



**FTTH Asia-Pacific Market Panorama
&
Asia-Pacific 4G/5G Mini Panorama
December 2017**

Membership Information



Who can become Member?

Membership to the FTTH Council is open to companies interested in leading the FTTH revolution! Any company, business entity, non-profit organization, academia or individual that is involved in the development, production, deployment, service, maintenance or analysis of FTTH networks or FTTH network components is welcomed as our member.

Membership Guideline

Platinum and Gold class membership are available for commercial profit based organizations and companies.

Silver membership is created especially for non-profit institutions, certified educational institutions like universities, govt. institutions.

Advisory membership tier is especially created for the Government organizations and Telecom Regulators across APAC region at zero membership fee.

Category	Platinum	Gold	Silver	Advisory
Annual Fee	5,000 USD	3,000 USD	1,000 USD	Free
Representatives	7	4	1	2
Attend Council Workshop and Seminar	✓	✓	✓	✓
Attend Annual Conference (At Member's Discounted Rate)	✓	✓	✓	✓
Attend General Meetings	✓	✓	✓	✓
Attend Committee Meetings	✓	✓	✓	✓
Chair a Committee	✓	✓	✓	✓
Hold a Board Seat	✓			
Have Voting Rights	Annual Meeting - Special Meeting Working Committee	Working Committee	Working Committee	Working Committee
Access to Working Documents	✓	✓	✓	✓
Access to Technical Reports	✓	✓	✓	✓

Membership Benefits

- Opportunities to promote your company to the industry
- Review the latest market analysis & projections
- Stay up-to-date on cutting-edge technologies
- Participating Annual Conference, Workshop, Seminar and General Meeting
- Networking opportunities: By joining one of our Working Committees you are able to work together with experts from all the leading FTTH related companies in Asia-Pacific. Benefit from new contacts, open discussions and new insights!

Join now!

1. Visit the Council website www.ftthcouncilap.org and submit the online membership application.
2. Your application is submitted to our membership committee for a formal voting procedure, then final approval is taken by Board of Directors.
3. You get a confirmation of your membership and are welcome as a new member in our organization!

Governance

FTTH Council Asia-pacific consists of approximately 60 company members, around 200 delegates and a six - member Board of Directors.

The FTTH Council Asia-Pacific has 4 working committees which focuses on developing the case for Fiber connectivity through a range of materials and activities.

Committee	Purpose
Membership	Provide a process that encourages the growth of membership and plans the events
Technology & Regulation	Promote the awareness and business implication of active system, passive components and deployment techniques of FTTH network.
Education & Training	Promote the FTTH Council APAC as a trusted & impartial central source for knowledge, facts, education and perspectives on FTTH.
Smart Cities	Provides knowledge and best practices to assist with fiber infrastructure for Smart City projects.

FTTH Council Global Alliance (FCGA)



Website: www.ftthcouncilap.org
Contact: info@ftthcouncilap.org

Updated in May 2018

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• Market trends for FTTH/B in APAC

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Version 1.0, Published in May 2018

FTTH/B in Asia-Pacific

A year where alternative ISP and Incumbents are leading the FTTH/B evolution. In addition National programs as a way to consolidate fiber in the region

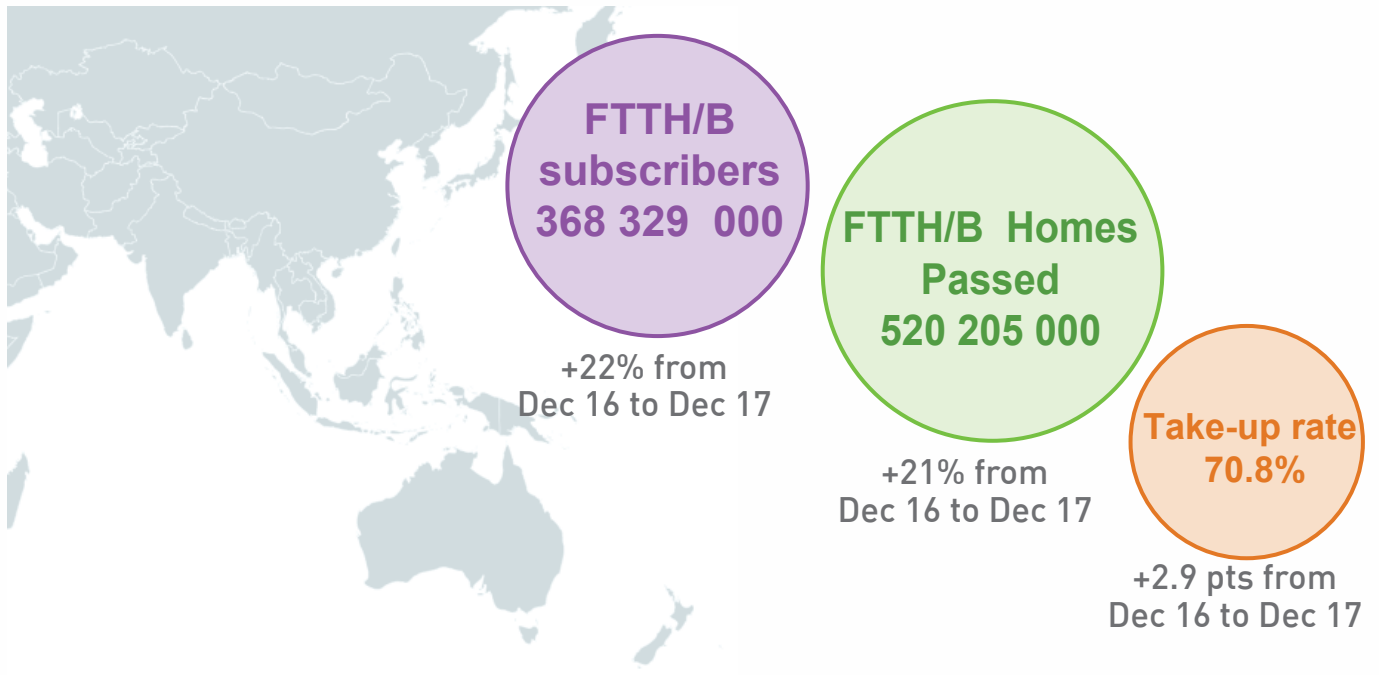
- A positive evolution: **111** FTTx projects in the region **(+18% from 4Q16)**
- Incumbents and public initiatives are leading these fiber projects, however alternative players evolved with new projects in 2017:
 - Incumbents growth rate: **18.75%** representing more than **64%** of the initiatives
 - Alternative operators growth rate: **14.5%** representing more than **34%** of the initiatives
 - National Programs as a key strategy to improve fiber coverage in Australia, New Zealand and Singapore

Source: IDATE for FTTH Council APAC

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FTTH/B in Asia-Pacific

APAC is a region with a huge evolution of FTTH/B due to a positive evolution in the deployment and specially in the user's adoption

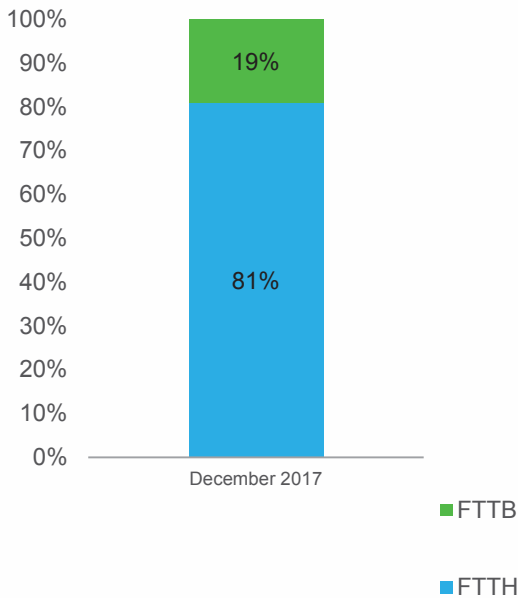


Take up rate = FTTH-B subs / Total FTTH-B Homes Passed

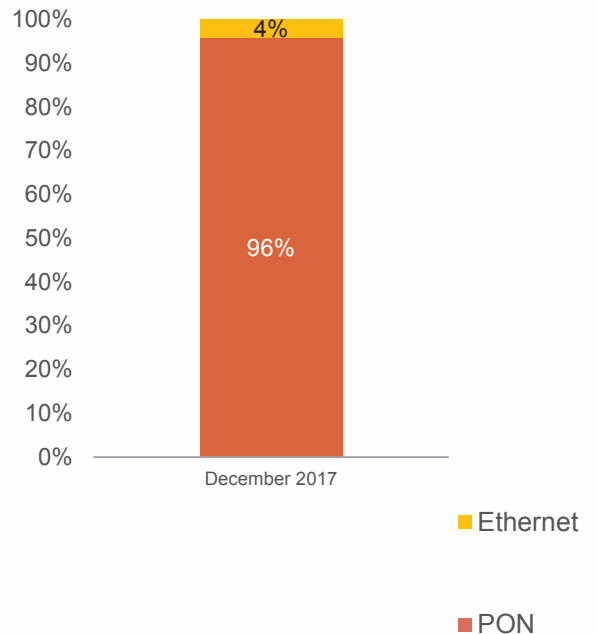
FTTH/B in Asia-Pacific

FTTH deployments over PON were moving forward deployments in APAC during 2017

Main Architecture Deployed (*) in % by Dec 2017



Main Technology Deployed (*) in % by Dec 2017



*Home Passed segmentation

Source: IDATE for FTTH Council APAC

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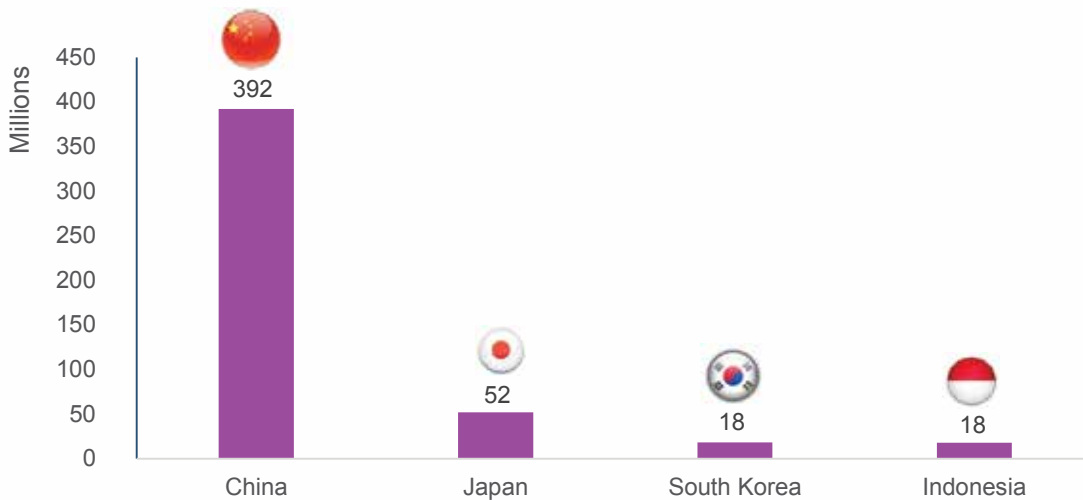
APAC FTTH/B leading countries

Total FTTH/B Homes Passed by country

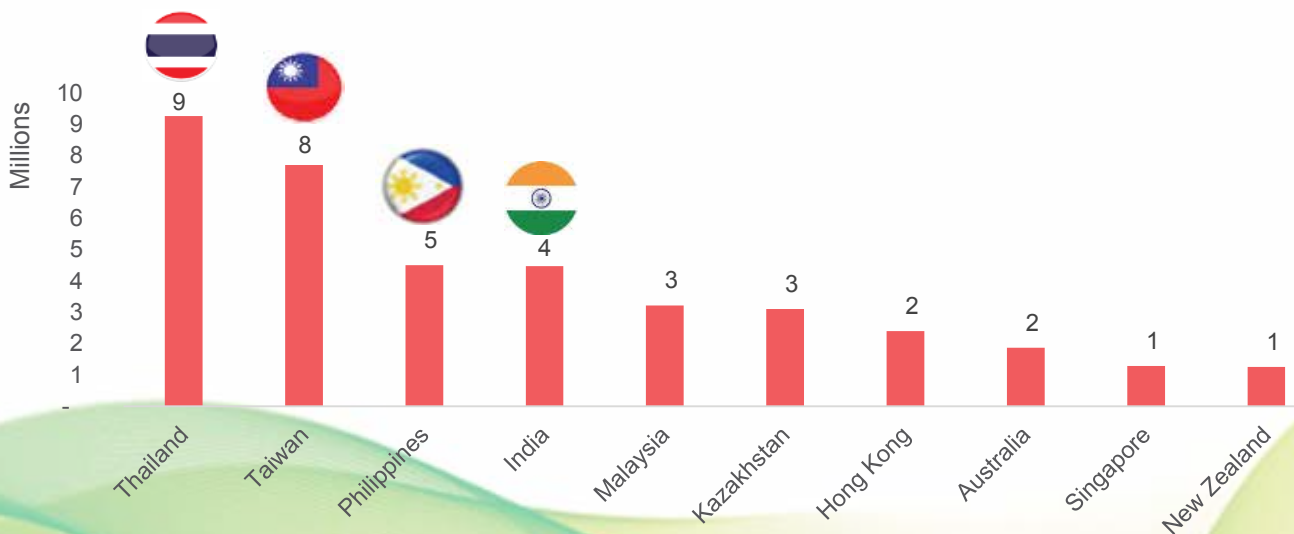
Top 4: China is leading the region in terms of homes passed.

However there are countries with more than 10 million homes passed: Japan, South Korea, Indonesia and also Vietnam.

The largest market worldwide. Important network overlapping. Coverage higher than Govt's objectives



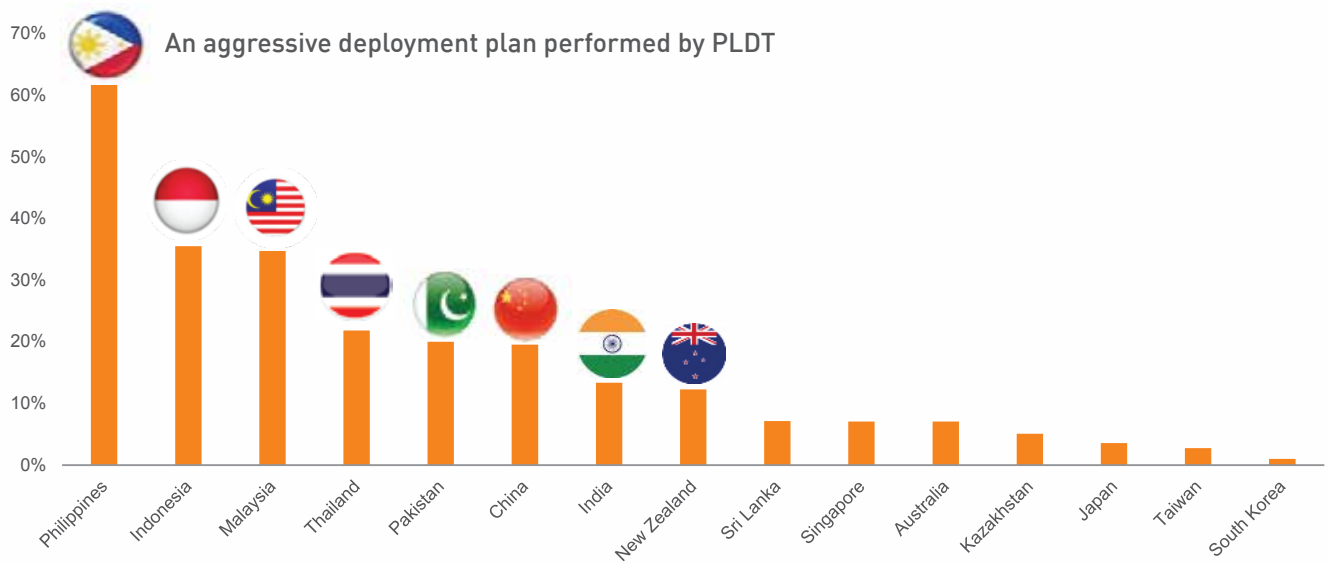
Also it can be observed 10 countries that have deployed FTTH/B networks passing more than 1 million homes



APAC FTTH/B leading countries

Philippines is the leader in terms of new homes passed during 2017 followed by Indonesia, Malaysia and Thailand

% variation from December 2016 to December 2017 in the number of FTTH/B Homes Passed by country

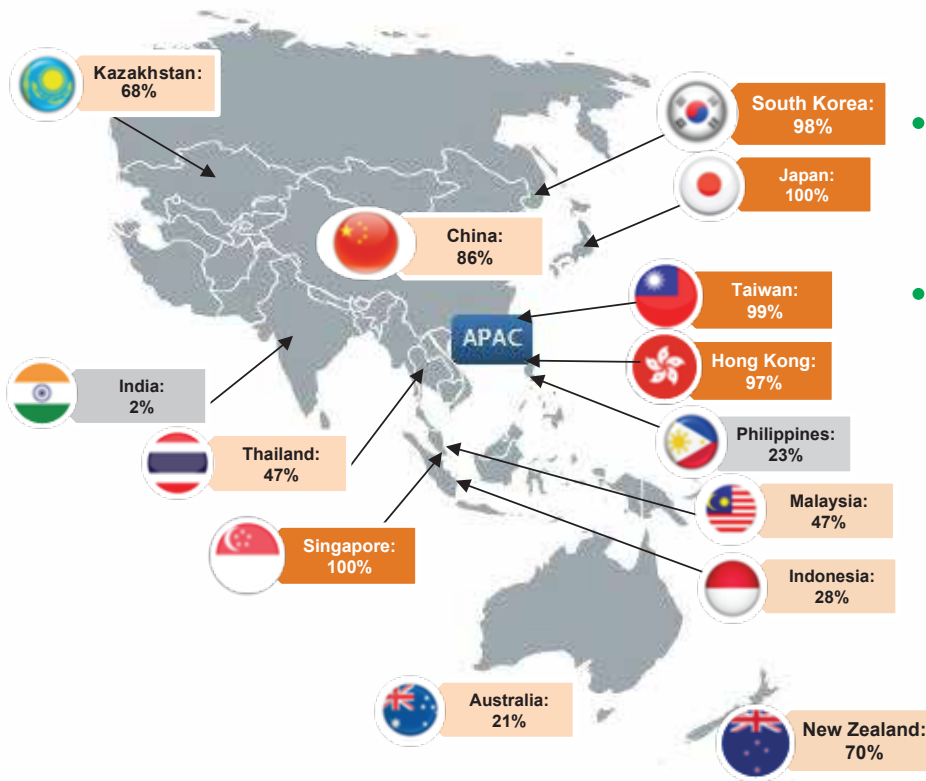


Source: IDATE for FTTH Council APAC

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APAC FTTH/B leading countries

Top countries in terms of % of FTTH/B Homes Passed in total Households



- Number of Homes Passed not representative of effective coverage
- Here, the ratio represented is % of FTTH/B Homes Passed in total households

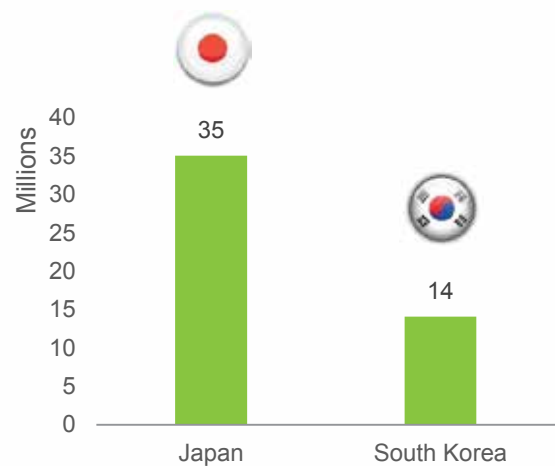
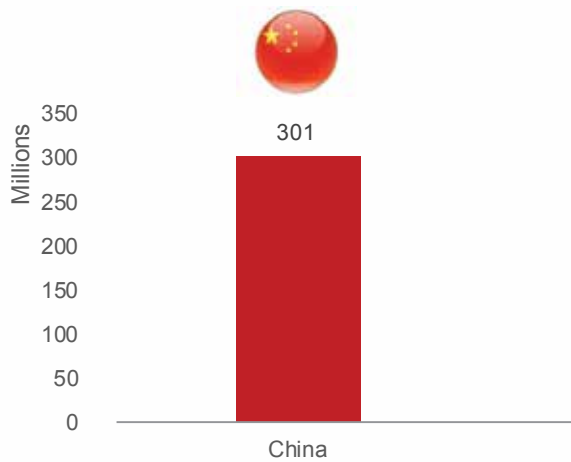
- 5 countries → 90% !!!
- 8 countries → 20%

APAC FTTH/B leading countries

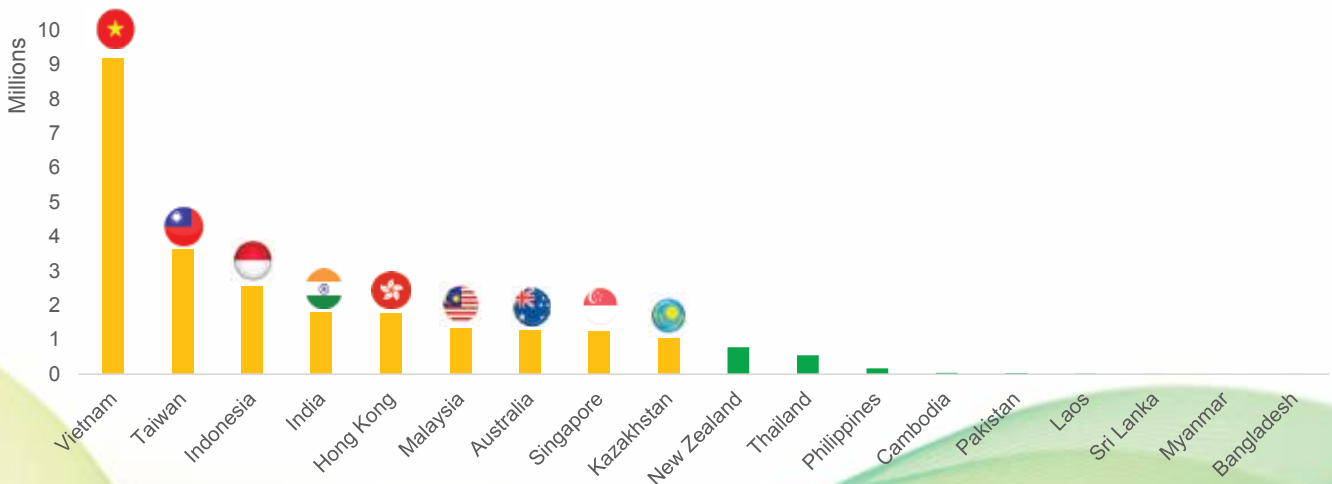
Total FTTH/B Subscribers by country

China is also the leader in terms of subscribers far way from other countries

Countries like Japan have more than 35 million subscribers and South Korea could reach more than 14 million subscribers taking into account FTTH and FTTx/LAN



and it can be observed 8 countries that already passed 1 million of FTTH/B subscribers



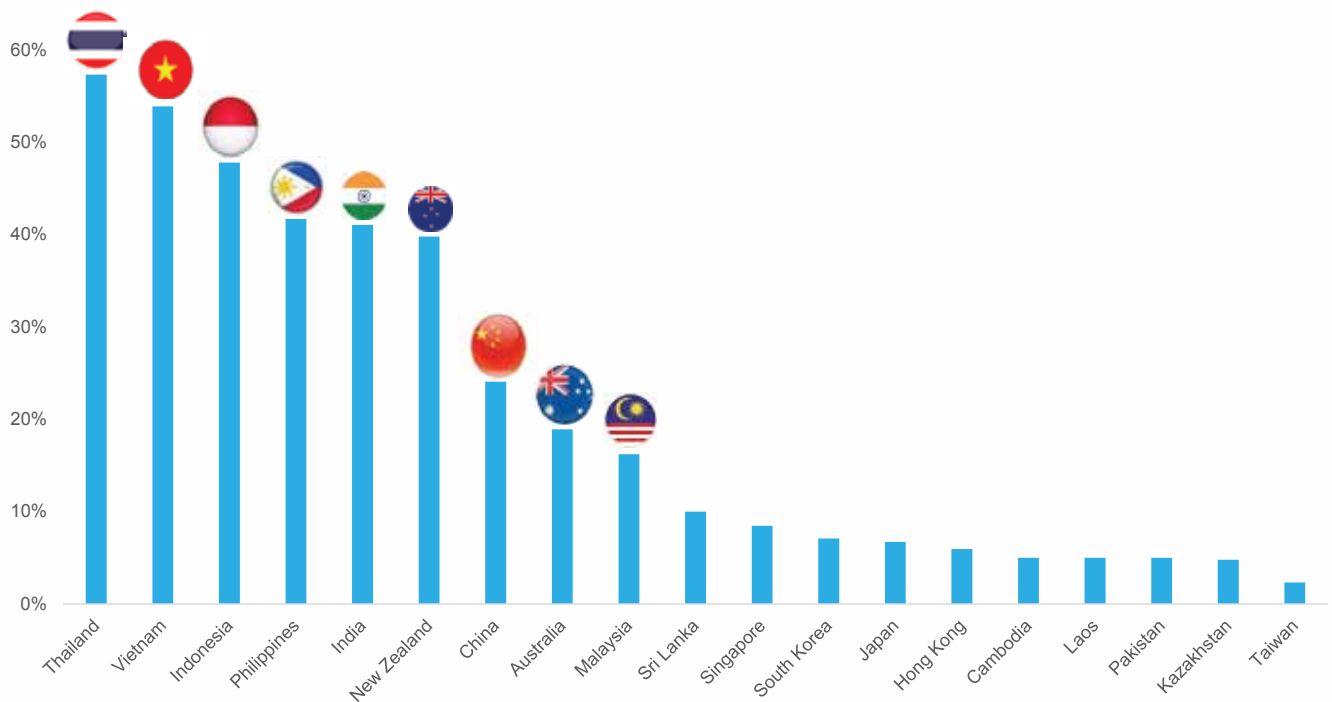
Source: IDATE for FTTH Council APAC

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APAC FTTH/B leading countries

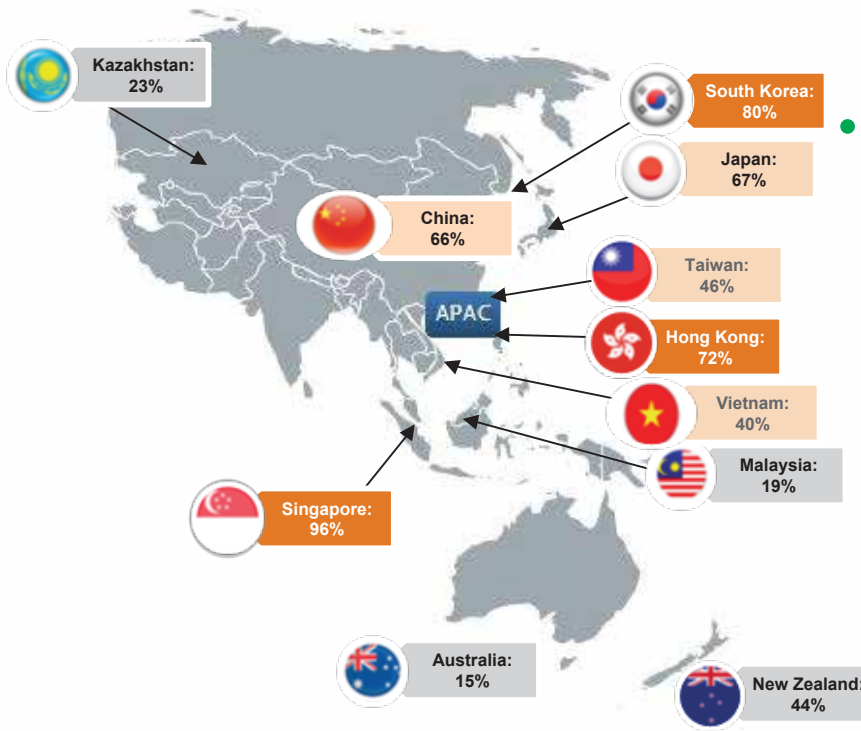
During 2017 a dynamic evolution to connect more homes to the fiber networks was observed in Thailand, Vietnam, Indonesia and Philippines, India and New Zealand

% variation from Dec 2016 to Dec 2017 in the number of FTTH/B Subscribers by country



APAC FTTH/B leading countries

Penetration rates of FTTH/B in the region



- APAC has continued the trend to deploy FTTH/B
- 13 countries among in the Global Ranking:
 - 3 countries with a penetration rate → 70%
 - 6 countries with a penetration rate between 20% and 70%
 - 2 countries with a penetration rate → 10%

Source: IDATE for FTTH Council APAC

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Market trends for FTTH/B in APAC

China is the leader in APAC but also worldwide in terms of FTTH/B subscribers and Homes Passed

- 86% of FTTH coverage by end 2017.
- 3 Players (China Telecom, China Unicom and China Mobile) with a large coverage in FTTH networks
→ A strong overlap coefficient.
- A huge evolution this year with **China Mobile** in terms of new subscribers and new homes reached by its fiber network.
- The **Government's objectives** in terms of deployment was to get 300 Million FTTH homes passed by end 2020. The goal was overachieved by end 2017 with 301 M subscribers and 392 million HP.

Japan and South Korea as FTTH pioneers, have continued to improve their FTTH networks

- The markets are still growing its FTTH subscribers but at a lower pace based on technology migration of existing broadband subscribers (Both, Japan and South Korea +7% subscribers in 2017).

Vietnam, Thailand and Indonesia: A dynamic evolution in FTTH/B subscribers by end 2017

- Vietnam has evolved towards fiber adoption, mainly by a strategy implemented by VNPT and Viettel.
- Thailand with fast evolution with its operator in the FTTH deployment and adoption.
- Indonesia with Telkom Indonesia is focused in the migration of customers toward FTTH.

Philippines evolving very fast in FTTH deployment along the country

- A huge fiber deployment has been performed by PLDT and Globe Telecom to reach more homes in a very short term.

Australia and New Zealand rollout based on national programs

- National programs in Australia and New Zealand continued where main players are involved in the rollout of FTTH and in the commercialization of the new network.

Challenges and drivers for FTTH in APAC

Drivers and challenges for FTTH in APAC

A huge market:

- APAC is a region with high level of population and more than 1 billion households, lead by China and India.
- India, Philippines, Indonesia and Sri Lanka accounts more than 350 million homes where a small portion is covered with FTTH/B networks.

National Broadband Plans as an opportunity in those countries not yet completely covered with fiber:

- It can be appreciated the good evolution that this strategy in New Zealand and now in Australia.

FTTH/B networks preferred over other xDSL and Cable networks:

- The strategy in main countries where FTTx/VDSL has been implemented is to migrate these connection in the middle term towards FTT/B solutions.
- Cable is not a strong technology deployed in APAC as it is in Europe or in USA.

5G as a driver to speed up fiber deployment:

- An increase in the fixed data bandwidths will evolve towards a higher mobile data bandwidths demand.
- 5G will require a concentration of cell transmission units that will need to be backed by a strong fiber backbone.

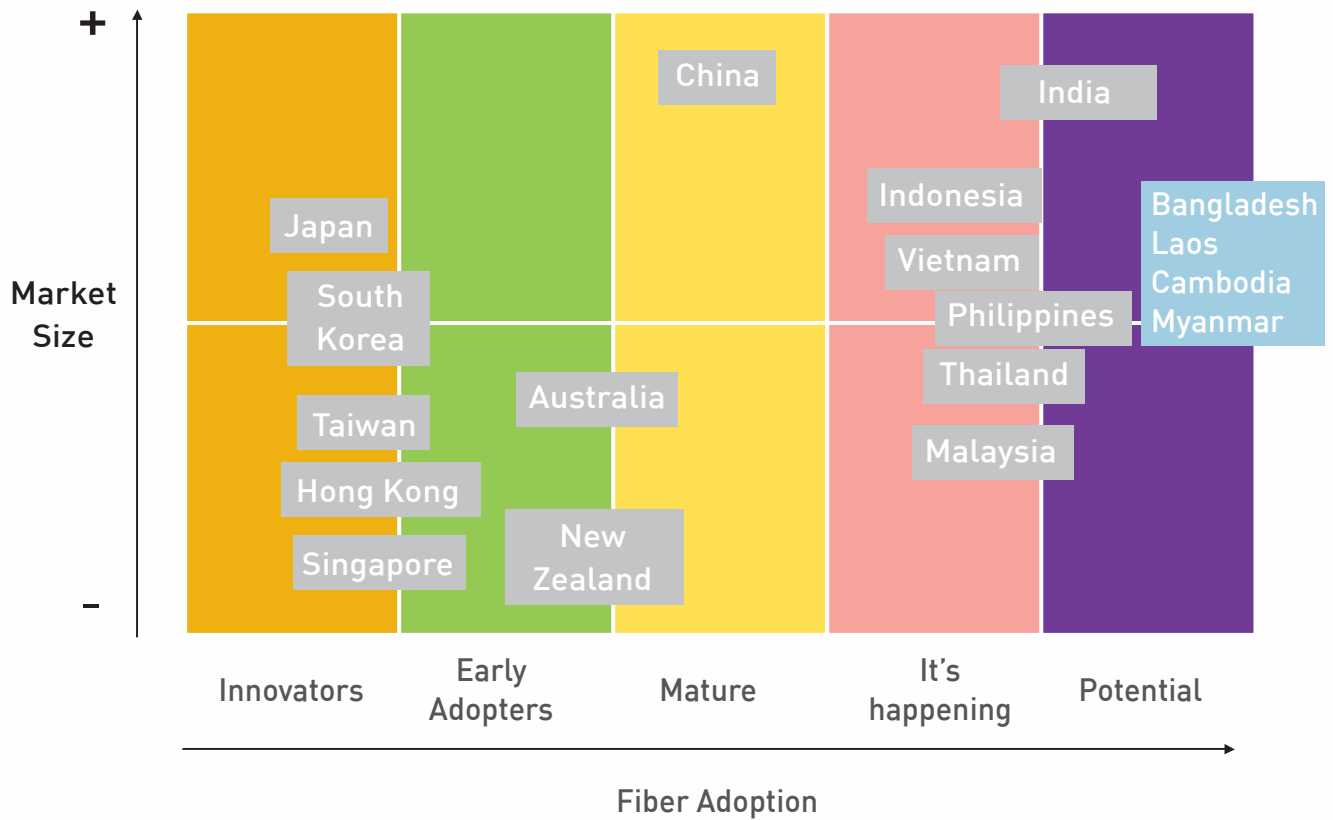
Smart cities are booming in APAC

- More cities wants to integrate services.
- Services has to be supported by a strong fiber network that allows to support mobile and also to centralize information.

Source: IDATE for FTTH Council APAC

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APAC FTTH evolution in terms of Market Size and Adoption

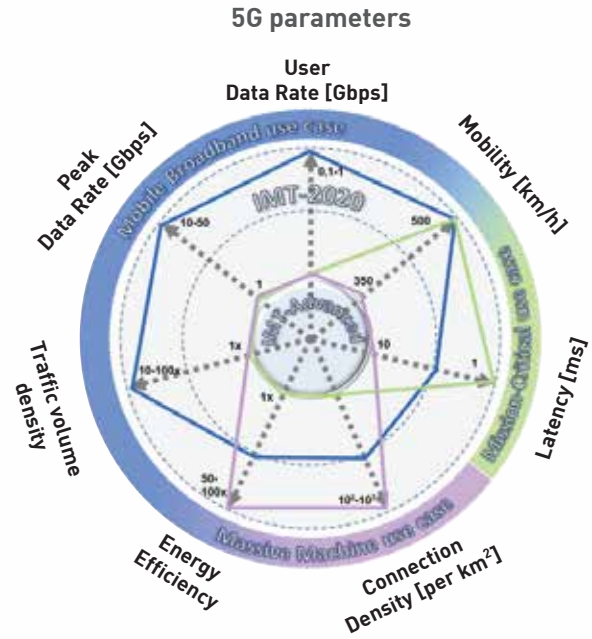


What about LTE and 5G in APAC?

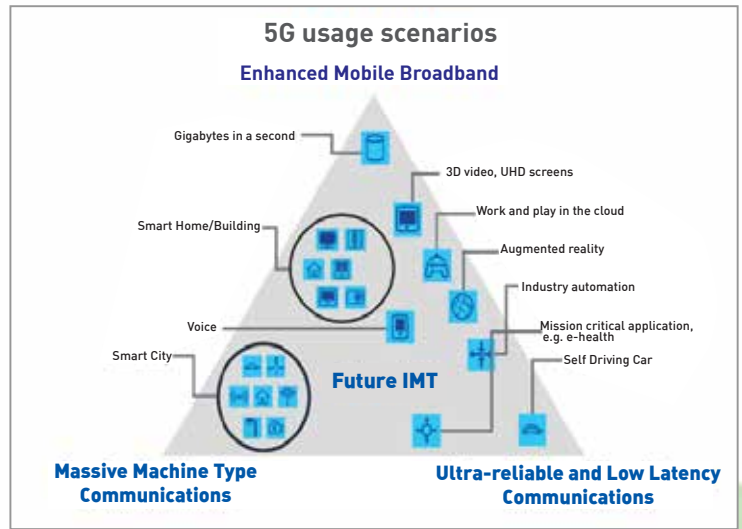
Multi-gigabits 5G is not only about very high data speeds

- Multi-gigabits user/peak data rate > 10 Gbps
- High mobility
- Lower network costs
- Increased connection density
- Very low latency < 1ms
- 99.999% reliability
- Low energy consumption

- New business opportunities with 5G
 - 3 major usage scenarios
 - eMBB/MMTC/URLLC



Source: ITU



Source: ITU

Source: IDATE for FTTH Council APAC

5G spectrum issues are heating up

Need of low and high frequencies for 5G

- Low frequencies for full coverage and capacity
- High frequencies for very high data rates

Considered very high bands for WRC-19 studies (above 24 GHz)

- 29.45 GHz already allocated to mobile on a primary basis
- 3.6 GHz which require additional allocations to the mobile service

Bands identified at WRC-15 and likely to be identified for mobile at WRCs in APAC

- Pushing 3.4-3.8 GHz identified at WRC-15 for major countries
- Supporting 26 GHz/28 GHz (South Korea)

Six countries at least consulting/considering options

- HongKong, India, Indonesia, Japan, New Zealand, Singapore, Vietnam

Six countries with planned auctions

- Australia, China, India, Pakistan, South Korea, Thailand

Indeed, the C-band likely to be a 5G band at regional level

- Intense activity around 3.4-3.6/3.7 GHz spectrum
- Large blocks available

Spectrum activity in APAC

Country	Spectrum bands	Comments
Australia	1.3.4 GHz 2.3.5 GHz 3.1500 MHz	1.Auctions achieved in 2017 2.Auctions planned in October 2018 3.Auctions planned in Q4 2019
	Mmwave	Auctions planned in Q3 2019
China	1.3.3-3.4 GHz (indoor usage) 2.3.4-3.6 GHz 3.4.8-5.0 GHz	1.December 2018/January 2019
HongKong	1.3.4-3.6 GHz (200 MHz) 2.24.25-27.5 GHz (3250 MHz) 3.27.5-28.35 GHz (850 MHz)	1.Auction in early 2020 2.2019 3.2019
India	3.3.3.6 GHz	Auction in 2018
Indonesia	28 GHz	N.A.
Japan	3.7 GHz 4.5 GHz 28 GHz	N.A.
New Zealand	600 MHz, 1500 MHz, 3.4-3.7 GHz 24.25-27.5 GHz	N.A.
Pakistan	3500 MHz	2021
Singapore	800 MHz, 1500 MHz, 3.4-3.6 GHz, 24.25-29.5 GHz, 31.8-33.4 GHz; 37-43.5 GHz; 45.5-50.2 GHz; 66-76 GHz; 81-86 GHz	
South Korea	3.5 GHz 28 GHz	Auctions planned in June 2018
Thailand	2.6 GHz	Auctions initially planned in January 2018 (put on hold by NBTC in Feb. 2018)
Vietnam	2.3 GHz, 2.6 GHz	N.A.

Source: IDATE, based on NRA/ministry public information

Source: IDATE for FTTH Council APAC

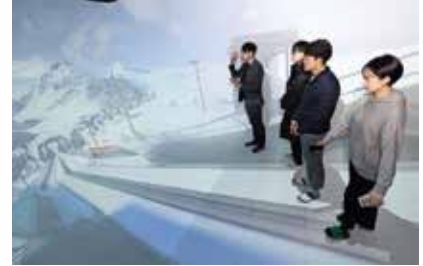
5G development and trials in Asia

Japan, Summer Olympic games

- 5GMF
- August 2020, Summer Olympic Games
- Field trials for two years



KT exhibition hall fitted with a ski jumping simulator that incorporates 5G and VR



South Korea, Winter Olympic Games

- Strategy defined in 2014: 2014-2020, 1.6 trillion KRW, 5G Forum
- Feb. 2018, Winter Olympic Games
- Field trials for two years
- 5G commercial launch in March 2019



China

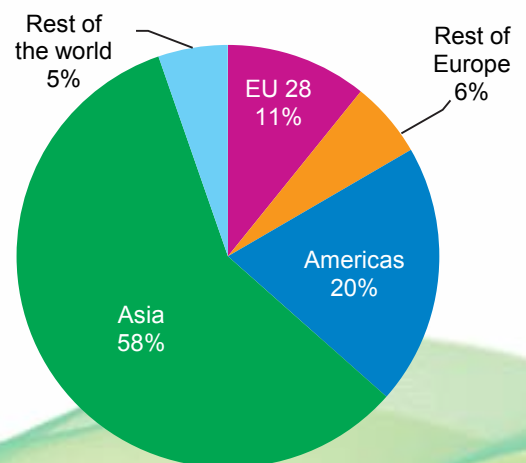
- IMT-2020-Promotion Group
- 2020



In 2025, we forecast 1.7 billion 5G subscribers, 4 years after launch

- Launch in 2018 in Asia and the USA, 2020-2021 in Europe
- Faster adoption than LTE expected
- Impressive subs growth: 149% CAGR
- Mainstream in 2023

5G subscribers regional breakdown in 2025



Source: IDATE/METIS-II

Source: IDATE for FTTH Council APAC

A number of countries/players with concrete strategy

South Korea

- 5G commercial launch in March 2019
- 3.5 and 28 GHz 5G spectrum auction scheduled in June 2018
- Live demos at the Winter Olympic Games in PyeongChang, in Feb. 2018: “Immersive broadcasting” used 5G-powered gadgets like cameras, communication equipment and sensors attached onto players, sports gear and arenas, so that viewers can experience the game on their mobile apps (Spectators’ experience limited to test phones). Self-driving vehicles also showcased with KT.

Japan

- Pre-commercial services by Summer Olympic games in Tokyo, Japan in August 2020 by NTT DoCoMo with Nokia

China

- IMT-2020 development group established in 2013 in a move to foster the development of 5G technologies. The IMT-2020 Promotion Group completed the initial phase of its trial program in 2016 (tests of massive MIMO, novel multiple access, new waveforms, advance coding, ultra-dense network implementations and high-frequency communications, network slicing, edge computing, and network function reconstruction).
- 3rd tests phase opened late in 2017 in China
- Pre-commercial China Mobile trials in Q3 2018 (PR dated Feb. 2018), 500 base stations (100 first base stations by end June 2018)., 20 cities early 2019 (with another 500 base stations), to test out business applications using 3.5 GHz spectrum and some of the 4.9 GHz band. Commercial 5G launch scheduled for June 2019 (China Mobile)

India

- “5G for India” launched: 5 billion Indian rupees (\$77 million) allocated to 5G development early 2018. Some of those funds will go toward a mammoth research project involving around 200 researchers, students and teachers from the five Indian Institutes of Technology (IIT).
- 5G launch expected to be “in sync with other parts of the world” (Bharti)

What about LTE and 5G in APAC?

LTE in APAC: Highly developed

South Korea, Japan are among the most advanced and innovative LTE markets in the world

- 62% of world LTE connections in Asia
- LTE-Advanced available almost in every country

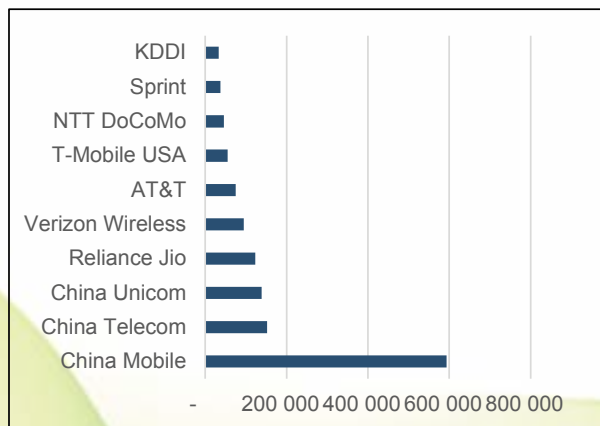
LTE in APAC is lifted by China (China Mobile)

- Advanced have a high 4G penetration
- Over 1 billion LTE subs in China as at end 2017. Top 3 players are Chinese over 170 million LTE subs each
- #4 is Indian, #11 is Indonesian
- Other countries expected: Bangladesh, Nepal
- Over 110 LTE networks in operation

LTE is spreading in less advanced markets thanks to many drivers

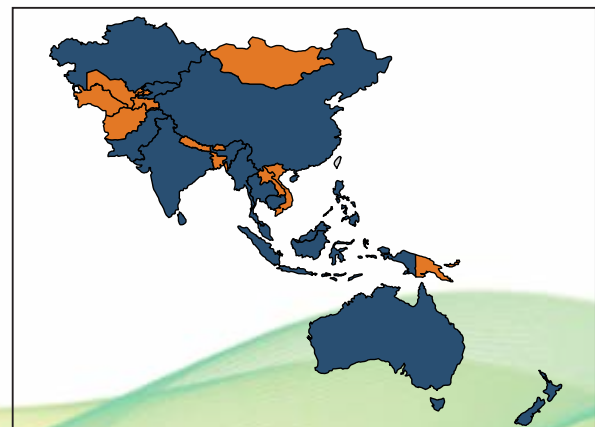
- Increased competition
- MNOs network investment
- Decreasing smartphone prices
- Price of LTE packages at discounted prices (Vietnam, India)
- Growing young population using digital skills

Top 10 LTE MNOs by subs nbr (June 2017)



Source: IDATE DigiWorld, World LTE Markets
5G Initiatives & MBB Spectrum, December 2017

LTE and LTE-Advanced in APAC in 2017



Source: IDATE DigiWorld, 2016

Source: IDATE for FTTH Council APAC

The APAC region is moving aggressively on 5G

Very heterogeneous regional overview

Almost no 5G plans so far for emerging Asian countries, a few exceptions

- Especially where LTE services have not been launched at YE 2017
- Where LTE services are commercial at YE 2017 but for a relatively short time (2/3 years)

But the 5G scene is very active in advanced countries

- Non-standalone (NSA) mode standardized in December 2017. Standalone (SA) 5G NR mode expected in June 2018
- Lead by national entities: 5G Forum (South Korea), 5GMF (Japan), IMT-(5G) Promotion Group (China)
- Concrete strategies made of announcements, trials and spectrum driven by major sport events in the region

Challenges surrounding 5G remain: spectrum, standardisation, business models and use cases

Asia leads in LTE, Asia will likely lead in 5G:

- Large adoption expected: 1 billion 5G subs, →50% of total 5G subscriptions in 2025 (IDATE/ME-TIS-II)

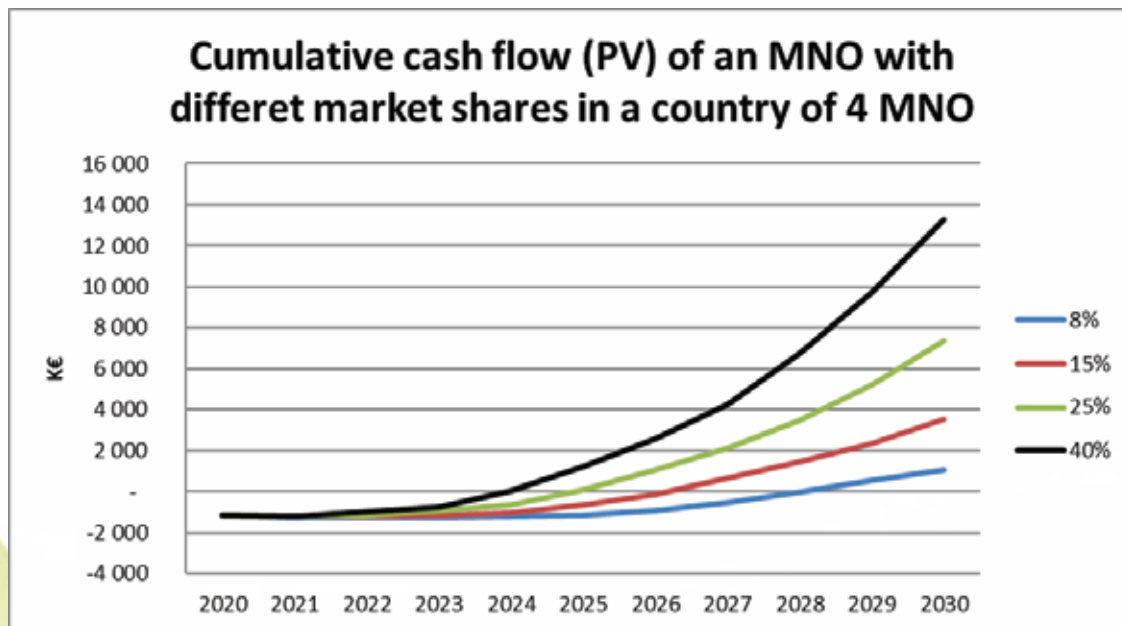
What about 5G costs?

A few estimated rough cost numbers for a whole network

- 300 billion USD according to a 2016 Barclays report
- 300-500 billion EUR according to Deutsche Telekom in 2017
- 5G upgrades in EU28 estimated at 57 billion EUR by the EU Commission according to the Financial Times

Big caveats on the CAPEX front

- Several spectrum bands used with implications on network deployment
 - A very high number of small cells
 - Re-use of older network equipment such as backhaul, software-reconfigurable technologies used in 4G and 5G
 - Use of active antennas, more expensive than current ones
- Sharing

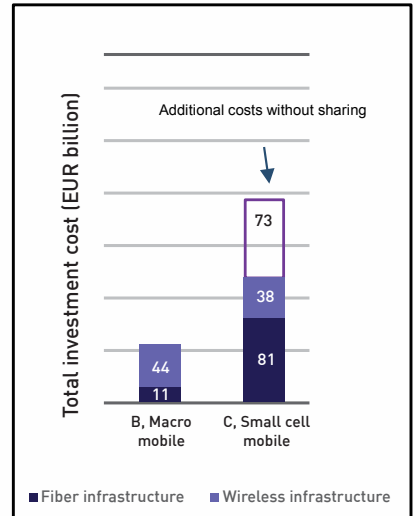


Source: IDATE for FTTH Council APAC

But some preliminary techno-economic studies subject to uncertainties & assumptions!

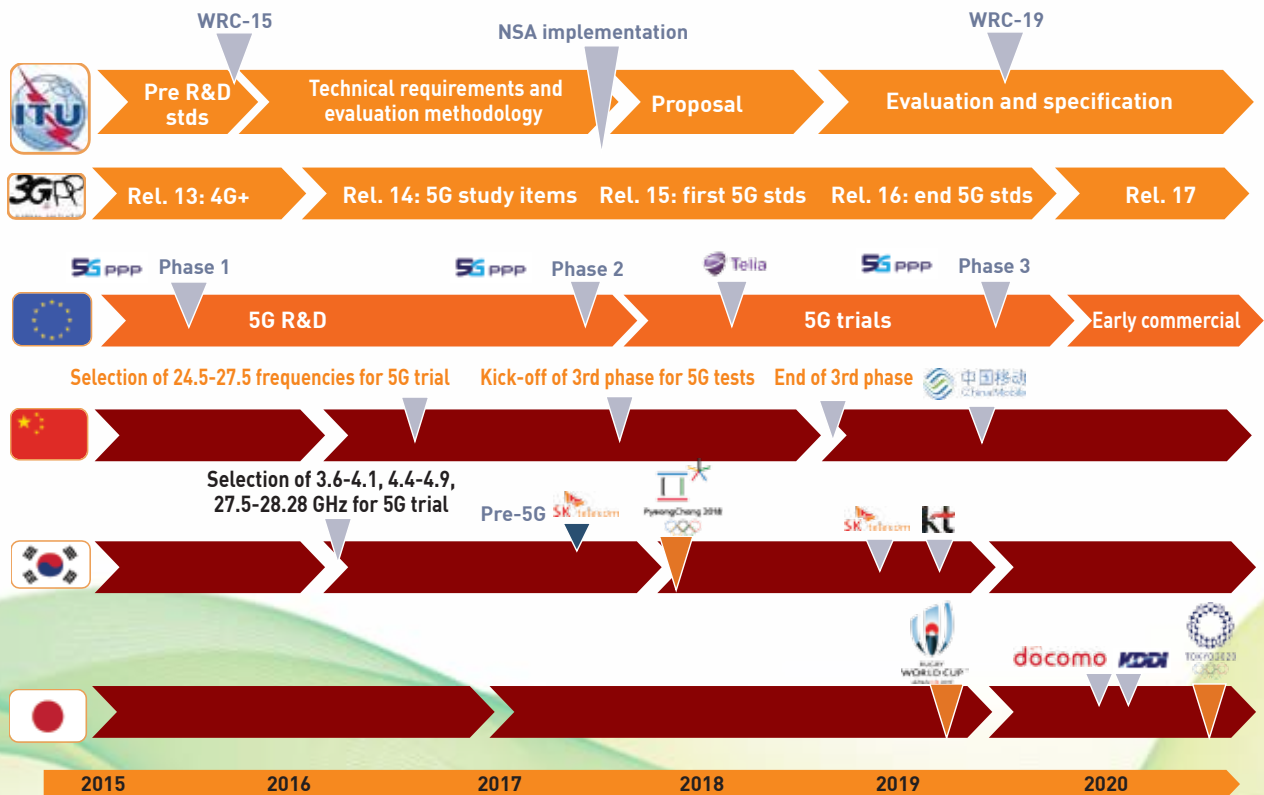
- Cumulated discounted cash flow analysed by the 5G PPP METIS-II project
 - Access and backhaul network CAPEX and OPEX considered only (core network, commercial expenditure not included)
 - Launch in 2021 in a European market for a dense urban area (where it is more profitable)
 - In all situations, 5G deployment is financially profitable for a MNO in dense urban areas (under defined traffic and costs assumptions).
- Total investment cost modeled on a standalone basis (Analysis report, 2016) to reach population coverage of:
 - 95%: 55 billion EUR ow 11 for the fiber infrastructure
 - and of 100%: 119 billion EUR ow 81 for the fiber infrastructure
 - Underlying hypotheses: cost of a small cell at 1,000 EUR in 2025 due to high volumes, 50% of cells connected via fiber. 50 Mbps delivered. Radius of small cell=200m

Standalone costs, sharing included



Source: AnalysisMason, 2016, Costing the new potential connectivity needs

Expected 5G timetables, compared



Source: IDATE for FTTH Council APAC



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SEE THE LIGHT