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700 MHz band - current status & approaches

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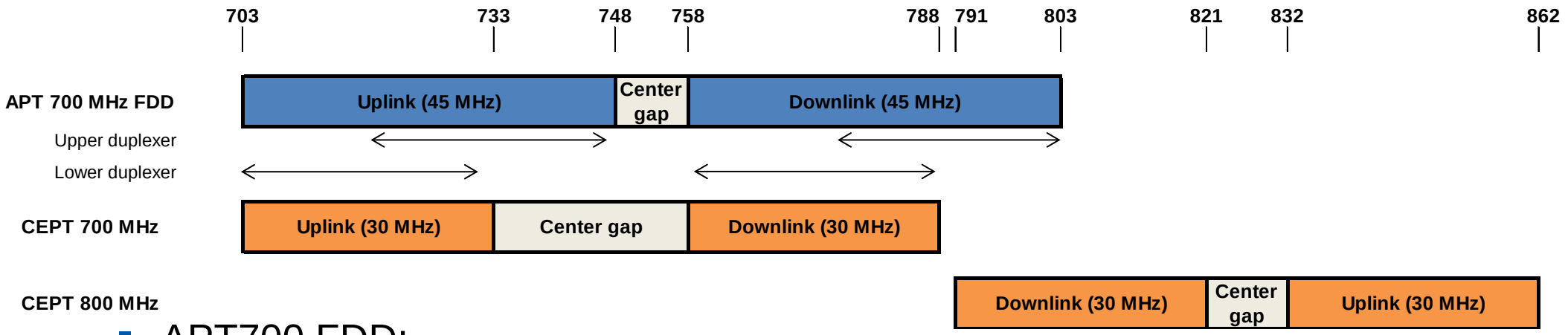
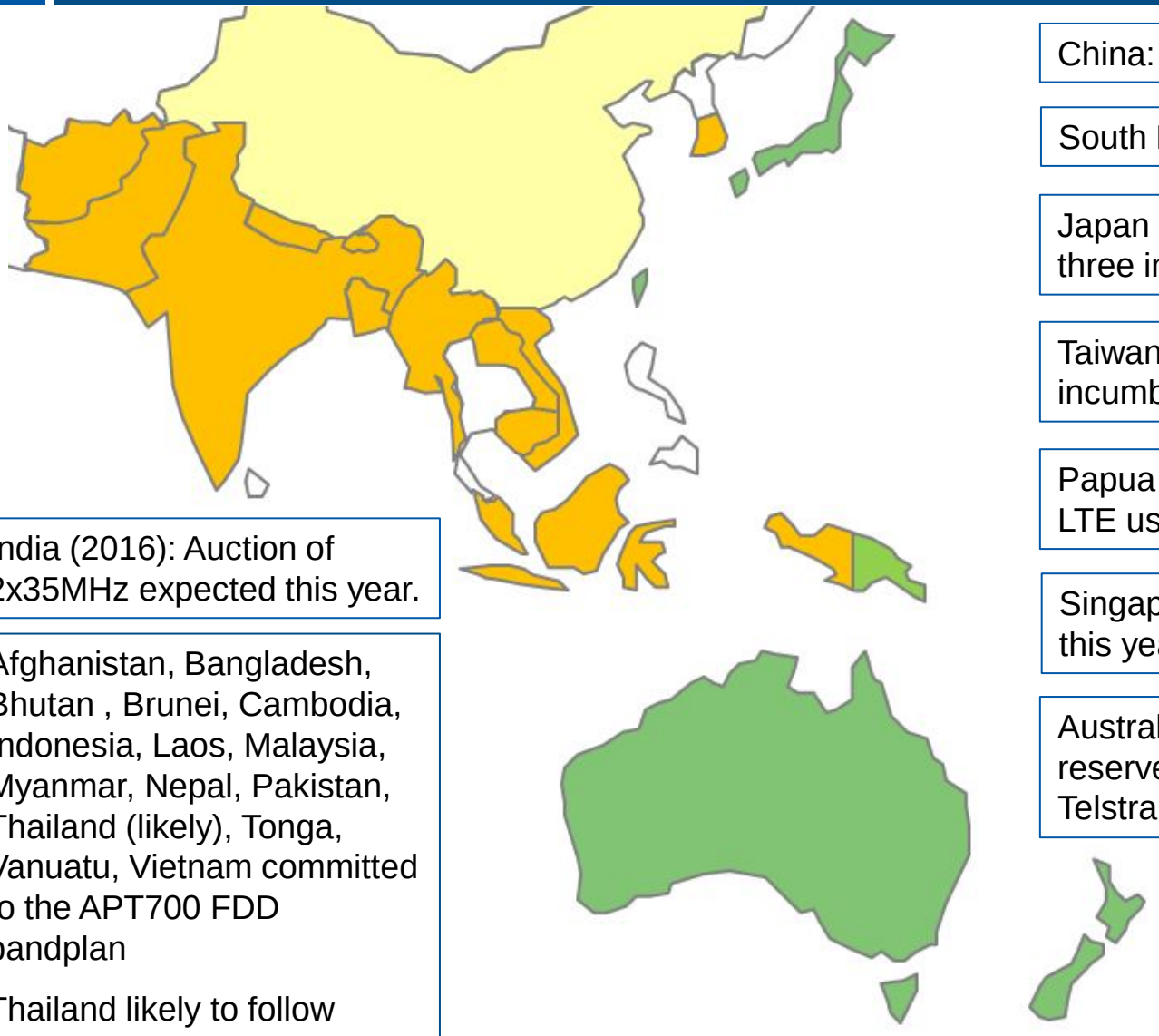
Insight in Economics™

The APT 700 MHz band plan



- APT700 FDD:
  - World's largest low frequency mobile band (2x45 MHz)
  - Small center gap, so extremely efficient
  - CEPT 700 MHz aligned with lower duplexer
  - High adoption rate across South America and Asia Pacific
- Other variations on 700 MHz band plan losing ground in terms of global adoption:
  - China only adopter of APT700 TDD (100MHz unpaired spectrum)
  - US band plan only adopted by US, Canada and Bolivia

Adoption across the Asia Pacific region



India (2016): Auction of 2x35MHz expected this year.

Afghanistan, Bangladesh, Bhutan , Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Thailand (likely), Tonga, Vanuatu, Vietnam committed to the APT700 FDD bandplan

Thailand likely to follow

Committed to APT700 TDD

Committed to APT700 FDD

Allocated APT700 FDD

China: Plans to adopt TDD bandplan

South Korea: Auction delayed

Japan (2012): 2x30MHz split equally between the three incumbents by administrative assignment

Taiwan (2013): Auction, spectrum won by 3 of the 5 incumbents

Papua New Guinea (2013): Digicel has launched LTE using 700MHz

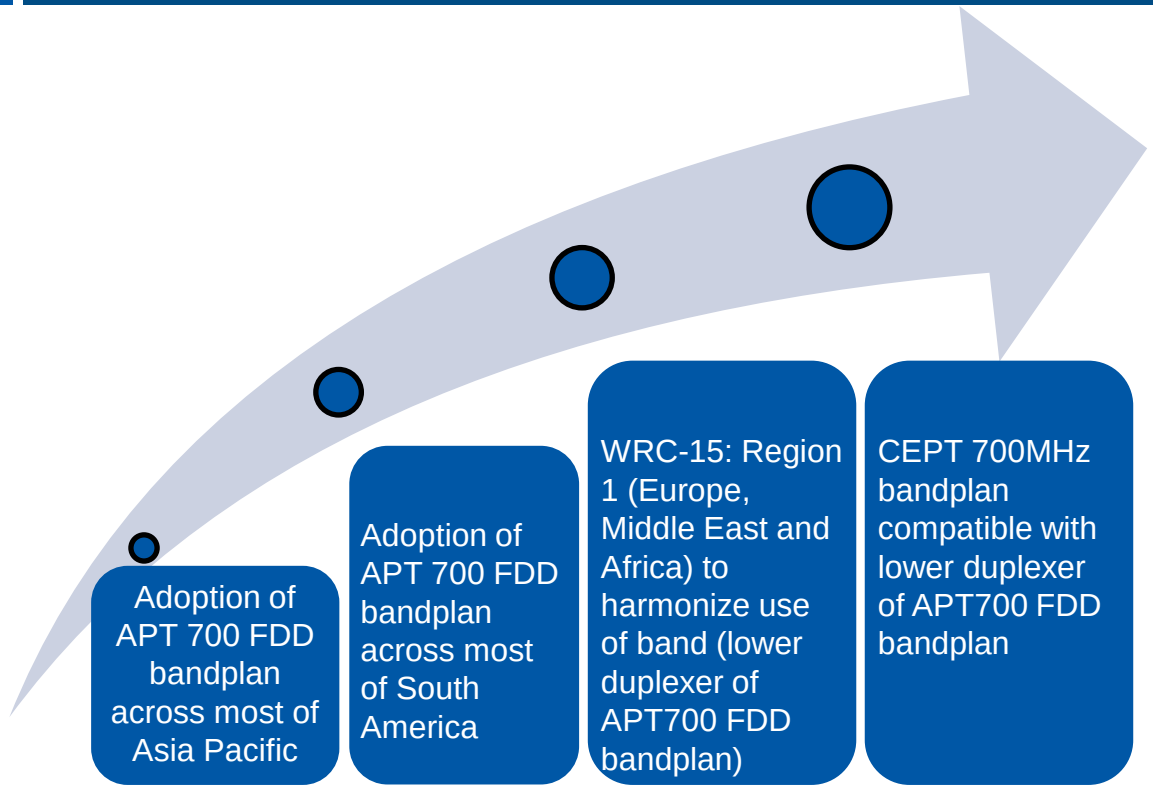
Singapore (2016): Auction of 2x45MHz expected this year.

Australia (2013): 2x30MHz sold in auction. High reserve prices cited as reason for unsold spectrum. Telstra and Optus have launched LTE networks.

New Zealand (2013): All 2x45MHz sold in auction and shared amongst the three incumbents

Fiji (2013): Auction of all 2x45MHz

700MHz – a global LTE band



- Economies of scale
- Interoperability
- Roaming

- Ecosystem is growing: More than 200 user devices and more than 120 smartphones available from Apple, HTC, LG, Samsung, Sony, Alcatel, ZTE, Huawei, Motorola and others
- Wide adoption of APT700 should turn this band into a global LTE carrier
  - Economies of scale
  - Cheaper handsets in local Asian markets
  - Will this make lower duplexer more valuable in Asia?

12 Commercially launched networks worldwide

Taiwan	New Zealand	Australia	Papua New Guinea	Panama
FarEasTone, Taiwan Mobile, Asia Pacific Telecom, Ambit	Spark, Vodafone	Optus, Telstra	Digicel	C and W, Movistar, Claro

TDD bandplan would most likely require separate ecosystem, so if China goes ahead with its plans, benefits to Asia Pacific region would be diminished

What's happening to prices?

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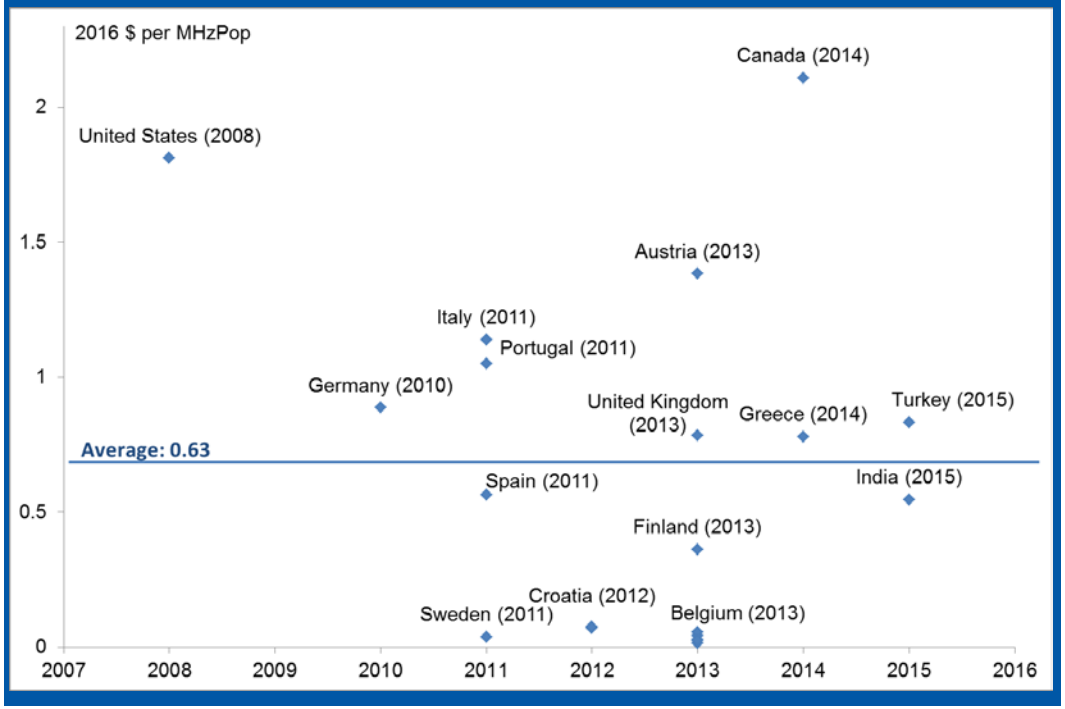
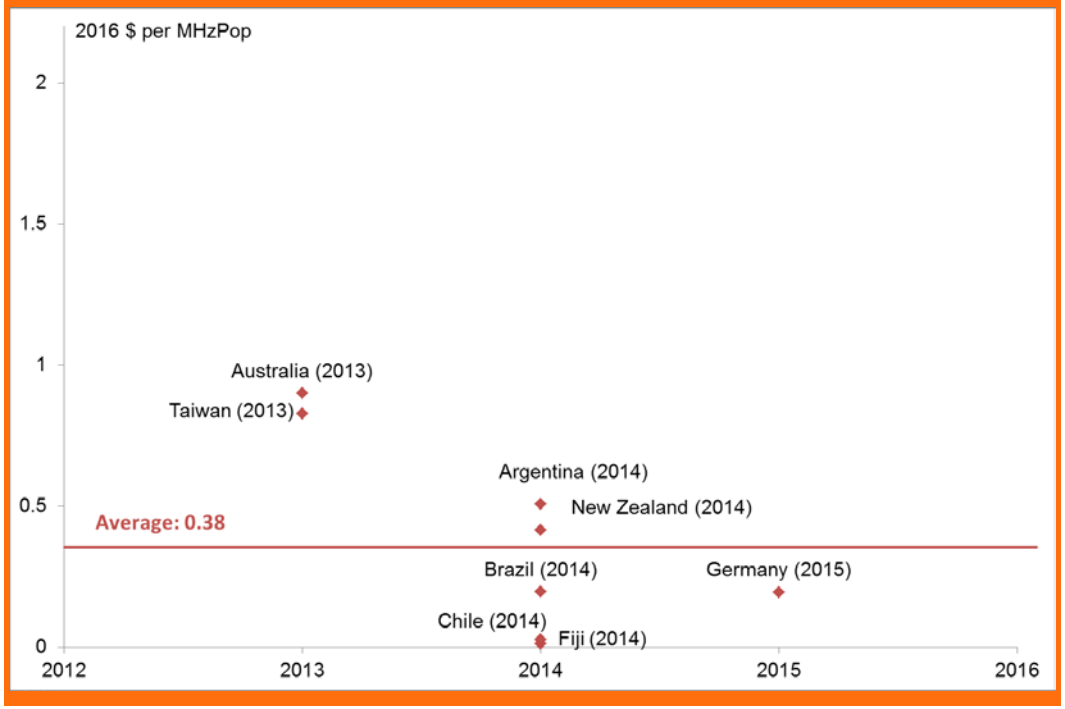
800 MHz and US 700 MHz bandplan



700 MHz



- Prices lower than in previous awards of comparable spectrum
  - Australia and Brazil ended at reserve
  - Limited competition in Germany

- Possible explanations:
  - Less scarcity owing to more supply and industry consolidation
  - Ecosystem uncertainty still a factor?
  - Is operator focus shifting to capacity in higher bands?

*Prices converted to USD using PPP exchange rate, adjusted for inflation and license duration (equivalent: 15-year license)

700 MHz – an ideal opportunity to improve coverage

- 700 MHz is ideal, low-band coverage spectrum
- Regulators in Europe used award of digital dividend to improve coverage and fill white spots

	All licenses	One coverage block	Auction design allocates coverage obligation
Description	• Coverage obligation applies to all licenses • Examples include Germany (2010), France (2011), Portugal (2011)	• Coverage obligation attached to a single block in the band (which may be wider than the other blocks) • Examples include UK (2013) and Austria (2014)	• Coverage obligation applies to all blocks • Bidders can bid for exemptions • Supply of exemptions set endogenously to ensure that one winner serves obligation • Obligation can be defined regionally • Only example to date: Denmark (2012)
Impact on allocation	• Serving coverage obligation may be too costly for some operators and they may not participate in the auction (Oi in Chile) • Competition in urban areas determines price • No need for coverage by all operators everywhere	• Regulator can ensure that coverage block is large enough to fulfil the obligation • Coverage obligation does not deter entry or participation • Coverage block may be unsold	• All bidders potentially on the hook for serving coverage obligation unless they can win an exemption • Regulator guaranteed to award coverage obligation • Flexible, regional specification possible
Impact on prices	• Prices of all blocks depressed	• Only coverage block is affected by cost of serving coverage obligation	• Prices of all blocks depressed • Price of exemptions reflect cost of serving coverage obligation
Impact on auction design	• Reserve prices should reflect cost of serving coverage obligation	• Reserve price for coverage block should reflect cost of serving coverage obligation	• Requires combinatorial design • Increased complexity for both bidders and the auctioneer

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