FTTH COUNCIL
ASIA PACIFIC | FIBER TO THE HOME APAC

FTTH APAC Market Panorama 2019 & 5G APAC Mini Panorama 2019

As of December 2018

FTTH Council Asia-Pacific
E: info@ftthcouncilap.org W: www.ftthcouncilap.org

SEE THE LIGHT

Membership Information

FTTH COUNCIL ASIA PACIFIC | FIBER TO THE HOME APAC

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 Woking 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 50 company members, around 200 delegates and a five-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)

Fiber Broadband Association | Fibre to the Home Council Europe | FTTH Council Asia Pacific | Fibre to the Home Council Middle East & North Africa | FTTX Council | Fiber Broadband Latam Chapter

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

Updated in January 2019

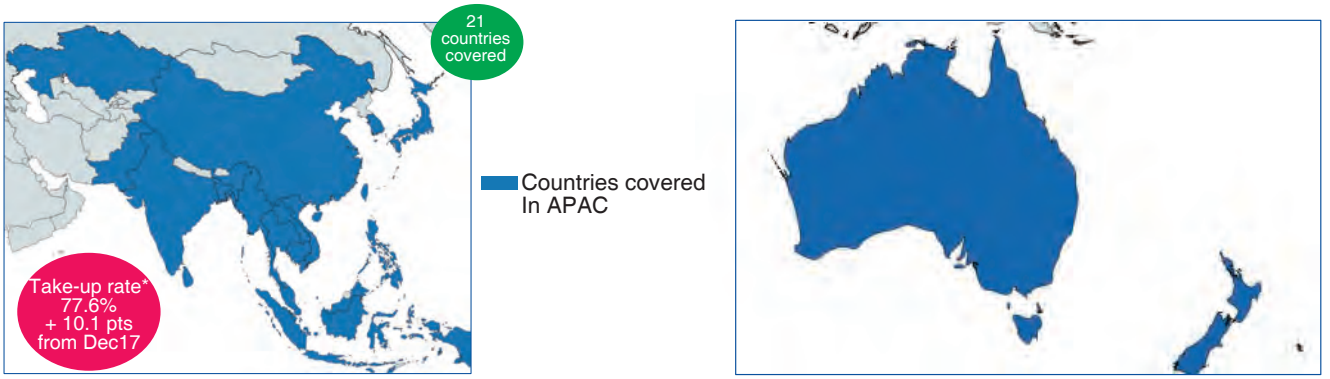
General Overview and Main Trends

FTTH/B figures as at December 2018

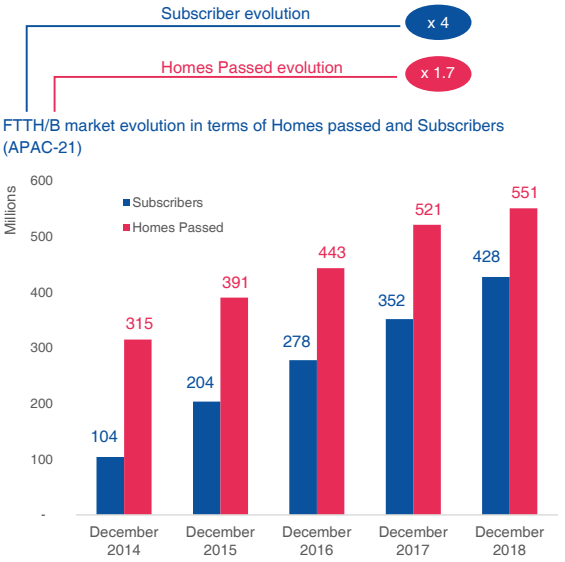
As at December 2018 in APAC*:

- 427.7 million FTTH/B subscribers
- More than 550 million FTTH/B Homes Passed

FTTH Council APAC scope at December 2018



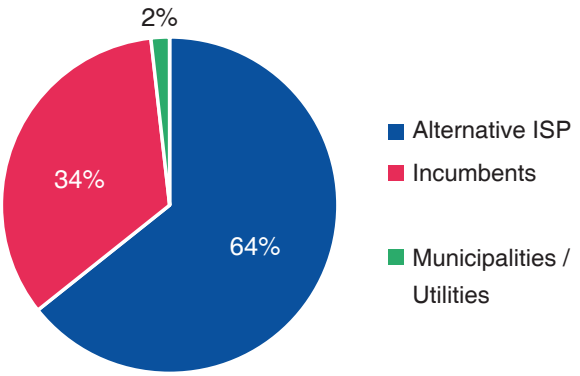
(*) APAC - 21 = Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Laos, Malaysia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam



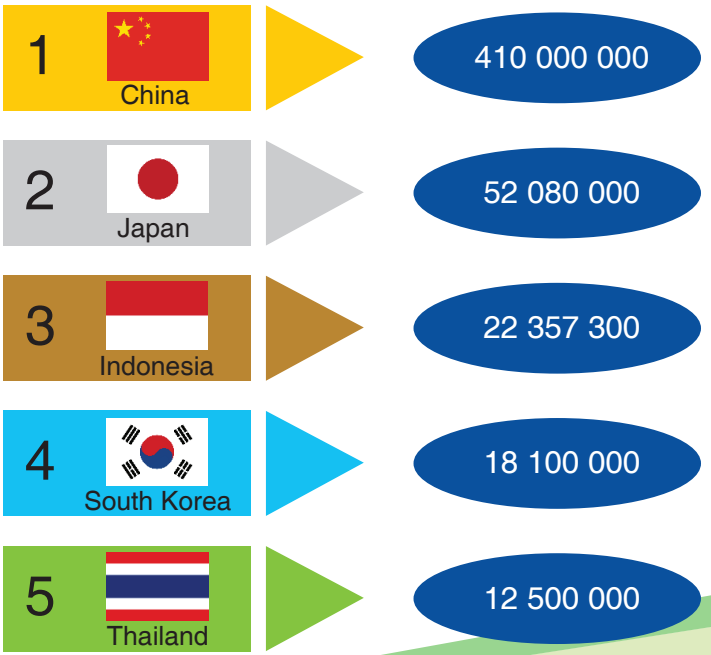
Alternative players are taking a leading role in FTTH/B initiatives

- Analysis of around 112 FTTH/B projects in Asia Pacific at December 2018
- Around 64% of total Homes in the region have been passed by Alternative ISPs, and approx. 34% by incumbents (stable trend when compared to 2017)
- Municipalities/Local Authorities, along with utilities when appropriate, will remain those ones that will help ensure an exhaustive coverage at term

Breakdown of FTTH/B Sockets deployed by type of player (%)
Data by December 2018



FTTH/B Homes Passed Ranking – Top 5 Asia Pacific countries (Dec. 2018)



*Take-up rate = FTTHB Subs / FTTHB Homes Passed

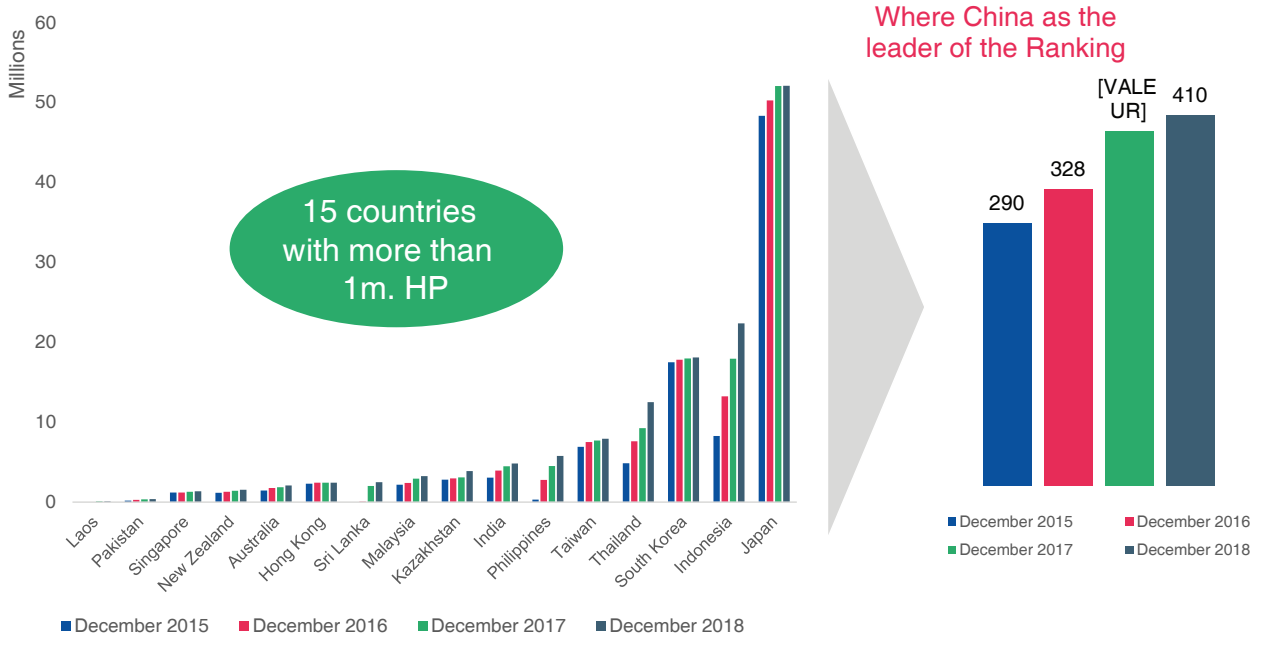
APAC : Leading Countries

General Ranking: FTTH/B Homes Passed

China represents 74% of the total FTTH/B Homes Passed in the APAC region

Asia Pacific ranking in terms of FTTH/B Homes Passed over time (in million homes)

Data comparison between Dec. 2015 and Dec. 2018



Top 5 annual growth rates – Homes passed (in %)

Data from Dec. 2017 to Dec. 2018

+ 35.0 %

Thailand

+ 28.0 %

Philippines

+ 25.0 %

Sri Lanka

+ 24.9 %

Kazakhstan

+ 24.6 %

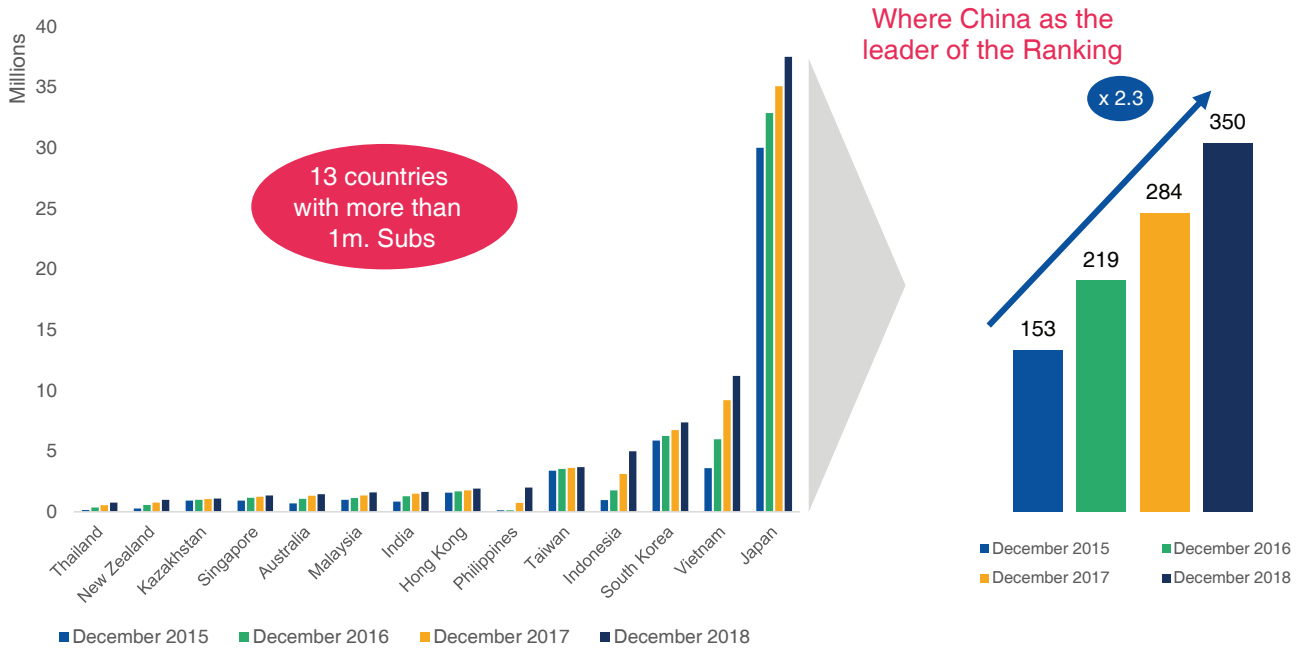
Indonesia

General Ranking: FTTH/B Subscribers

China accounts for 63% of the total FTTH/B Subscribers in Asia-Pacific

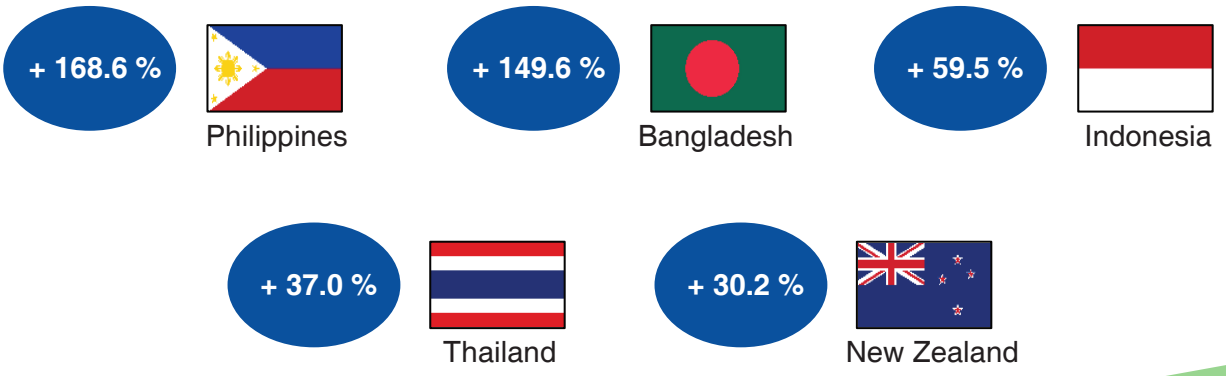
Asia Pacific ranking in terms of FTTH/B Subscribers over time (in million homes)

Data comparison between Dec. 2015 and Dec. 2018



Top 5 annual growth rates –Subscribers (in %)

Data from Dec. 2017 to Dec. 2018



Fiber Expansion is Still Ongoing in APAC

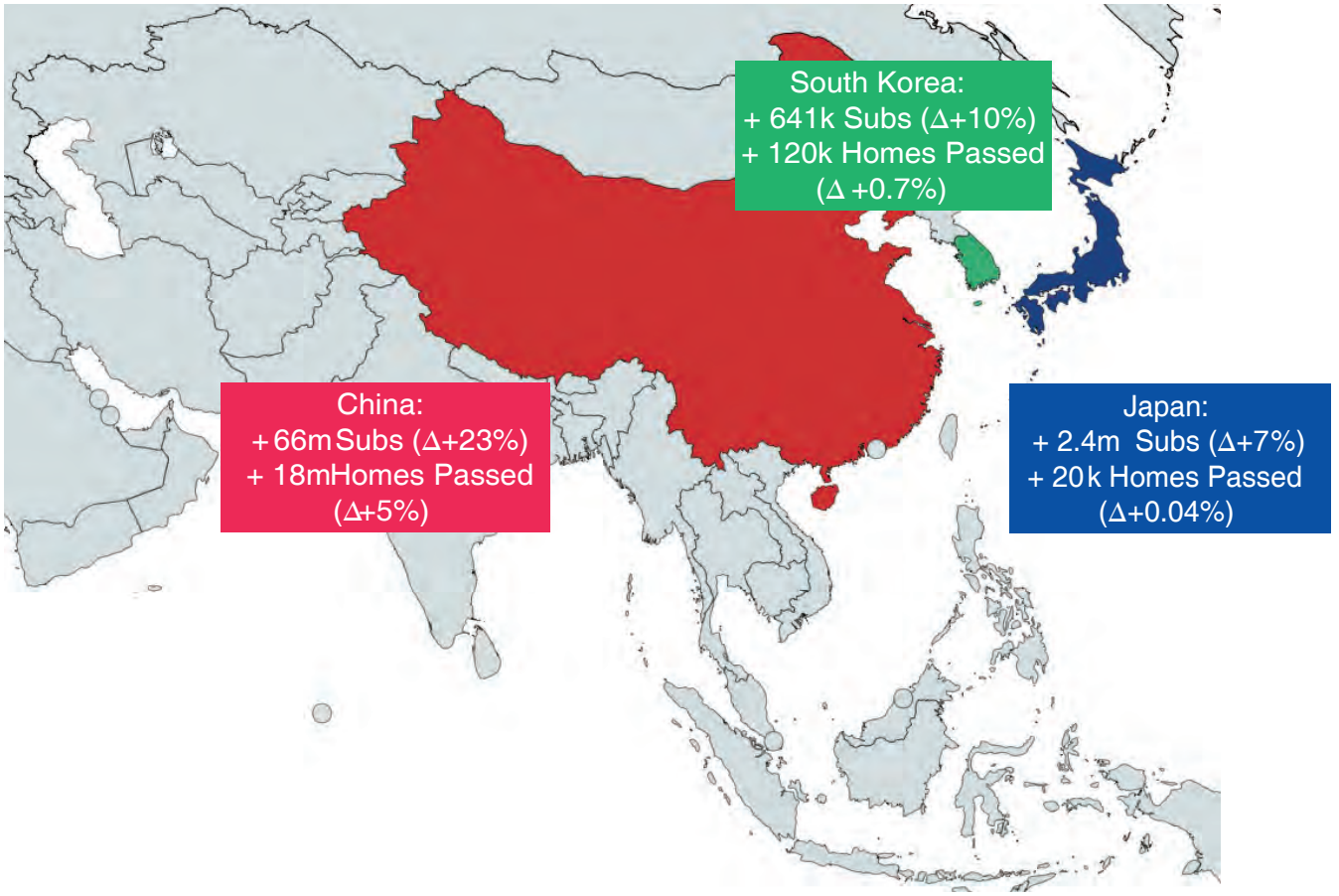
75.8 million new FTTH/B subscribers and 29.6 million FTTH/B homes passed were added by Dec. 2018 YoY

Main countries in Asia Pacific:

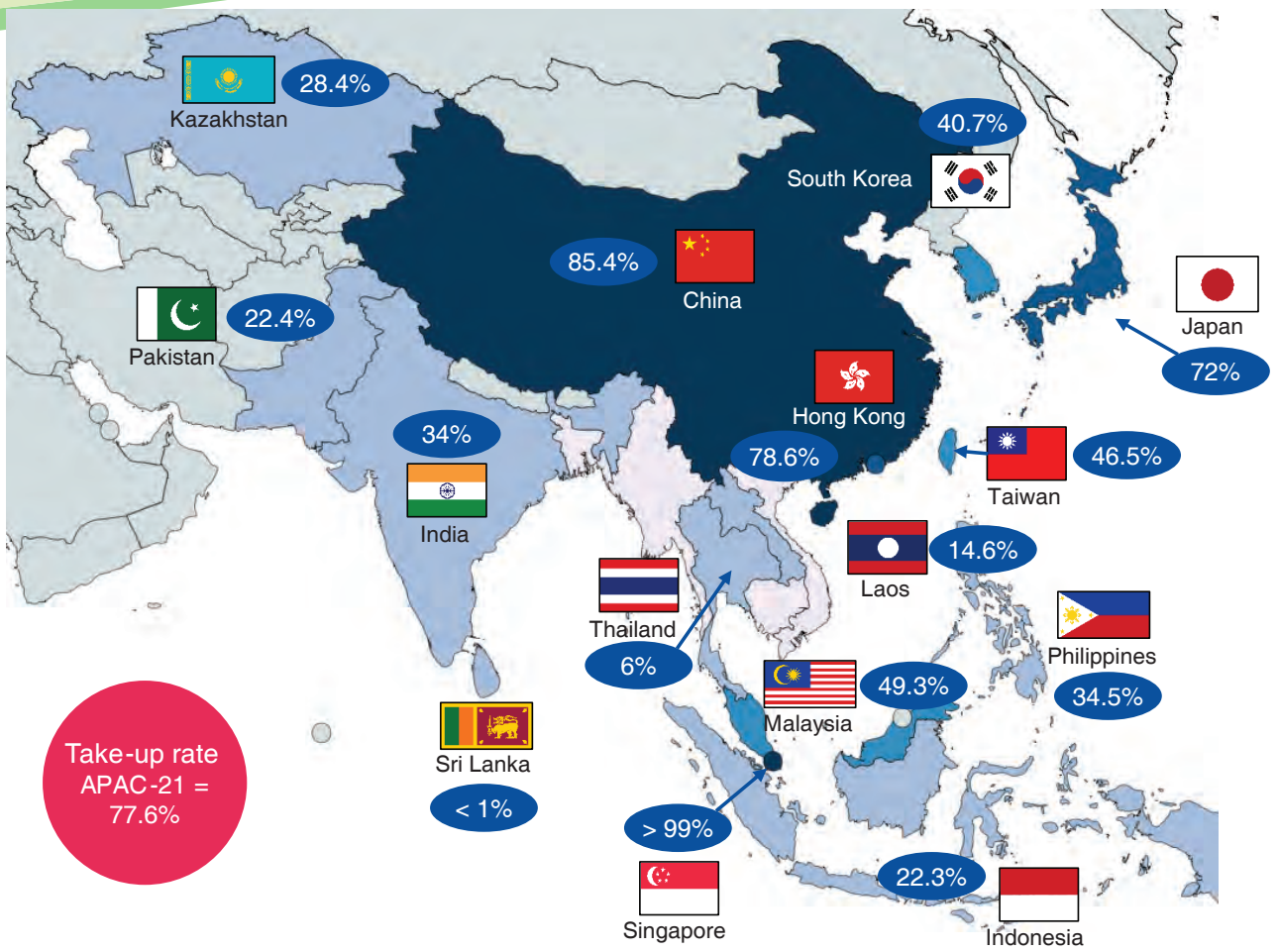
China: Strong move forward in FTTH deployments for the 3 main players in China, progressively migrating from copper-based / cable-based connections towards fiber solutions

Japan: A consolidated market that is focused on fiber adoption among its fixed broadband subscribers

South Korea: More initiatives make FTTH/B and FTTx/LAN solutions the leading technologies in the country

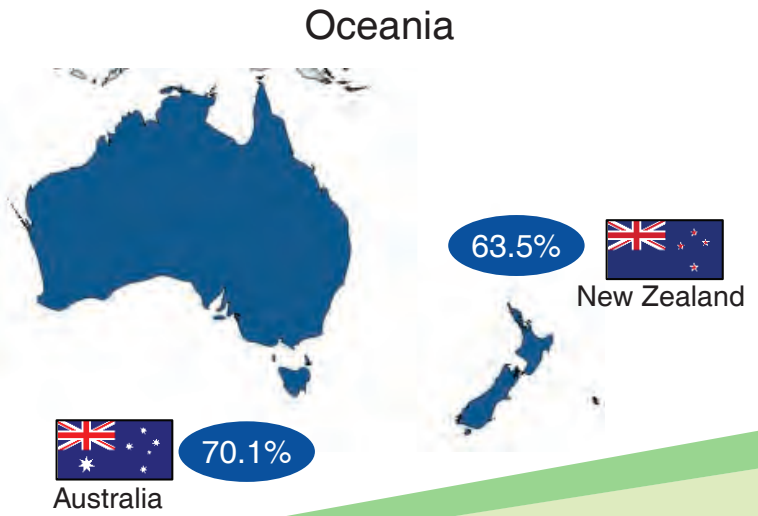


General Ranking: FTTH/B Take-up



FTTH/B take-up* as at December 2018

- FTTH/B take-up > 80%
- FTTH/B take-up 60 – 80 %
- FTTH/B take-up 40 – 60 %
- FTTH/B take-up < 40 %
- Data not available



*Take-up rate = FTTHB Subs / FTTHB Homes Passed

APAC : FTTH/B Technical Trends

FTTH GPON is the norm for fiber networks in APAC

FTTH vs FTTB: FTTH deployments have strongly expanded throughout the APAC regions. FTTH solutions are preferred when migrating from copper and cable technologies, and more especially in greenfield areas

PON vs Ethernet P2P: PON solutions are clearly the N°1 choice for players engaged in FTTH deployments in the APAC region

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

APAC : FTTH/B Ranking

Indicators affecting the FTTH adoption

Positive criteria

1		Demand for data and bandwidth continues to grow, thus operators have to adapt their networks to robust technologies able to provide those speeds
2		Many public authorities in APAC have launched national broadband plans in order to deploy fiber-based networks throughout their countries
3		Some players are shifting their business models to focus on FTTH rather than copper-based or cable-based technologies
4		Mutualized networks as well as sharing agreements tend to push FTTH development
5		Technology innovation to help lowering costs

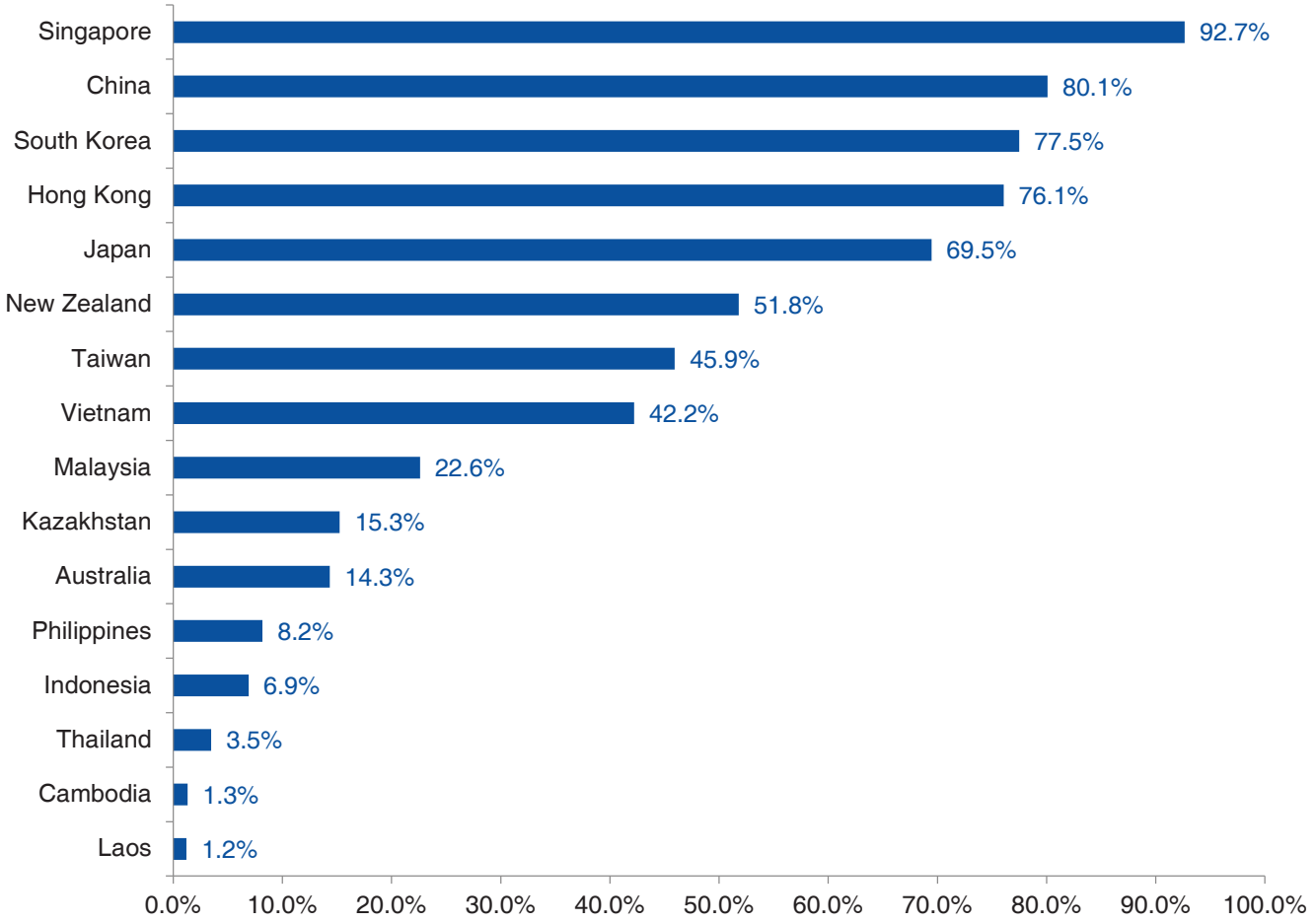
Indicators affecting the FTTH adoption

Negative impacts

1		Still no clear mass-market applications for FTTH
2		New variants or mixed-build architectures, along with G.Fast or DOCSIS 3.1, could delay FTTH investments by operators. These options tends to be economically more feasible.
3		Future 5G technology used in high spectrum bands (26 GHz) will directly challenge FTTH in the fixed residential market
4		Public funding initiatives may not be enough to effectively encourage FTTH growth
5		Substitution by fixed-wireless access or 'hybrid' access in remote or difficult to service areas

APAC Ranking as at December 2018

Penetration rates in Asia Pacific as at December 2018
(FTTH/B Subscriptions / Households)



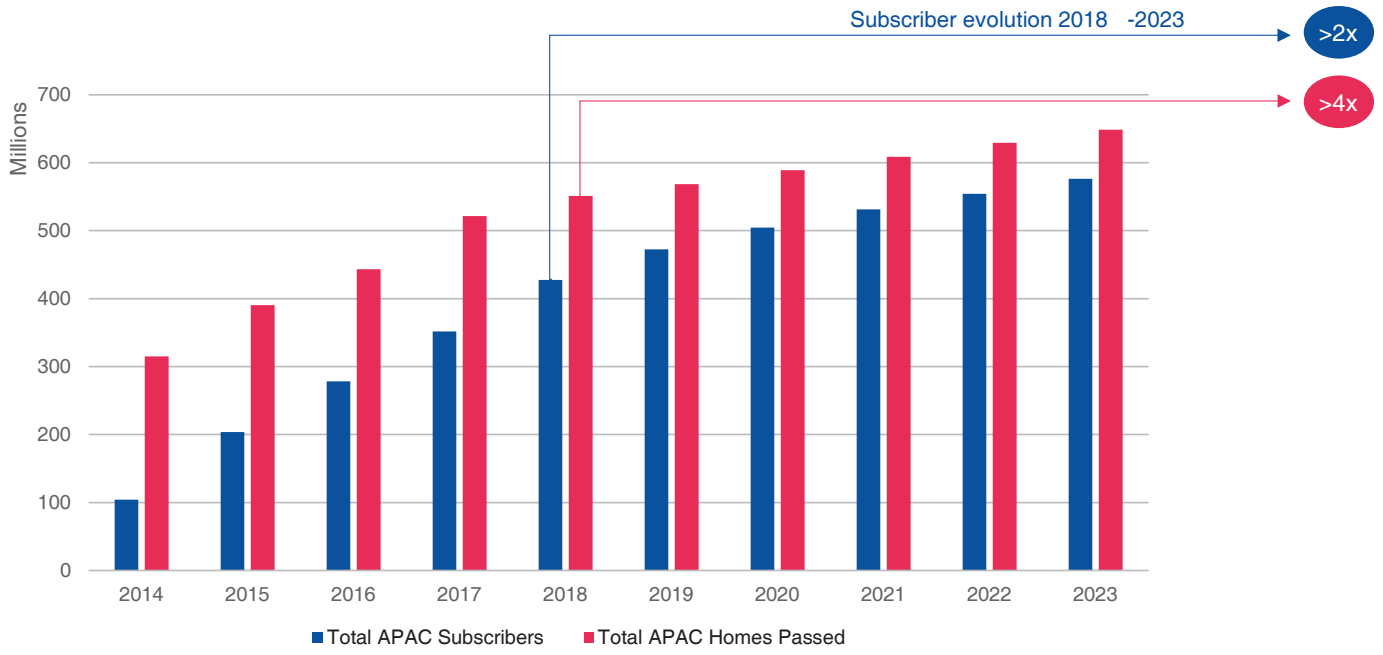
- Includes countries of +200k Households in which FTTH/B subscribers represent at least 1% of total households
- Most densely populated countries are among the top of penetration ranks, mainly due to a proactive state intervention towards fibre expansion
- FTTH enhancement in some APAC countries is still at the early stages, mainly due to a predominance of copper-based technologies

FTTH/B Forecasts by 2023

FTTH/B solutions will become mainstream, followed by a strong fiber adoption

- By 2023, Homes passed by FTTH networks are expected to increase by 18% (~649 million homes), while FTTH Subscribers will grow by 35% (~576 million subscriptions)
- Growth will be mainly supported by most densely populated countries (India, China)
- A majority of countries are successfully deploying fiber networks nationwide (Japan, South Korea, etc.), hence operators will be highly focused on fiber adoption

FTTH/B Subscribers and Homes Passed Forecasts (million)



LTE in APAC is More Mature

APAC is the main driving force behind global LTE adoption

South Korea, Japan and city-countries are leading the pack

- 62% of world LTE connections in Asia
- Nationwide coverage reached a couple of years ago
- LTE-Advanced available almost in every country
- VoLTE available widely

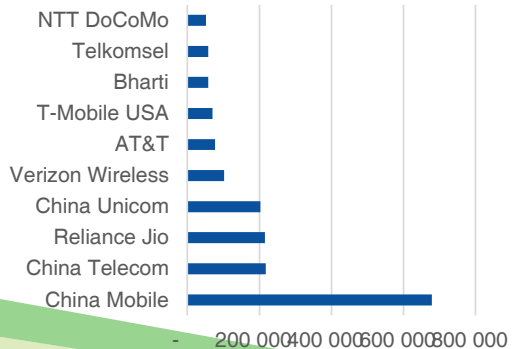
LTE in APAC lifted by China

- Advanced have a high 4G penetration for a while, developing countries previous laggards such as Malaysia, Vietnam, Indonesia and India catching up
- Over 1.1 billion LTE subs in China as at June 2018. 3 of Top 4 players are Chinese over 200 million LTE subs each
- #3 & 8 are Indian, #9 is Indonesian
- Other countries expected: Bangladesh, Nepal…
- Over 110 LTE networks in operation

LTE is spreading in less advanced markets thanks to many drivers

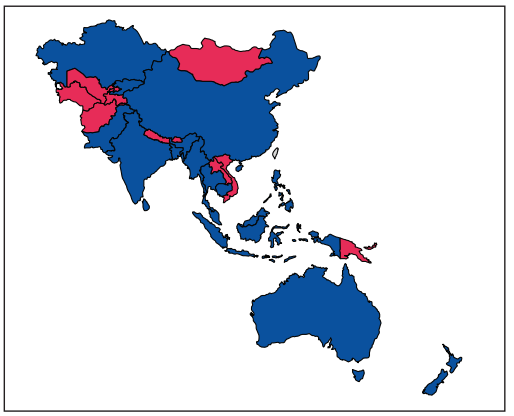
- Increased competition
- MNOs network investment
- Decreasing smartphone prices
- Price of LTE packages at discounted prices (Vietnam, India,…)
- Growing young population using digital skills

Top 10 LTE MNOs by subs nbr (June 2018)



Source: IDATE DigiWorld, World LTE Markets - 5G Initiatives & MBB Spectrum, December 2018

LTE and LTE-Advanced in APAC in 2018

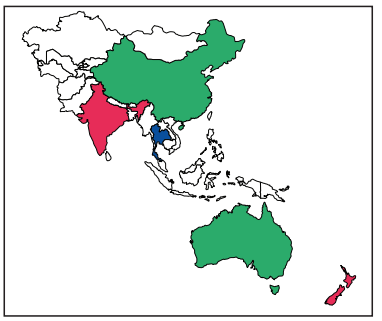


APAC Region Moving Fast on 5G

Launches expected earlier than previously expected

- **Still very heterogeneous regional overview**
- **Still almost no plans/poor visibility/lack of regulatory guidelines in emerging countries**
- **The 5G scene is very active in advanced countries**
  - The mobile 5G ecosytem is in place. Sometimes it has been pushed by governments
  - Concrete strategies made of roadmaps, trials, spectrum assignements, announcements
  - South Korea first country to pre-launch 5G in Dec. 2018
    - @3.5GHz
    - Limited to business users, awaiting compatible smartphones
- **Challenges surrounding 5G remain**
  - Business models and business cases
  - Lack of extensive business / vertical trials
  - EMF (Electro Magnetic Field)
  - Deployment costs

Earliest expected 5G launch by country



From Trials to Early Commercialisation (1/2)

Early commercial launches expected in East Asia

SOUTH KOREA	• Strong support from public authorities
	• 5G pre-commercial launch in December 2018, limited areas, using mobile routers
	  • 13 cities (SKT)
	  • Seoul (KT)
	  • 4,100 5G base stations (7,000 5G base stations expected YE2019, 85 cities)
	• Pre-Commercial launch in December 2018, 5G commercial launch in March 2019
	• Focus on consumer services (incl. M&E, Automotive)

JAPAN	• Pre-Commercial launch by NTT DoCoMo expected in Autumn 2019 Commercial services by Summer Olympic games in Tokyo, Japan in August 2020 by • NTT DoCoMo with Nokia

From Trials to Early Commercialisation (2/2)

South East and Central Asia lagging behind

CHINA

- China Mobile is currently trialling pre-commercial 5G and targeting 5G commercial services to be launched by the end of 2019, a year in advance.
- China Unicom and China Telecom are targeting 2020 for commercial services.

AUSTRALIA

- Strong support from public authorities
- Trials across different bands (3.6 and 26 GHz) and use case (eMBB, FWA, autonomous cars, 8K video streaming)
- First launch expected early 2019 (1 player), 2nd player in 2019-2020

Other Countries are Lagging Behind

South East and Central India laucnhed 5G R&D early 2018 and is considering freeing 5G spectrum lagging behind

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).
- Significant infrastructure challenges that will limit 5G deployment
  - such as the lack of a robust network to connect cellular sub-networks to a core networks
- Ongoing harmonizing spectrum in the 3.3-3.6 GHz band and 26 GHz band, along with the 71-76 GHz, the 81-86 GHz and the 57-64 GHz frequencies as 5G candidate bands.
  - Price for 3,3-3,6 GHz spectrum announced (985 INR per MHz (12.4 EUR) considering the 1800 MHz reserve price of 3285 INR. Mid-frequencies should be put for sale in 20 MHz blocks with a spectrum cap of 100 MHz per bidder)

2019 a Very Important Year for Spectrum Auctions

South Korea first country to have auctioned 5G

- **Five countries at least consulting/considering options**
  - Indonesia, Japan, New Zealand, Singapore, Thailand, Vietnam
- **Seven countries with planned auctions/assignments**
  - Australia, China, HongKong, India, Pakistan, Taiwan
- **Two countries with performed auctions**
  - South Korea
  - Australia
- **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

2019 a Very Important Year for Spectrum Auctions/Assignments (1/2)

South Korea first country to have auctioned 5G

Country	Spectrum bands	Comments
Australia	1.3.4 GHz 2.3.5 GHz 3.1500 MHz 4.24.25-27.25 GHz	1.Auctions achieved in 2017 2.Auctions ended in December 2018 3.Auctions planned in Q4 2019 4.2020
	Mmwave	Auctions planned in Q3 2019
China	a/3.3-3.4 GHz (indoor usage) b/3.4-3.6 GHz c/4.8-5.0 GHz	H2 2019
HongKong	1.3.4-3.7 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.April 2019 3.April 2019
India	3.3-3.6 GHz	June 2019
Indonesia	28 GHz 3.4-3.6 GHz	By 2022.
Japan	3.7 GHz 4.5 GHz 28 GHz	Q1 2019 Q1 2019 Q1 2019

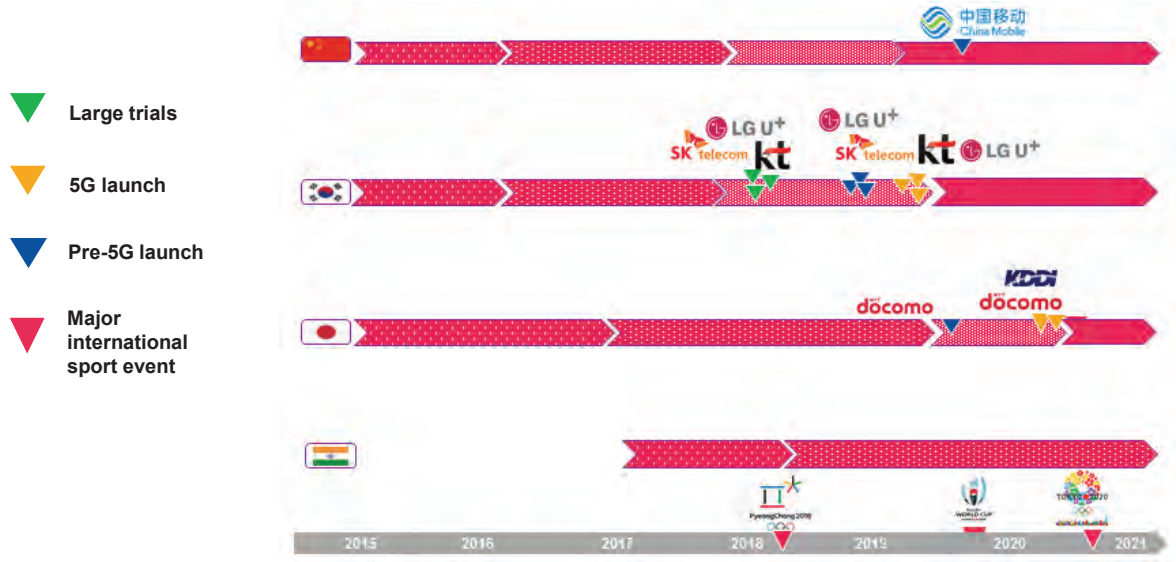
2019 a Very Important Year for Spectrum Auctions (2/2)

South Korea first country to have auctioned 5G

Country	Spectrum bands	Comments
New Zealand	3.4-3.7 GHz 1800 MHz 24.25-27.5 GHz	2019 2021 2022?
Pakistan	3500 MHz	2021
Singapore	800 MHz 24.25-29.5 GHz, 31.8–33.4 GHz; 37–43.5 GHz	2021 2022
South Korea	3.5 GHz 28 GHz	Auctions ended in June 2018 Auctions ended in June 2018
Taiwan	3.4-3.6 GHz	Late 2019
Thailand	2.6 GHz 26-28 GHz	2019
Vietnam	2.3 GHz, 2.6 GHz	N.A.

5G Timelines

China, South Korea, Japan, India

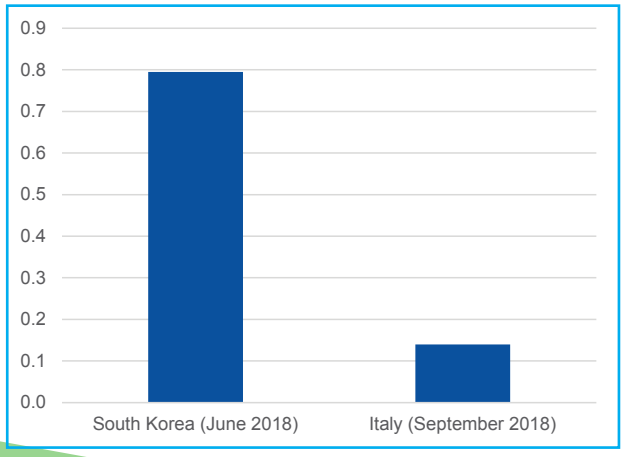


Still Big Caveats in the CAPEX Front

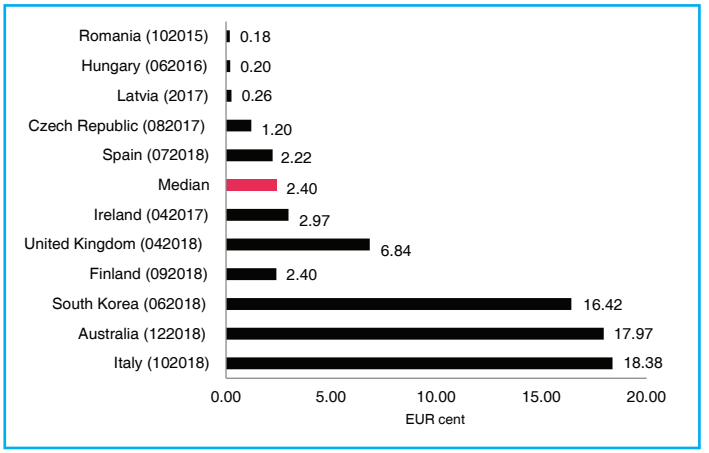
New spectrum

- 3.5 GHz spectrum on an inflationary spiral? 3.5 GHz spectrum quite expensive in South Korea in June 2018
- While 26 GHz spectrum was quite low with lowest ever price

Price of 26 GHz spectrum (eurocents) per MHz per pop., for 10 years



Price of 3.4-3.8 GHz spectrum (eurocents) per MHz per pop., for 10 years



Average yearly exchange rates are based on the IMF figures published for year of the award process

Still Big Caveats in the CAPEX Front

High number of small cells / Active antennas

- **Very high number of small cells**
  - Around 84% of th costs related to small cell civil works (compared to 16% today) according to a Stratix report on Cost elements in the rollout of 5G networks in the Netherlands
  - Costs may vary greatly depending on access to street furniture and on local municipalities.

- **Use of active antennas, more expensive than current ones**

What About 5G Prospects and Deployment Costs?

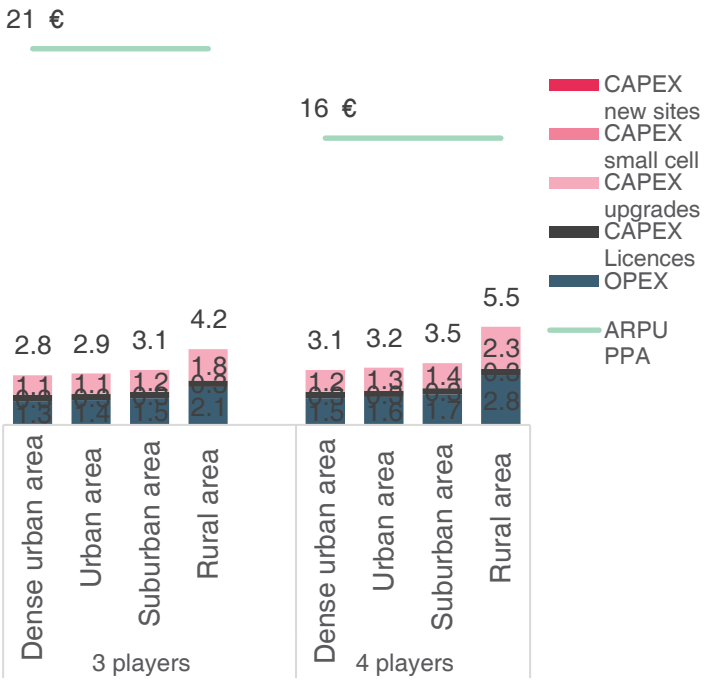
Expensive deployment in rural areas

- **IDATE DigiWorld released a study on 5G profitability based on data consumption of**
  - Current/linear scenario: 10 GB in 2020 on average, 20 GB in 2030 and 22 GB for heavy-data users (UL+DL) in 2020 and 42 GB in 2030
  - Disruptive scenario: 14 GB in 2020 on average, 77 GB in 2030 and 32 GB for heavy-data users (UL+DL) in 2020 and 185 GB in 2030

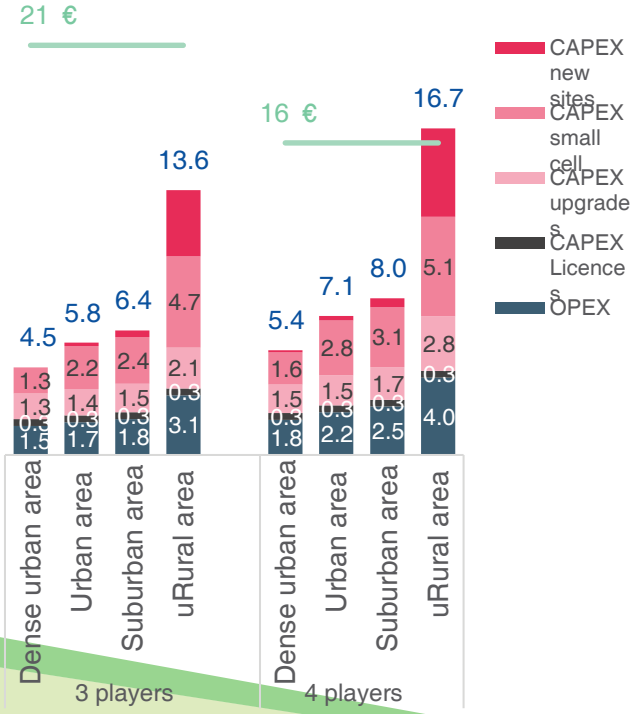
- **5G profitability heavily depends on future competition in national markets and on future usage/traffic conditions.**
  - Current/linear scenario: no need to densify the network. 3-player or 4-player markets both profitable
  - Non-linear scenario: 4-player markets not profitable at all, 3-player markets in question

Average network cost per 5G subscriber (10 years of deployment, EUR/month)

Linear/current scenario,
no fixed mobile substitution



Disruptive scenario with substantial
growth in data consumption



Key Output

1 Government Involvement

- Public-private initiatives are key enablers for growth in APAC: growing efforts to promote fiber expansion throughout their country (Sri Lanka, Thailand, etc.)
- In countries where FTTH is still in the early stages, efforts are made to create incentives for players via National Broadband Plans and deployment targets for coming years ('Digital Bangladesh', Pakistan's 'Broadband Policy', Cambodia 'ICT Master Plan 2020', etc.)

2 FTTH Growth

- By Dec. 2018, the 21 APAC countries under study have reached almost 550 million homes with FTTH/B networks, representing a coverage of 61.5% when compared to total homes
- Countries like Thailand, Philippines and Sri Lanka have experienced strong growth, increasing their Homes Passed by more than 25%
- But the effort is now made on fiber adoption among Fixed Broadband subscribers in countries where coverage is almost complete nationwide (Japan, South Korea, Taiwan)

3 Emerging Tech

- 5G implications: 5G will be a key factor for the promotion of fibre deployments and therefore will boost investments from public and private players
- Technological migration: Evolution from previous years have showed that cable-based and copper-based ISPs have started to diversify their core technologies towards full-fiber.

This booklet is the brief version of the entire FTTH APAC Market Panorama & APAC 5G Mini Panorama 2019 research report. The entire detailed report is exclusively available for Council members only.

Research Partner

IDATE DIGIWORLD