

Fredebeul-Krein, Markus; Steingröver, Markus

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## Enhancing broadband development and internet usages for improving networks and services in APEC member economies: Bridging the digital divide

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# **The 19th ITS Biennial Conference 2012**

## **“Moving Forward with Future Technologies: Opening a Platform for All”**

18 - 21 November 2012, Thailand

**Enhancing broadband development and internet usages for improving networks  
and services in APEC member economies: Bridging the digital divide**

Markus Fredebeul-Krein and Markus Steingröver

Aachen University of Applied Sciences

[Fredebeul-Krein@fh-aachen.de](mailto:Fredebeul-Krein@fh-aachen.de)

Detecon International GmbH

[markus.steingroever@detecon.com](mailto:markus.steingroever@detecon.com)

# **Enhancing broadband development and internet usages for improving networks and services in APEC member economies: Bridging the digital divide<sup>1</sup>**

By Markus Fredebeul-Krein and Markus Steingröver

## **Abstract**

The competitiveness of a country and entire regions today is strongly connected to its broadband adaptation. Broadband is not only playing a critical success role in the economy, it connects consumers, businesses, governments and facilitates social interaction. Many studies have been carried out over the last decade in the APEC region highlighting the status and the different developments of broadband in each economy. The e-APEC strategy and its goal to enable the people in urban, provincial and rural communities in every economy to have individual or community-based access to information and services via the internet by 2010 have been largely achieved.

Embedded are the key principles for broadband development to maximize access and usage, to facilitate continued competition and liberalization, to foster enabling regulatory frameworks and to build confidence in the use of broadband networks and services. Future prospects and the recommendations of APEC ministers are to set an ambitious goal of access to next generation high-speed broadband by 2020 to expand and improve ICT infrastructure for knowledge-based economies in the APEC region. In a recent meeting in Okinawa the commitments towards achieving the goal of universal access to broadband in the APEC region by 2015 were reaffirmed.

This paper evaluates measures to promote broadband development and internet usage in APEC countries. The first section highlights the importance of mobile technologies for broadband rollout in APEC countries. The second section makes a comparative study of the digital divide in the APEC economies. It identifies three major drivers for the digital divide and discusses how regulatory and public policy intervention can be leveraged to bridge the digital divide. The last chapter analyses appropriate regulatory policies to increase broadband penetration. One result is that an efficient and flexible spectrum management regime is of utmost importance for promoting mobile broadband development. It lowers market entry barriers, increases competition and leads to higher broadband penetration and geographic coverage. A decisive factor is also the amount of spectrum allocated for mobile communication on different mobile technologies and the different license types. The paper demonstrates, that is crucial to be efficient with spectrum management of the digital dividend in order to promote cost efficient mobile broadband coverage to rural and remote areas. The digital dividend will have a massive effect on rapidly increasing broadband penetration and coverage in emerging economies.

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<sup>1</sup> The content of this paper is based on a APEC commissioned study produced in 2011. See Detecon (2011).

## **1 Introduction**

The competitiveness of a country and entire regions today is strongly connected to its broadband adaptation. Broadband is not only playing a critical success role in the economy, it connects consumers, businesses, governments and facilitates social interaction. Many studies have been carried out over the last decade in the APEC region highlighting the status and the different developments of broadband in each economy. The e-APEC strategy and its goal to enable the people in urban, provincial and rural communities in every economy to have individual or community-based access to information and services via the internet by 2010 have been largely achieved.

Embedded are the key principles for broadband development to maximize access and usage, to facilitate continued competition and liberalization, to foster enabling regulatory frameworks and to build confidence in the use of broadband networks and services. Future prospects and the recommendations of APEC ministers are to set an ambitious goal of access to next generation high-speed broadband by 2020 to expand and improve ICT infrastructure for knowledge-based economies in the APEC region. In a recent meeting in Okinawa the commitments towards achieving the goal of universal access to broadband in the APEC region by 2015 were reaffirmed.

This paper evaluates measures to promote broadband development and internet usage in APEC countries. It is organised as follows: The first section highlights the importance of mobile technologies for broadband rollout in APEC countries. The second section makes a comparative study of the digital divide in the APEC economies. It identifies three major drivers for the digital divide and discusses how regulatory and public policy intervention can be leveraged to bridge the digital divide. The last chapter analyses appropriate regulatory policies to increase broadband penetration. This is done with respect to spectrum management and the digital dividend.

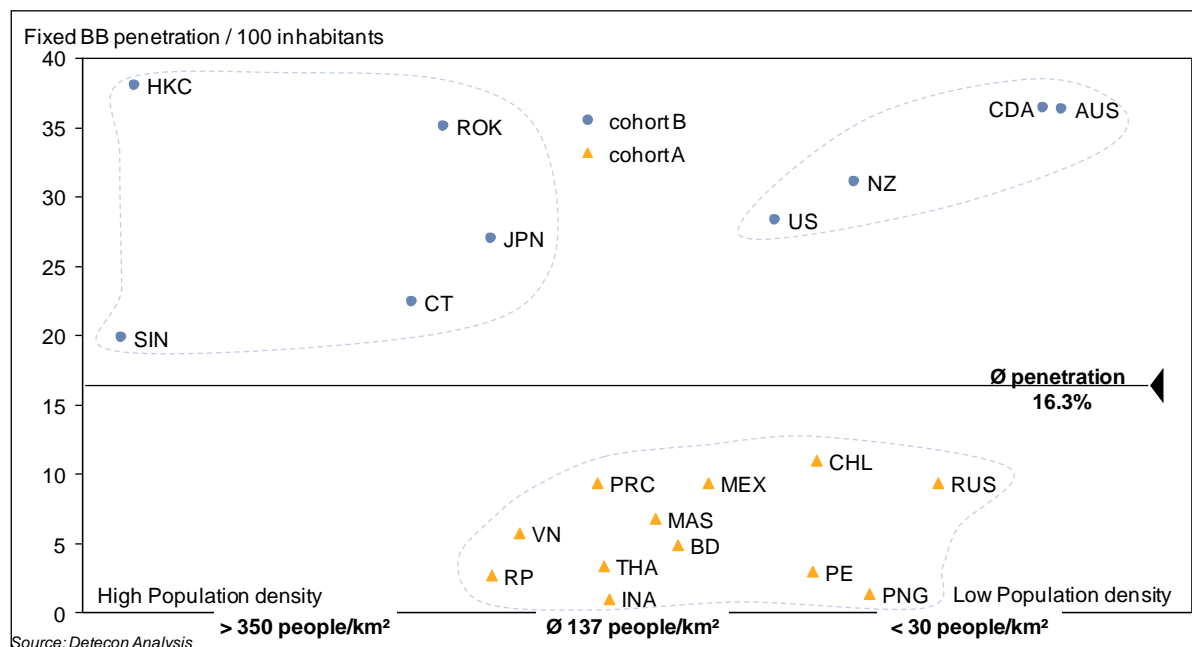
## **2 The importance of mobile technologies for broadband rollout in APEC countries**

With respect to broadband rollout, broadband penetration is a key metric and indicator for policy makers and regulators to determine the status of broadband usage per economy (ITU, 2012, p. 2). Penetration rates further allow policy makers to obtain a clearer picture of the effectiveness of their policies regarding the development of broadband across different economies as well as over time. A relatively slower increase of penetration rate might indicate certain market deficiencies or reflect market or economy-specific factors.

The figure below depicts the different fixed broadband penetration rates along the population density per APEC economy and gives evidence that APEC members with a high average population density have higher broadband penetration than economies with lower population density. Creating access to broadband in those densely populated economies is less expensive than in economies with lower

population density. Economies in the cohort of an average population density of 137 people per km<sup>2</sup> show fixed penetration rates below the average of 16.3% in the APEC. These member economies lack behind extensive fixed network infrastructures from the past. As the deployment of fixed networks to create broadband coverage requires large investments, less developed APEC economies rather focus on mobile technologies for providing broadband.<sup>2</sup>

**Figure 1: Fixed Broadband Penetration and Population Density in the APEC <sup>3</sup>**



As some economies in the APEC lack a strong and solid fixed infrastructure from the past, mobile technologies provided an alternative to close the gap in broadband access development. Today mobile internet is gaining more and more importance due to geographical necessity or more cost efficient access to rural areas where fixed infrastructure is of low quality or non-existent. Mobile internet is also gaining attention through the availability of numerous portable devices that foster usage of internet anytime and anyplace.

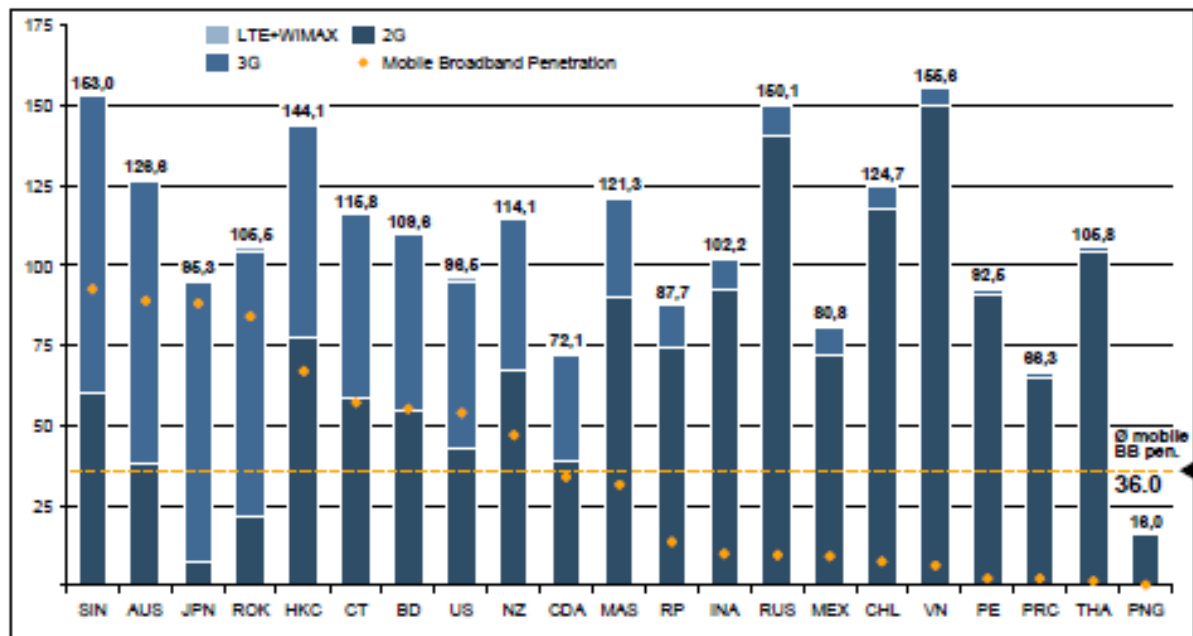
Mobile broadband penetration is mostly dependent on the availability of 3G mobile technologies. The next figure depicts mobile penetration considering all subscriptions related to 2G technologies or higher. 2G, although being substituted with 3G, is still a common technology to use mobile voice as well as basic data services. Mobile subscriptions with access to data communications at broadband speed in comparison to the overall mobile penetration are lower. Only Korea, Singapore, Japan and Australia exhibit a rather high mobile broadband penetration which is related to their high share of 3G subscriptions. The average mobile broadband

<sup>2</sup> For the importance of mobile networks in the APEC see CRA International (2006, pp. 37). For an assessment of fiber rollout see for example Pyramid (2011)

<sup>3</sup> Source: Detecon 2011

penetration in the APEC at 36% compared to the fixed penetration of 16.3% is significantly higher and indicates that mobile technologies are important drivers for increasing broadband penetration rates in the APEC.

**Figure 2: Mobile Penetration in the APEC, differentiated by technologies<sup>4</sup>**



Nonetheless, developing economies in the APEC that introduced 3G recently have a comprehensive development path ahead to level up to broadband equivalent speed in the mobile segment and roll out 3G networks. Data connectivity on 2G is not always sufficient for basic internet services and as data traffic rise, capacity of bandwidth and spectrum shortage become issues to be addressed by regulators and governments.

Towards 4G technologies, especially long term evolution (LTE), most of the economies have no commercial offerings yet, although most APEC members have committed to elaborate LTE in trials and field tests. LTE is driving the discussion around technological innovation with significant proportion of investments flowing into trials and network development. Operators are still cautious about market development and demand of such services. So far only Hong Kong, USA, Japan, Singapore, Korea, Philippines and Canada have commercial LTE service offerings in place.

As a conclusion we note that on average, the mobile broadband penetration in the APEC is significantly higher than fixed broadband penetration. In economies in the cohort of an average population density of 137 people per km<sup>2</sup> 3G and LTE technologies are already a key enabler to increase broadband penetration. But also in countries with a lower population density mobile technologies have the potential to

<sup>4</sup> Source: Detecon (2011)

bring broadband penetration levels up. This is particularly the case because increasing broadband coverage via fixed networks is more cost intensive.<sup>5</sup> The next section will focus on those APEC countries with a low fixed broadband penetration. The question to be addressed is how to overcome the digital divide with regards to internet usage in these countries.

### **3 Digital divide in APEC**

There have been numerous studies on a digital divide<sup>6</sup> in developed and especially developing economies over the past decade and its unfavourable impact on the economy and society.<sup>7</sup> This section broadly discusses the digital divide with regards to internet usage in the APEC member economies and loosely refers to the emerging gap between people who participate in the “information society” within an economy and those who do not. A good indicator of the prevalent digital divide in the APEC member economies is the ICT Development Index (IDI) which measures ICT skills, usage and access of a country.<sup>8</sup> It is a composite index that tracks the overall development of economies towards becoming an information society. The IDI has been developed by the ITU and was used in the figure below to plot the APEC economies based on their adjusted GDP per capita.

A comparison of APEC economies by GDP per capita over the ICT Development Index yields two cohorts of APEC economies. The digital divide in cohort A economies is expected to be much higher than in cohort B countries. Economic wealth measured in GDP per capita is therefore a strong indicator for the prevalent digital divide.

The graph on the right of the figure below illustrates that mobile communications has the potential to represent an effective means for providing access to voice and data services to the rural and remote population. While there is still a widening gap emerging in developing economies of cohort A (there are 240 percentages more mobile subscribers per 100 inhabitants than actual internet users in percentage of population), developed economies of cohort B register only 48 percentages more mobile subscribers per 100 inhabitants than internet users in percentage of population.

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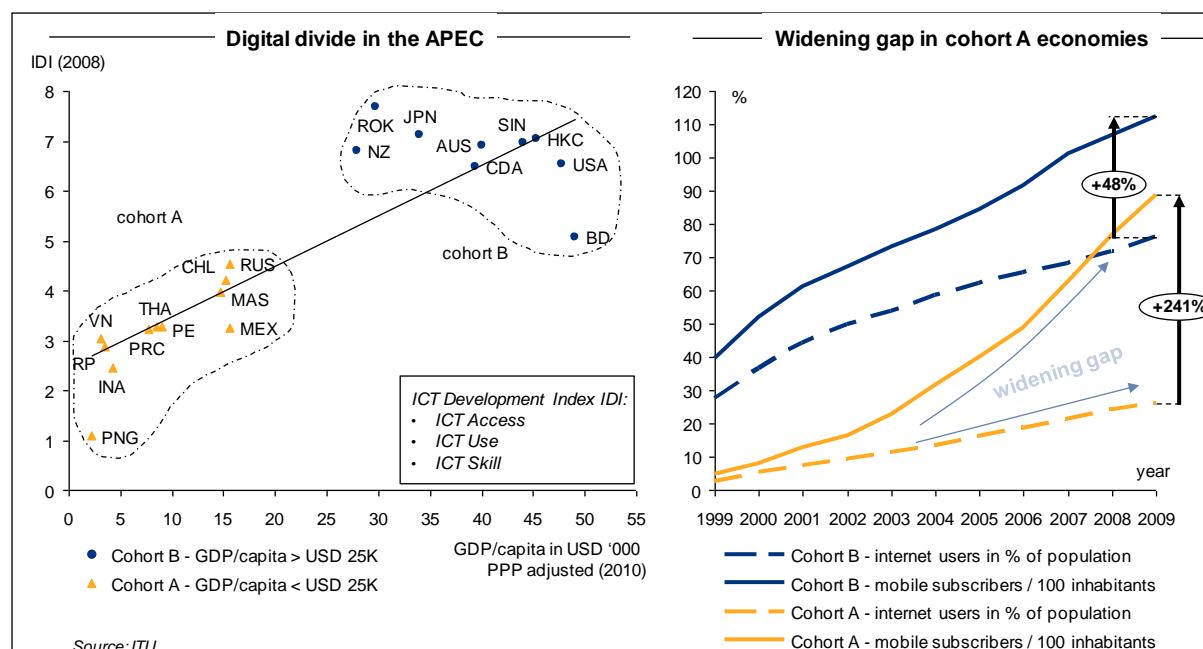
<sup>5</sup> See for example Pyramid (2008)

<sup>6</sup> Digital Divide refers to inequalities between groups in terms of access to information and communication technologies.

<sup>7</sup> See for instance Warschauer (2003) and Goldfarb, A and J. Prince (2008).

<sup>8</sup> For a specification of the index see ITU (2010).

**Figure 3: Digital Divide in the APEC**



The question to be raised is what governments do in view of bridging the digital divide? The internet-related digital divide of an economy is driven by three major factors that can be significantly influenced through either public policy or regulatory intervention in the telecom market: 1) Access, 2) affordability, and 3) technology skills:

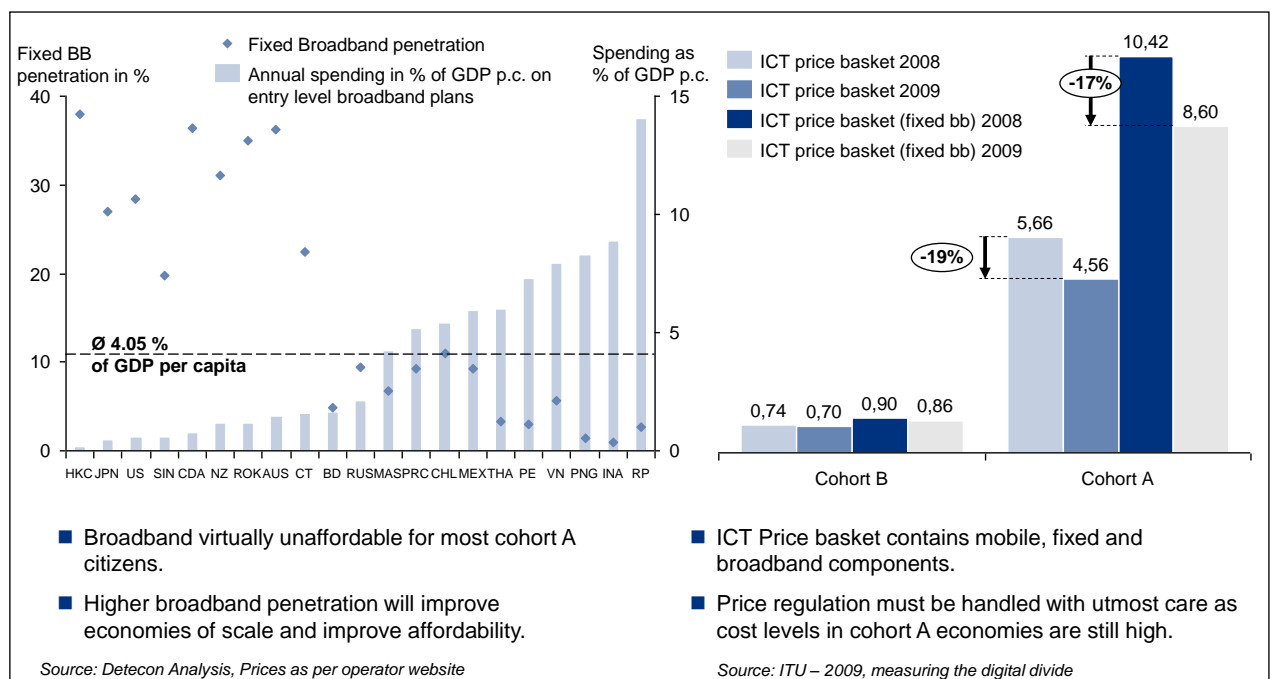
1. *Access to mobile or fixed line internet* is a prerequisite for consumers to participate as digital citizens in the information society. Access can exist either directly in the households or spatially offsite at local hubs or other facilities such as schools, universities or place of employment. Access bandwidth determines which services can be consumed and is a driver of the digital divide in the context of broadband access.
2. Having access to internet services, one must further account for *affordability of access* e.g. the xDSL subscription price or the mobile data package as well as for terminal equipment prices such as for mobile devices and desktop computers.
3. Finally, *technology skills and awareness* are drivers of the digital divide. However, compared with accessibility and affordability, skills are an ICT enabler driving internet usage once the ICT services are accessible and affordable. Naturally for people to participate in the information society, they need to be informed of all the possibilities of the information society that exist. Non-awareness, which is often the case in lower developed economies, can be a major inhibiting factor for internet usage. Likewise consumers need technology skills for using a computer or mobile device which in turn is dependent on demographic factors such as age, gender and income group.

The graph above indicates that access to internet services is in principle already possible. The reason why it is not used must therefore be either because of non-affordability or because of a lack of technology awareness as in all countries 3G networks are operating and allow for broadband internet access.

The figure below shows the affordability of broadband in the APEC economies. It compares the affordability of ICT services of cohort A and cohort B in the years 2008 and 2009 by using the ITU developed ICT Price basket. The ICT Price basket is a composite index that maps fixed, mobile and broadband service pricing as a percentage of the adjusted monthly GNI per capita, indicating the relative affordability of ICT telecommunication services in an economy.

The graph shows that ICT telecommunication services including fixed, mobile and broadband subscriptions are significantly more expensive in the APEC developing economies when measured as a percentage of the monthly GNI per capita. While broadband prices for cohort B economies are just 0.86% of monthly GNI, prices of cohort A economies amount to an average of 8.6% of monthly GNI per capita, hence making them less affordable for the general public. Fortunately, as telecommunication markets develop, prices are dropping i.e. broadband prices have dropped by 17% from 2008 to 2009 for cohort A economies making these services more affordable. The IDI and broadband affordability are strongly correlated and there seems to be a critical pricing threshold at about 2% of monthly GNI per capita where increased ICT uptake occurs and leads to elevated IDI ratings.

**Figure 4: Affordability of broadband in the APEC <sup>9</sup>**



<sup>9</sup> Source: Detecon (2011)

## **4 Bridging the digital divide in the APEC**

As has been shown above, there are three major drivers of the digital divide and promoters of the ICT uptake: accessibility, affordability and technology awareness/skill. These can be significantly influenced through either public policy covering industrial and social policy measures or through regulatory intervention in the telecom market (ITU, 2012).

Industrial policy through government funding is used to promote accessibility and affordability of broadband, while social policy is the key for creating technology awareness and skills in the population. As to regulatory measures for bridging the digital divide, wholesale access obligations as well as regulatory pricing and margin squeeze testing are important measures of driving accessibility and affordability. Also, Universal Service Obligations (USO) and the use of a Universal Access and Service Fund (UASF) are major drivers for providing rural broadband access. The UASF is further complemented by other financing mechanisms such as national and regional Public Private Partnership that also rank high among the survey participants.

Given that mobile communications represent the most effective means for providing access to voice and data services to the rural and remote population in the APEC, the remaining part of this section will look at spectrum-related factors which can increase mobile broadband penetration rates.

### **4.1 Spectrum policies**

Mobile services play a key role in achieving coverage in most developing economies. 3G and LTE take-off is largely determined by the amount of available spectrum allocated to these technologies. It is important that NRAs recognize that a flexible and efficient regulatory framework for managing the scarce resource spectrum is the key for providing the necessary incentives for investments while promoting broadband coverage of rural and commercially less profitable areas. Efficient spectrum management lowers market entry barriers, increases competition and leads to higher broadband penetration and geographic coverage.

In a recent report for the GSMA Spectrum allocation procedures in the Asia Pacific region are described as being sometimes unclear leading to inefficiencies. Unfair spectrum allocation and over-licensing was also observed (GSMA 2012).

In general it is agreed that efficient spectrum management requires a move from the traditional prevailing command and control approach to a more market oriented approach to spectrum management. In particular the following weaknesses are to be removed (ACMA 2007, Cave/Hatta 2008):

- overlapping bands for specific uses and users;
- no or little trading with spectrum;

- strong control of interference between users;
- slow progress of innovations to market;
- slow spectrum reallocation for new systems; and
- Simultaneous occurrence of spectrum shortages and spectrum hoarding.

These problems can be structured into following four different spectrum management topics:

1. *Spectrum availability of range and bandwidth* for provisioning of broadband services has a strong impact on required investment levels for network deployment, market pricing and coverage. In the APEC many low penetration countries can significantly improve the availability of spectrum by introducing reforming plans including compulsory acquisition of unused or inefficiently used spectrum. In countries like Indonesia also significant improvements could be achieved by rationalizing spectrum assignments, coordination of assignments to reduce interference and efficiency measures such as introducing dedicated guard channels. This requires a one-time clean-up of spectrum assignments and an adoption of efficient spectrum management techniques thereafter.
2. *Spectrum assignment and pricing* can be done competitive or administrative resulting in differences in pricing of licenses. Market demand and public policy objectives should be evaluated to choose the appropriate assignment mechanism. Otherwise increased artificial costs of licenses can delay the introduction of services and broadband deployment speeds. A recent study shows that future Spectrum assignment in APEC economies will mostly be done through competitive auctioning.<sup>10</sup> Recent WiMAX and LTE licenses for instance were auctioned in all economies except Japan imposed license conditions to achieve target market penetration levels for the new services (Detecon 2011). This was also done in Germany where Universal broadband service targets were part of the spectrum license auctioned in 2010. In the absence of Universal service funds this is an example of using spectrum assignment policies to achieve Universal service targets.
3. *Coverage obligations* imposed on the licensee can help to rollout network infrastructure in rural, less profitable areas, however they can also deter investments or increase price levels and therefore have to be carefully balanced. Coverage obligations are frequently used by APEC members when issuing licenses. APEC members asked in the Detecon Broadband survey averaged at 50-75% of population coverage obligations when issuing licenses in the past, well recognizing that the obligations vary depending on the frequency bands and the objectives that the NRA is following at the time of issuance (Detecon 2011).

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<sup>10</sup> See GSMA (2012)

4. *Spectrum trading and liberalization* can increase economic efficiency of spectrum management and competition in downstream markets through technology-/service neutral usage and tradable spectrum rights. Furthermore, there is an increasing trend that NRA's tend to issue licenses that are technology neutral and service neutral to give operators greater flexibility how to use the spectrum under changing conditions. At least 8 APEC economies have issued technology neutral licenses in the past or in recent auctions. However technology neutrality is still not rule but exception in many APEC countries – especially in those which suffer from the digital divide (Detecon 2011).

As a conclusion we note that cleaning-up the frequency spectrum and introducing efficient spectrum management are measures to improve broadband penetration, in particular in APEC economies with low fixed broadband penetration. This could hence be considered as Universal Service Policy measure as it will increase spectrum availability which will in turn translate into higher coverage and quality of service. However doing so is expensive as external help is usually needed due to a lack of capacity in NRAs. In low-penetration countries where fixed broadband does not really play a role, regulators are often following a Universal Service approach that focuses on funding roll-out projects in uneconomic areas. Shifting attention to basic pre-requisites like spectrum policy and re-allocation of funding to could significantly improve the situation.

## **4.2 Digital dividend**

In Asia-Pacific the transition to digital TV by switching off the analog TV in UHF band (470-862MHz) of the spectrum will be completed latest by 2020 (Analysys, 2012). Digital TV takes up 50-75% less spectrum space for the same amount of channels as compared to analogue TV (e.g. for 40 digital channels need only 200MHz out of 500MHz available). The resulting white space may be utilized for mobile broadband services, but requires prior harmonization of spectrum for optimal use (Analysys, 2012).

This analog/digital switchover provides a grand opportunity for increasing mobile broadband coverage and introducing innovative services into the market. The superior propagation characteristics of the digital dividend frequency band allow for a rapid rollout of infrastructure at reduced cost and make it perfect for rural network coverage. The potential benefit of leveraging the newly available spectrum is particularly large for APEC economies with comparatively low mobile broadband coverage while developed economies need new spectrum to increase capacity of mobile networks for coping with the exponential internet traffic growth (Detecon 2011).

Countries such as Indonesia, Vietnam and Peru with low mobile broadband penetration can significantly benefit from the digital dividend. Likewise, economies in the medium range of mobile broadband penetration such as New Zealand and Malaysia can further increase geographic coverage while already highly penetrated economies such as Japan and Korea can use the digital dividend for improving

network capacity. Regarding LTE/4G services, APEC member economies have either already issued specific licenses on higher frequency bands or permit 4G services through service neutral licenses.

The potential benefit of leveraging the newly available spectrum is hence particularly large for APEC economies with comparatively low mobile broadband coverage while developed economies need new spectrum to increase capacity of mobile networks for coping with the exponential internet traffic growth. So far, only the United States has released the digital dividend spectrum among the APEC economies, while nine other economies have plans when to perform the digital switchover (Analysys, 2012).

Apart from the individual country situation a coordinated and harmonized regional approach is necessary in order to realize economies of scale in device products and overcome regional fragmentation. Moreover practical usage of White Space Frequencies is limited if not coordinated. The APT Wireless Group (AWG) in 2010 provided guidelines on harmonizing of digital dividend to be applied locally and across APAC region (GSMA 2011b):

1. Allocation of all digital TV to lower frequencies, and
2. Allocation of all mobile broadband services to 698-806 MHz and use of frequency or time division duplex technology.

However, APEC countries still have a long way to go in regional harmonization of the spectrum; most countries in the region projected to complete analogue switch off. In Asia the UHF band still primarily used for analogue TV and countries varying in analogue standards and channelization. Digital TV penetration varies among APAC countries with different technical standards (DVB-T, ATSC, ISDB-T, DMB-T). Varying stages of plan development across region for analogues TV switch off; digital dividend can't be realized in full until complete switch off. For some countries, UHF is also used for other services other than broadcasting which may restrict the country on full harmonization of the digital dividend (see GSMA 2011).

The fact that especially those countries that suffer the most from the digital divide have poor spectrum policies and spectrum management capabilities leads to a similar conclusion for digital dividend as above with regard to general spectrum management: Capacity building in terms of assisting in allocating the digital dividend, planning the switchover and in regional co-ordination of digital dividend policies should be seen as Universal Service policy. Funding these activities is most likely highly valuable for narrowing the digital divide. National Universal service Policies as well as assistance for international donors should be aligned accordingly.

## **5 Conclusion**

For many of the emerging APEC countries, mobile communication is the predominant form of communication: The average mobile broadband penetration in the APEC is significantly higher than the fixed broadband penetration. Against this

background governments in APEC developing economies have realized that mobile communications represent the most effective means for providing broadband connectivity including access to voice and data services to the rural and remote population. Mobile communications have thus a high potential facilitating internet usage in these countries. Yet, data also demonstrates that there is a high digital divide in APEC economies with low broadband penetration. Moreover, the gap between mobile subscriber rate and internet user rate is increasing in these economies. When mobile technology remains below its potential, this is because of shortcomings in affordability and technology awareness. While access to internet services is in many cases already possible, empirical data demonstrates that in the APEC huge differences in affordability of telecommunication services in general and affordability of broadband services in particular exist.

Broadband penetration rates can be significantly influenced through either public policy covering industrial and social policy measures or through regulatory intervention in the telecom market. Implementing the right set of regulatory remedies is crucial to promote infrastructure development and support broadband growth. In this respect it is of utmost importance that these economies have an efficient and flexible spectrum management regime in place for promoting mobile broadband development. It lowers market entry barriers, increases competition and leads to higher broadband penetration and geographic coverage. Among the APEC economies, so far spectrum assignment has mostly been done through competitive auctioning. Recently, APEC members have started to increase flexibility of issued licenses by easing up license conditions and allowing secondary trading to reduce inefficient spectrum usage, increase economic efficiency and allow for an agile response to new technologies in the market. They have also begun to define roadmaps for the analog/digital switchover which is expected to have a massive effect on rapidly increasing broadband penetration and coverage.

Mobile broadband penetration is also determined by the amount of spectrum allocated for mobile communication on different mobile technologies and the different license types. As this paper has demonstrated, it is crucial to be efficient with spectrum management of the digital dividend in order to promote cost efficient mobile broadband coverage to rural and remote areas. The digital dividend will have a massive effect on rapidly increasing broadband penetration and coverage in emerging economies. The superior propagation characteristics of the digital dividend frequency band allow for a rapid rollout of infrastructure at reduced cost and make it perfect for rural network coverage. So far, only the US has released the digital dividend spectrum among the APEC economies, while nine other economies have plans to perform the digital switchover.

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