launch date	Coverage
JAPAN 	NTT DoCoMo	NSA: March 2020 SA: December 2021	**March 2022:** 45% of population covered **June 2022:** 60% of population covered with 5G NSA, main cities with 5G SA **June 2023:** an estimate 80% of the population covered with 5G
	KDDI	NSA: March 2020 SA: March 2022	**March 2022:** 90% coverage expected, soon, in the early part of FY ending March 2023 **June 2022:** an estimate of 50% population coverage with 5G NSA, 2 cities with 5G SA **June 2023:** an estimate 90% of the population coverage with 5G NSA
	SoftBank	NSA: March 2020 SA: October 2021	**March 2022:** 90% coverage expected before summer 2022 **June 2022:** 90% coverage reached with 5G NSA **June 2023:** an estimate 94% of the population coverage with 5G NSA and 60% with 5G SA
	Rakuten Mobile	NSA: September 2020 SA: October 2021	**September 2020:** parts of 6 Japanese prefectures **June 2022:** "thousands" of base stations for 5G NSA, coverage of Tokyo with mmWave spectrum **February 2023:** 7,058 5G base stations **June 2023:** an estimate 50% of population covered with 5G

China, Japan, South Korea: major 5G deployments in APAC (3/3)

In South Korea, 5G NSA covers 80%+ of the country population

> 5G NSA has already reached over 80% of the population and over 90% in Seoul

> 5G SA is currently being launched
5G SA coverage will be the next challenge

> Late in 2022, the Government cancelled KT and LGU+ rights to use 28 GHz spectrum in November 2022 due to lack of investment by players. SK Telecom will have its use time of the spectrum reduced by six months.
It is considering giving a 28 GHz license to a new player

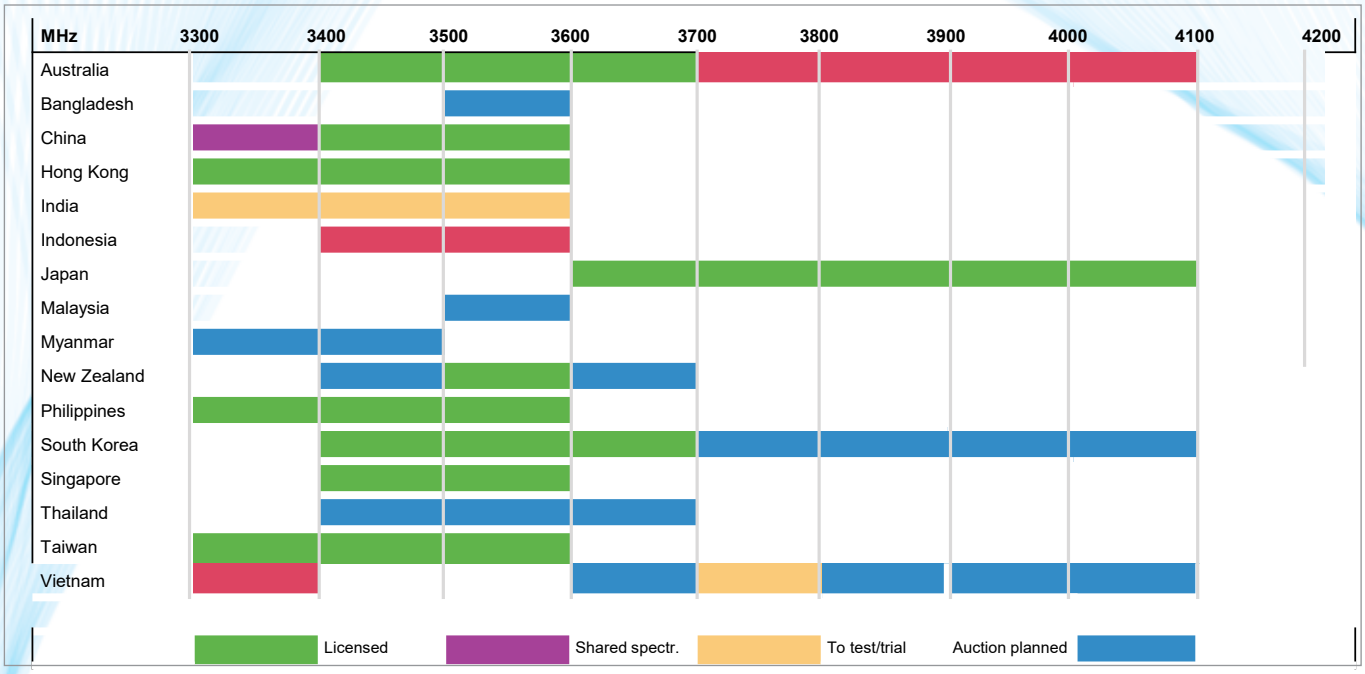
Overview of 5G coverage progress by country (coverage, number of base stations, number of people covered)

Country	Operator	Launch date	Coverage
SOUTH KOREA 	KT	NSA: April 2019 SA: July 2021	August 2021: 85 cities reached, over 90% population coverage in Seoul August 2022: Over 90% of population covered with 5G NSA
	LG Uplus	April 2019	
	SK Telecom	April 2019	

Spectrum – Assignments, plans and consultations

3.3-4.2 GHz – 3.5 GHz is the most favored spectrum band for 5G in APAC

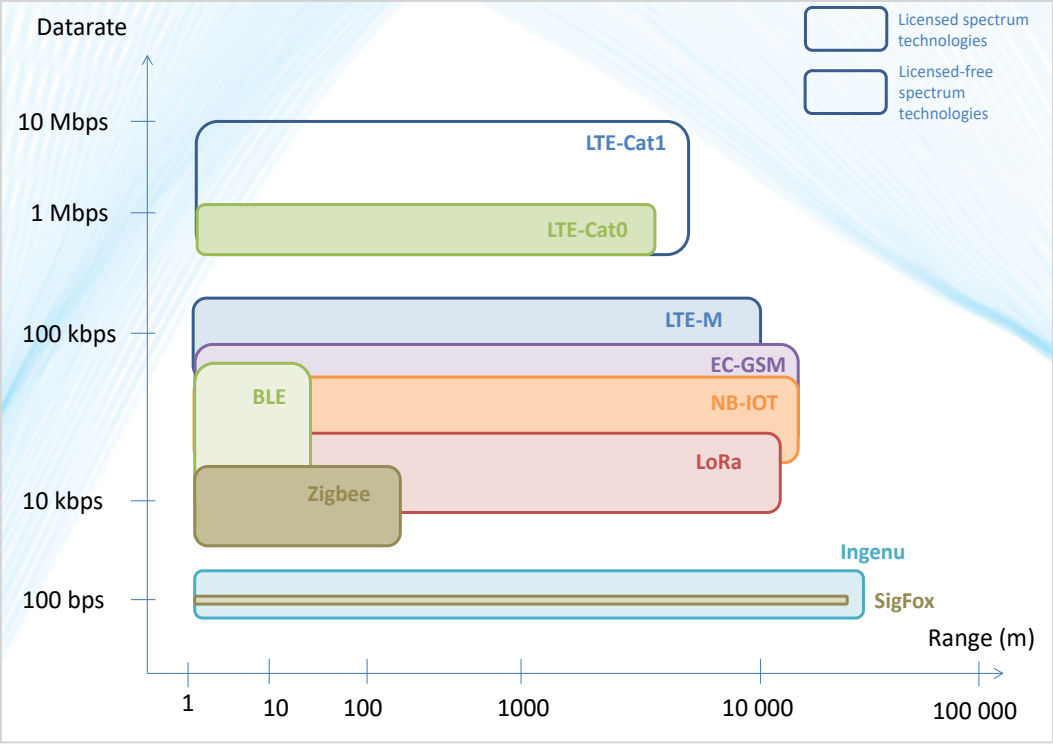
National spectrum in the C-band in Asia-Pacific



IoT Mini Panorama APAC

Today, many technologies are designed for IoT …

Mapping of key technologies, by data rate and by range



It will be recalled that IoT requirements rely on:

- Low energy consumption
- Long range
- Low cost as it involves billions of objects

Main technologies considered for end-to-end (E2E) communication between the object and the Internet

- Cellular mobile networks
- LPWA

Today, many technologies are designed for IoT …

> Different technologies, different performances on multiple technologies

Technical elements for each LPWAN technology

	SIGFOX	LoRa	LTE- 0	LTE-M	NB-IoT
Frequency bands	868 MHz (EU) 915 MHz (USA) 470 MHz (China)	868 MHz (EU) 915 MHz (USA) 470 MHz (China)	LTE (20 MHz)	LTE (1 MHz)	LTE (200 KHz)
Range	Up to 40 km in rural areas	Up to 15 km	10-15 km	10-15 km	10-15 km
Bidirectional	Not really (acknowledged usage since mid-2015)	Yes	Yes	Yes	Yes
Data rate	100 bps	From 300 bps to 50 kbps	Up to 1 Mbps	From tens of kbps to 1 Mbps	Up to tens of kbps
Mobility support	-	-	Yes	Yes	No
Power consumption	Low	Low	Low	Low	Low
Frequency bands	868 MHz (EU) 915 MHz (USA) 470 MHz (China)	868 MHz (EU) 915 MHz (USA) 470 MHz (China)	LTE (20 MHz)	LTE (1 MHz)	LTE (200 KHz)

Source: IDATE, The World Cellular M2M Market, July 2023

> Telcos have started to take positions on technologies, sometimes on multiple technologies

Deployment details, by technology

	LPWA		Cellular-based technologies		
	SIGFOX	LoRa	LTE-0	LTE-M	NB-IoT
Deployments / trials and telco position	▪ Present as a standalone operator in over 20 countries around the world ▪ Partnership with Telefónica (2015)	▪ Deployed by telcos ▪ Mainly in Europe: Orange and ByT in France, Swisscom, KPN and Proximus overseas ▪ Also in Asia with SKT	▪ None	▪ Telcos positioned by US telcos AT&T and Verizon ▪ Also selected by KT	▪ First live commercial trial launched by Vodafone in Madrid in September 2016 ▪ Telcos positioned: AT&T and Verizon, Telecom Italia, China Mobile, China Telecom, China Unicom, Etisalat, Telefónica, LG U+, Orange Belgium

Source: IDATE, The World Cellular M2M Market, July 2023

5G is already gaining foothold too

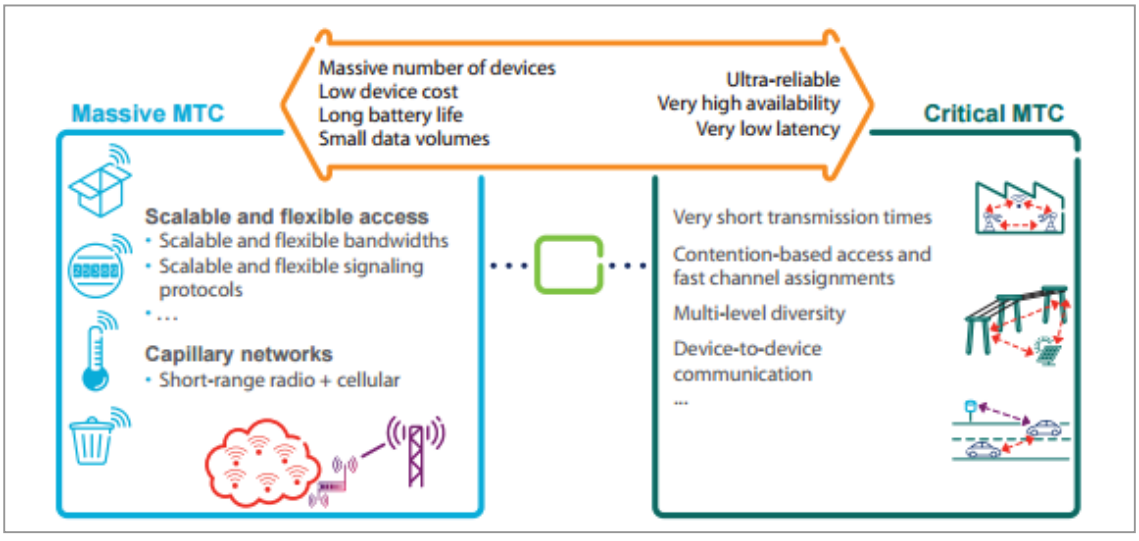
> Apart from faster mobile broadband, two categories of IoT (machine-type communications - MTC) applications to be supported by 5G

Key differences between Massive MTC and Critical MTC

	Massive MTC (M-MTC)	Critical MTC or ultra-reliable MTC
Number of devices supported	Very large	Not critical
Data transmission	Small amount and infrequent	Not critical
Bandwidth	Not critical	Large
Latency	Not critical	Very low
Reliable and availability	Not critical	Very high
Device cost	Extremely low	Not critical
Energy consumption	Very low	Not critical
Network connectivity	Local connectivity and mobile networks	Same mobile networks, same spectrum as other applications (no spectrum fragmentation)

Source: IDATE, The World Cellular M2M Market, July 2023

Requirements of massive IoT networks and time-critical networks in 5G specifications



Source: Ericsson 5G – Requirements and capabilities

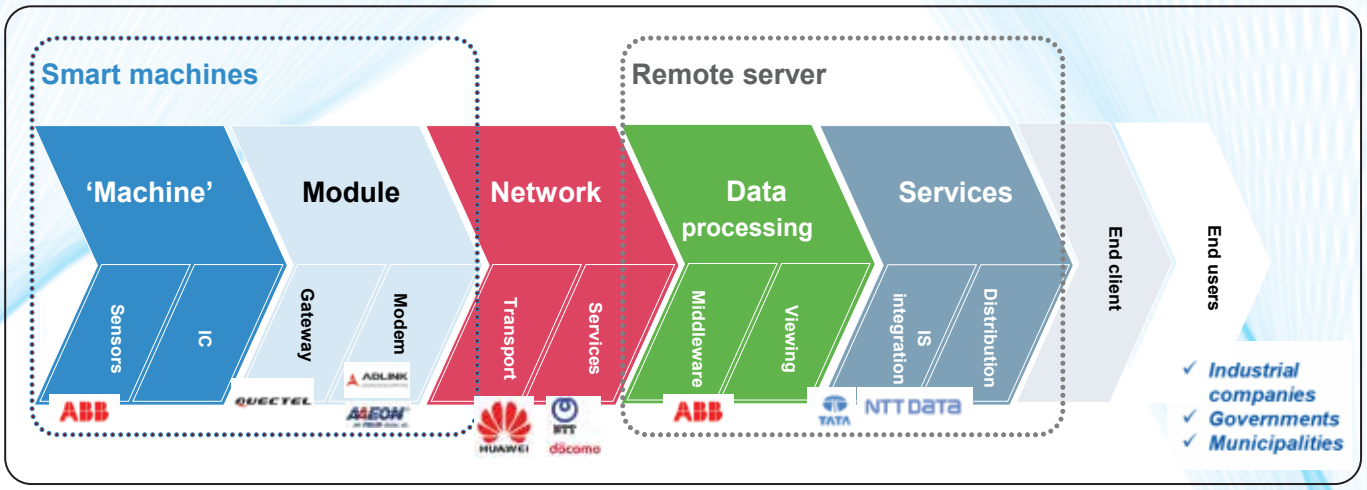
Source: GSMA

Market value chain

M2M/IoT market value chain is very fragmented

> The value chain lacks solid coherence – it could be rationalised into three main types of players

A combination of value chains, and some players from the APAC region



Source: IDATE, The World Cellular M2M Market, July 2023

- Electronic value chain
- Telecommunications value chain
- Computing value chain
- Value chain of the machines themselves

Three types of players

- Module manufacturers
- Communication providers
- Integrators

Source: IDATE from operators' financial releases

Overview of main market players

Asia-Pacific

Main market players in Asia-Pacific

	Geographical coverage	Quantitative elements (Active SIM cards base and/or related revenues)
China Mobile	China	1 billion IoT card customer base at end 2022 (806 million at end 2021 - +32% yoy)
China Telecom	China	407 millions IoT connexions for a revenue of RMB 4.01 billion (US$ 553 million) at end 2022, with IoT connections exceeding human connections for the first time
KDDI	Japan	30 million IoT connections at end 2022 (32 million at end March 2023)
NTT DoCoMo	Japan	No longer communicates any IoT data. A total base of more than 22 million in 2017
Telstra	Australia	6.4 million IoT cards as of December 2022 – 7.1 million as of June 2023 for FY 23 revenue of $ 283 millions (year ending June 23)
China Unicom	China	386 million IoT connections at end 2022 for revenue of RMB 8.6 billion (US$ 1.2 billion), with IoT connections first exceeding human connections

Source: IDATE, The World Cellular M2M Market, July 2023

Recent IoT data available

No recent disclosure of IoT KPIs

NB-IoT/LTE-M deployment examples in Asia-Pacific

Existing real-life use cases

> Pilots and existing solutions

- **Utilities** remain the main priority of telecom companies in terms of mobile IoT deployment

  NB-IoT has been actively tested by operators for smart metering:

  - Water metering by China Mobile with ZTE

  - Water and gas meters by China Telecom

- **Smart city** use cases: Huawei with Insigma Group bring NB-IoT to test street lights management

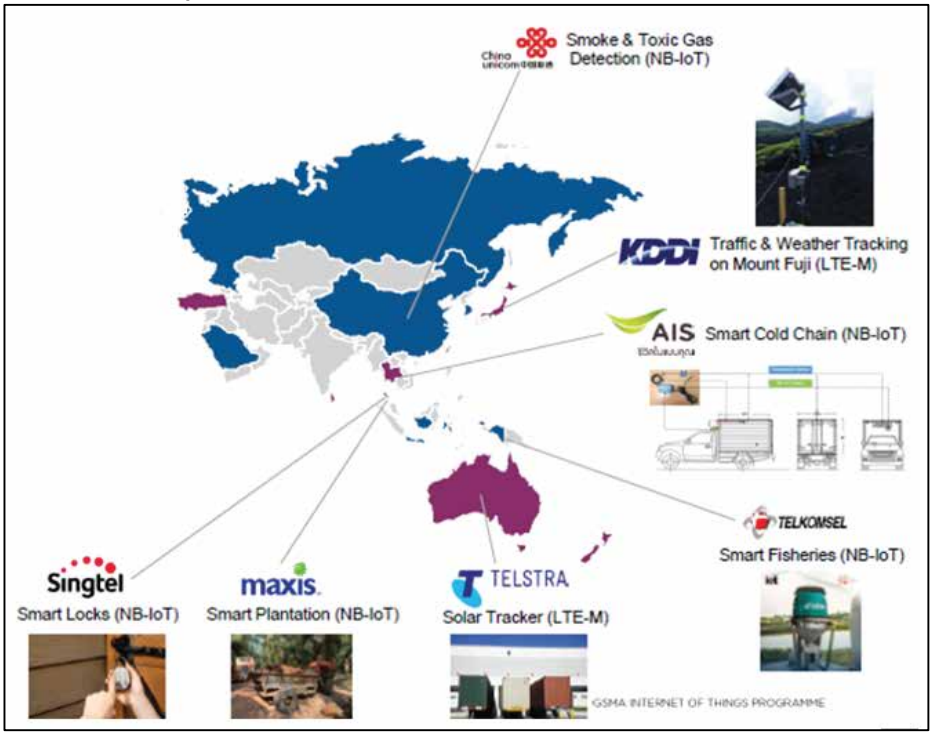
- **Agriculture:**

  - Pilots of connected sensors to enable farmers to monitor compost and irrigation systems with NB-IoT connectivity by Maxis

- **Public safety:** KDDI providing connectivity for weather conditions tracking at their Fuji Mount station (first with LoRa then switched to LTE-M)

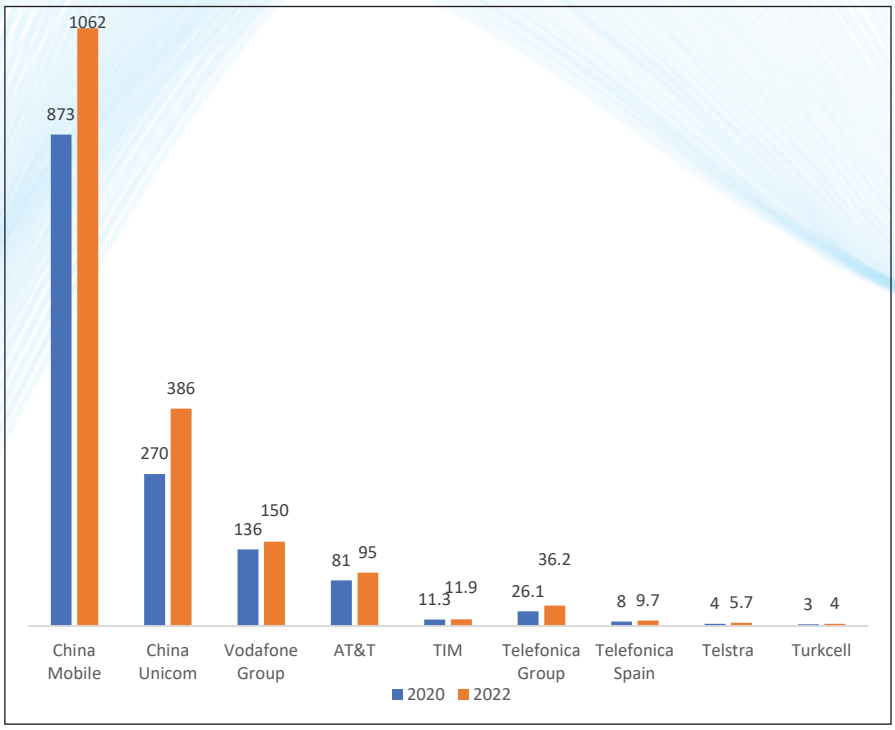
- **Security:** NB-IoT-connected smart locks by Singtel

Other examples of real-life use cases with NB-IoT and LTE-M



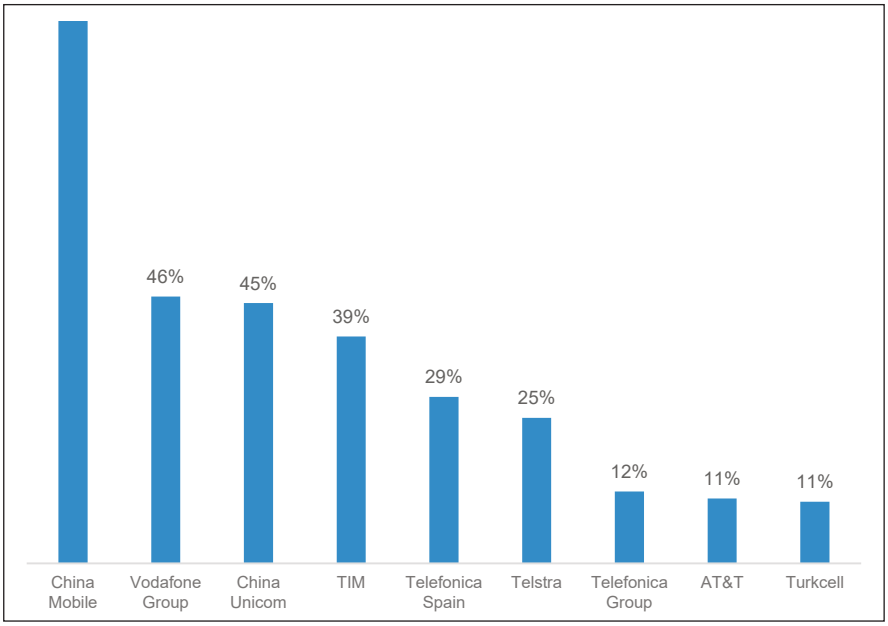
IoT connections are becoming an increasingly important part of operators' business in terms of the number of connections...

Evolution of IoT connections for selected operators for the 2020-2022 period (million connections)



Source: IDATE from operators' financial releases

Share of IoT connections in total mobile SIMs, 2022 only, %



Drivers and barriers

> Customer benefits (cost savings)

- ROI
- Higher customer satisfaction

> Solutions mostly based on very mature and well-deployed technologies (both technical and economical interests)

- Internet
- SMS
- GPRS

> Public policies and regulations adopted in some vertical markets

- eCall in automotive industry
- Smart grid and smart metering projects

> Telco involvement in this market

- Credibility (financial and technical)

> Impact of the COVID-19 crisis on many vertical markets including logistics, transportation and manufacturing amongst others

- While revenues are shrinking, investment in IoT is not the top priority for companies

> Education of the market

- Remains a key focus of concern > Cost is still a key issue
- High fixed costs (upfront costs)

> Security and privacy

- Cyber-attacks threats

> Improvements requirement for application

- Autonomy
- Network coverage
- Latency

> M2M market fragmentation

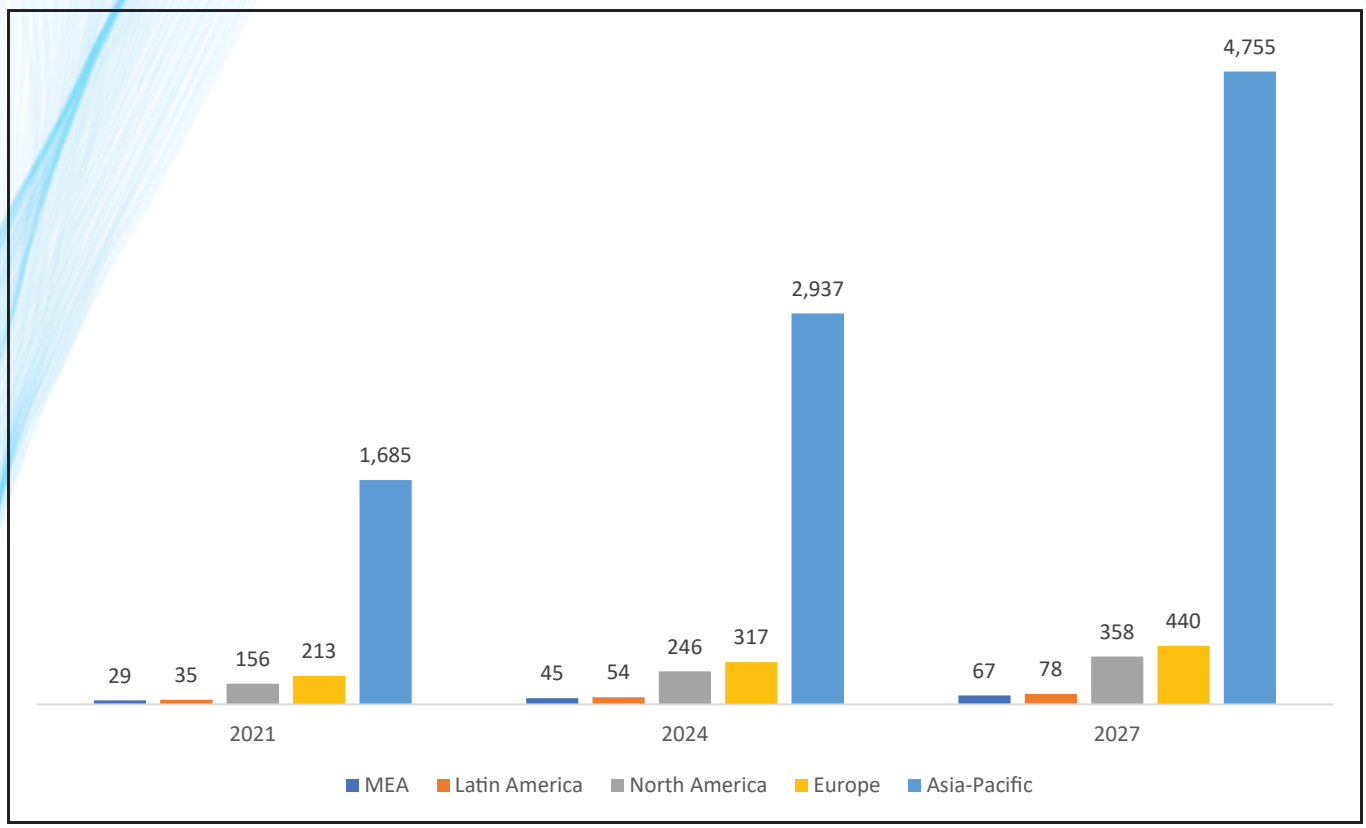
- Numerous technologies and players
- Complexity in both technical integration and supplier identification

The M2M module base is growing fast - but also very heterogeneous

> Asia-Pacific will continue to lead in volume and widen the gap with other regions

- Asia-Pacific will account for more than 80% of the total installed base in 2027.
- Gains for the APAC M2M market will come mainly from China.
  - China is the key driver of global M2M connectivity volumes, already accounting for around 70%+ of global M2M connections in 2021
  - In fact, China Mobile has reported 1 billion IoT connections by 2022.
- Europe is number 2, expected to reach 440 million modules by 2027
- MEA will have the lowest CAGR '20/'27 at 11.9%.

Cellular M2M modules/SIMs, by region (million units)



Source: IDATE, The World Cellular M2M Market, July 2023

Connectivity provider example: China Mobile

Offering and positioning in IoT markets

中国移动 China Mobile

Fast IoT facts

* **1 billion IoT** connections by the end of 2022 (873 million in 2020).
* **IoT revenues of EUR 1.9 billion** in FY2022.
* Strong focus on **NB-IoT network** deployment.

The world's largest M2M connectivity provider

* Along with China Telecom, China Mobile is one of the operators that has been most active in promoting NB-IoT connectivity.
* Although China Mobile's total M2M SIM card fleet declined by 1.2% in 2020, the Chinese operator remains the world's largest provider of IoT connectivity in terms of the number of devices connected to its network.
* The OneNet platform provides 'classic' telco IoT services, comprising three key blocks: connectivity management, device management and application enablement.
* The platform is used in a wide range of industries including automotive, manufacturing, environmental monitoring, agriculture and energy.
* With its application development capabilities, OneNet enables companies to tailor IoT to specific use cases.
* The platform also offers artificial intelligence and AI integration capabilities.

Example of China Mobile's OneNet IoT platform applied to healthcare

Source: China Mobile

Research Partner

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