THE CONCEPTUAL FRAMEWORK FOR BROADBAND INTERNET AND GLOBAL TRENDS

Telecom Advisory Services, LLC

9th Meeting Of The Comcec Transport And Communications Working Group
Ankara, Turkey March 16th, 2017

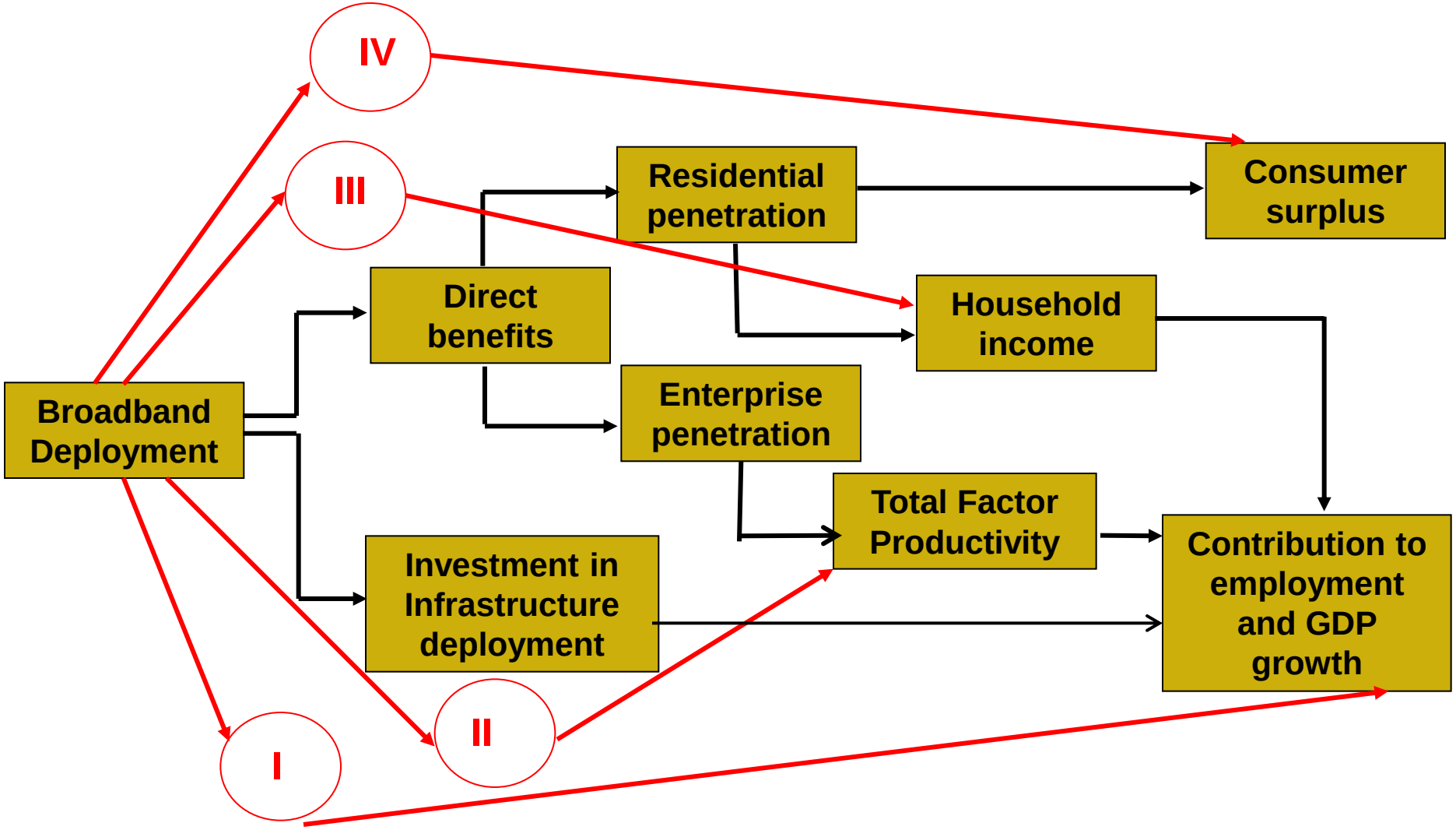
AGENDA

- Social and economic impact of Broadband Internet
- Global broadband supply trends
- Global broadband demand trends
- How to increase broadband penetration? Supply and demand challenges

BROADBAND TECHNOLOGY IN THE COMMUNICATIONS VALUE CHAIN

Value Chain Link	Function	Alternative Technologies
International Connectivity	Connections to the rest of the world and Internet "cloud"	• Satellite • Fiber optics (submarine cable and long-haul terrestrial) • Microwave
Domestic backbone	Traffic carried between fixed points of interconnection and to the routing switch	• Fiber optics • Microwave links
Switching/routing	Intelligence in the network that ensures that communications traffic is routed correctly	• Optical switching
Last mile distribution	Access to the customer premise or individual terminal	• Fixed wireline (ADSL (copper), Cable modem, Fiber optics) • Fixed wireless (WiMax, Satellite) • Mobile (3G, 4G, 5G)
Distribution within customer premise	Modem Router	• Ethernet • Wi-Fi

SOCIAL AND ECONOMIC CONTRIBUTION OF BROADBAND



Source: Telecom Advisory Services

AS A GENERAL-PURPOSE TECHNOLOGY, BROADBAND YIELDS SIGNIFICANT POSITIVE EXTERNALITIES

BROADBAND ECONOMIC EFFECTS

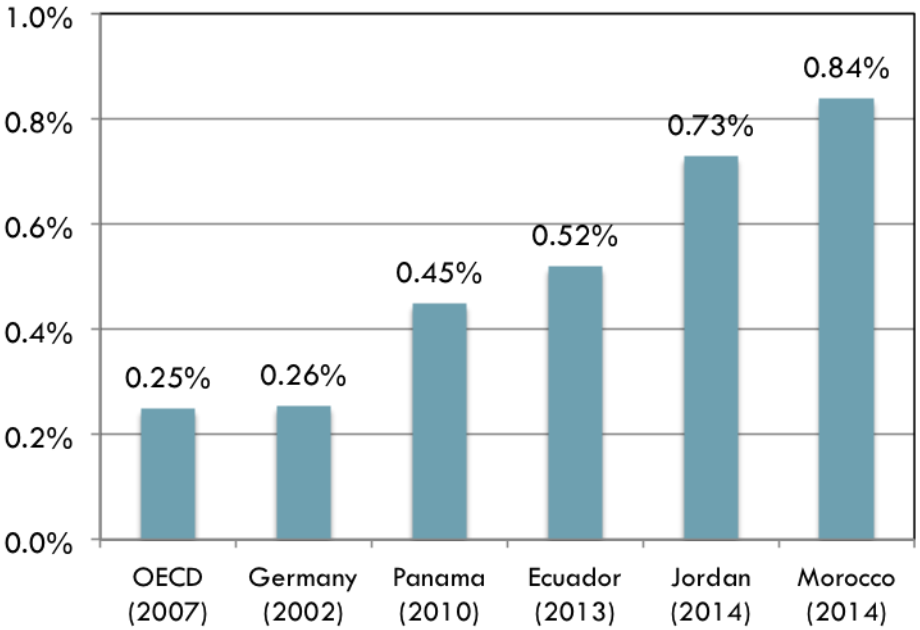
Productivity	• Improvement of productivity as a result of the adoption of more efficient business processes enabled by broadband	• **Marketing of excess inventories** • **Optimization of supply chains**
Innovation	• Acceleration of innovation resulting from the introduction of new broadband-enabled applications and services	• **New applications and services (telemedicine, Internet search, e-commerce, online education, VOD and social networking)** • **New forms of commerce and financial intermediation**
Value chain restructuring	• Attract employment from other regions as a result of the ability to process information and provide services remotely	• **Outsourcing of services** • **Virtual call centers** • **Core economic development clusters**

Source: Telecom Advisory Services

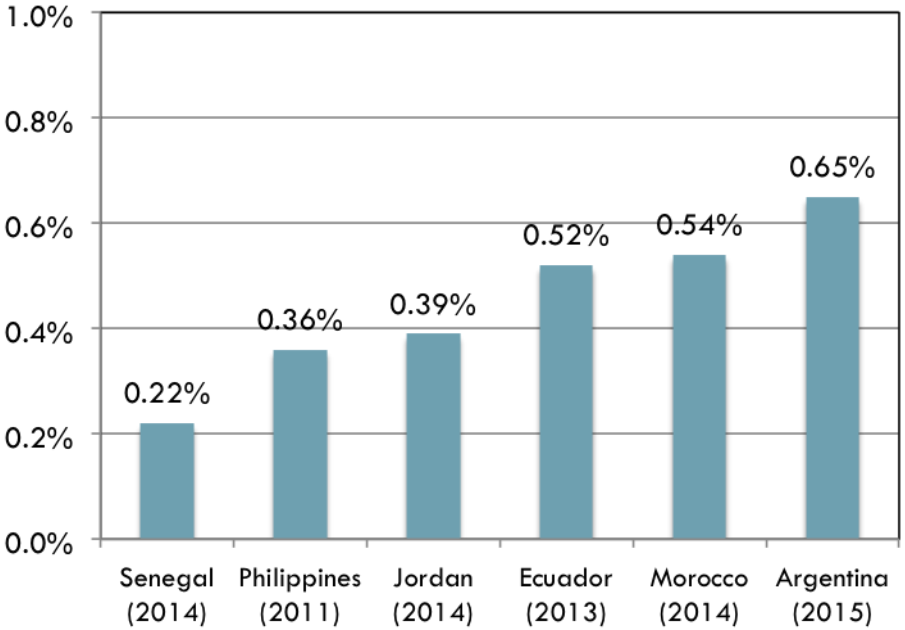
EXTENSIVE EVIDENCE EXISTS OF THE POSITIVE ECONOMIC EFFECT OF BROADBAND TECNOLOGY: FIXED BROADBAND HAS HIGHER IMPACT THAN MOBILE

CONTRIBUTION TO GDP GROWTH FOR EVERY 10% INCREASE IN BROADBAND PENETRATION

Fixed Broadband

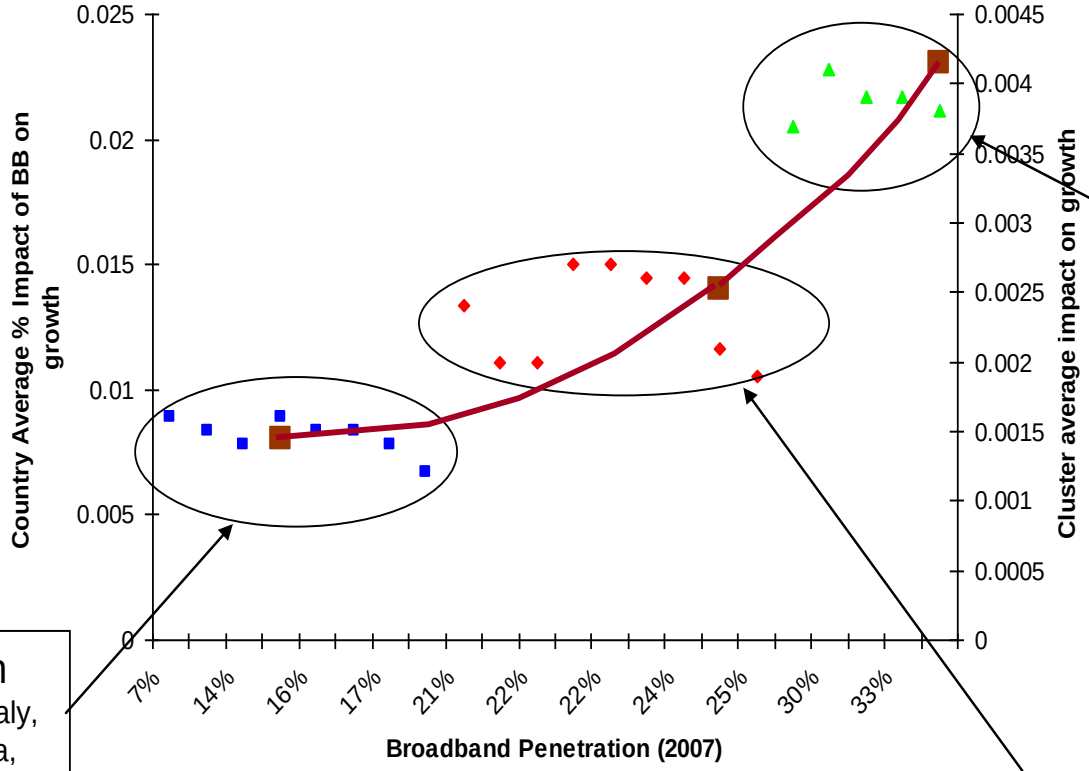


Mobile Broadband



Source: Koutroumpis (2009); Katz and Suter(2010); Katz and Koutroumpis (2012); Katz and Callorda (2015); Katz and Callorda (2016); Katz, Callorda and Renteria (2016)

CONTRIBUTION TO GDP GROWTH FOR EVERY 1% INCREASE IN FIXED BROADBAND PENETRATION



Source: adapted from Koutrompis (2009)

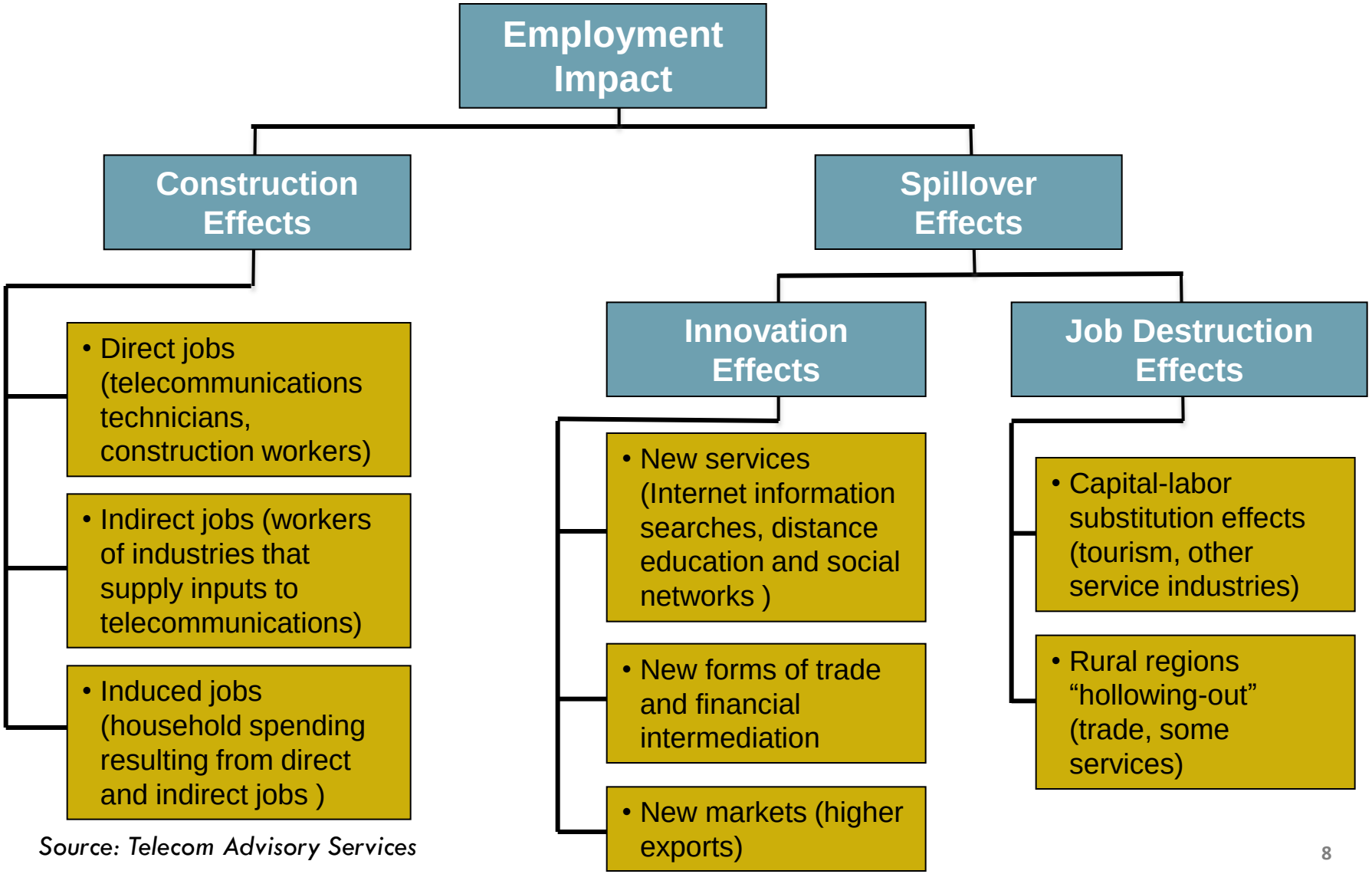
High penetration
- Denmark, Norway, Netherlands, Sweden, Switzerland
- Average contribution to GDP growth: 0.023

Low penetration
- Greece, Portugal, Italy, New Zealand, Austria, Hungary, Spain, Ireland
- Average contribution to GDP growth: 0.008

Medium penetration
- Germany, France, Japan, Belgium, UK, Australia, US, Canada, Luxemburg
- Average contribution to GDP growth: 0.014

IMPACT OF BROADBAND ON EMPLOYMENT IS MORE COMPLEX, RESULTING IN JOB CREATION BUT, IN SOME CASES, DESTRUCTION

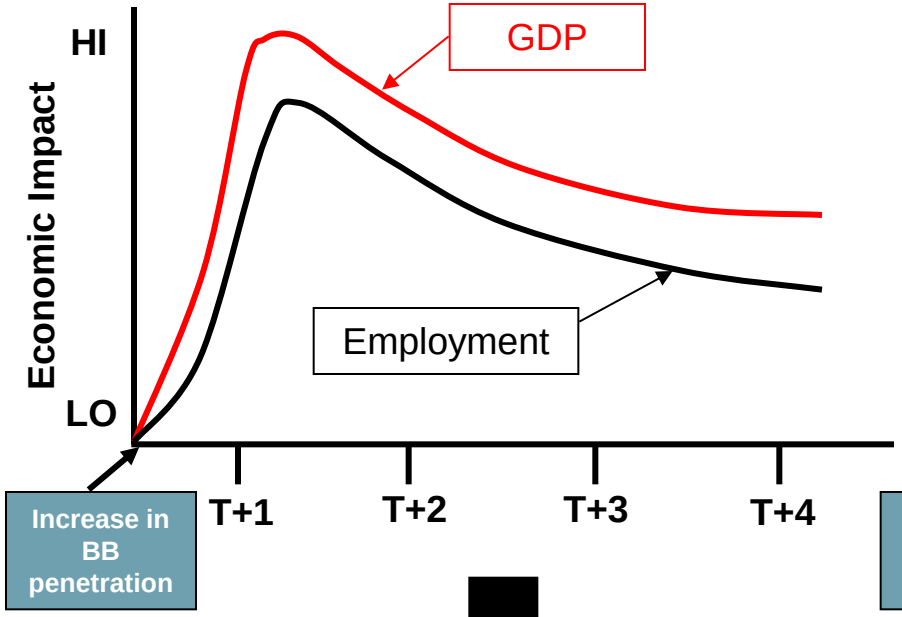
BROADBAND CONTRIBUTION TO JOB CREATION



Source: Telecom Advisory Services

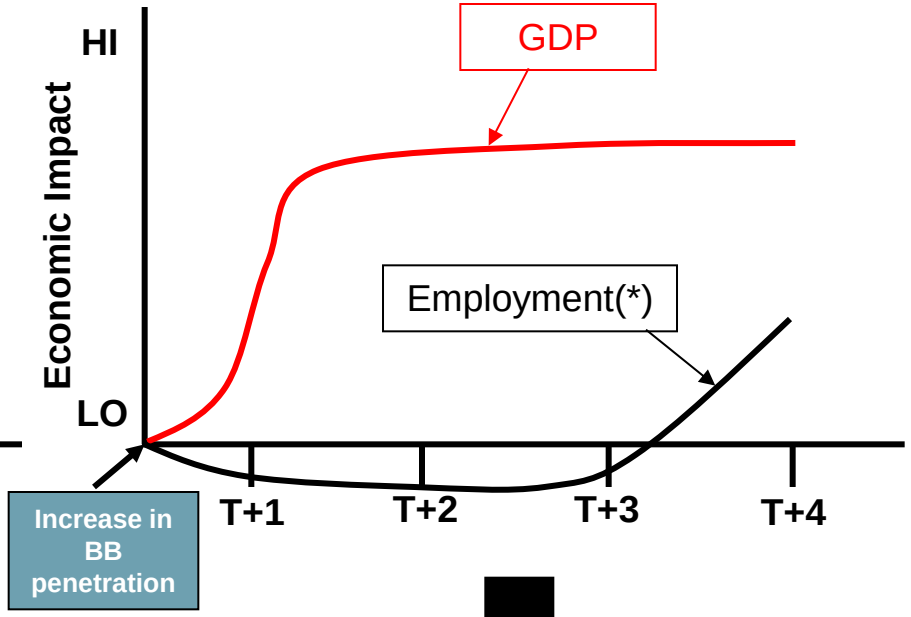
CONCEPTUAL BROADBAND ECONOMIC IMPACT

High Broadband Penetration Countries



- **High economic growth initially, diminishing over time ("supply shock" effect)**
- **New Economic Growth (innovation, new services)**

Low Broadband Penetration Countries



- **High stable economic growth ("catch up" effect)**
- **Capital/labor substitution limits employment growth ("productivity effect")**

Source: Telecom Advisory Services

(*) Results are at a low significance level

CONCLUSIONS ON BROADBAND SOCIAL AND ECONOMIC IMPACT

- Broadband is defined as a high capacity data transmission technology that allows a large number of messages and telecommunications traffic types (video, data, voice) to be communicated simultaneously
- As a general purpose technology, broadband is a critical infrastructure to foster economic growth and welfare (GDP and productivity growth, job creation, consumer surplus)
- Abundant empirical evidence of broadband contribution to GDP growth: fixed broadband higher impact than mobile, so far
- Broadband economic impact increases with penetration: "return to scale" effect
- Broadband contribution to employment is more complex: short term "construction" effect, long term "innovation" combined with capital-labor sustitution in some industries and geographies
- These effects result in distinct economic impact profiles between developed and emerging countries
- Implications of broadband social and economic impact are numerous
  - Countercyclical contribution
  - Critical infrastructure for stimulating trade and integration
  - Need to combine broadband planning with conventional economic development public policies

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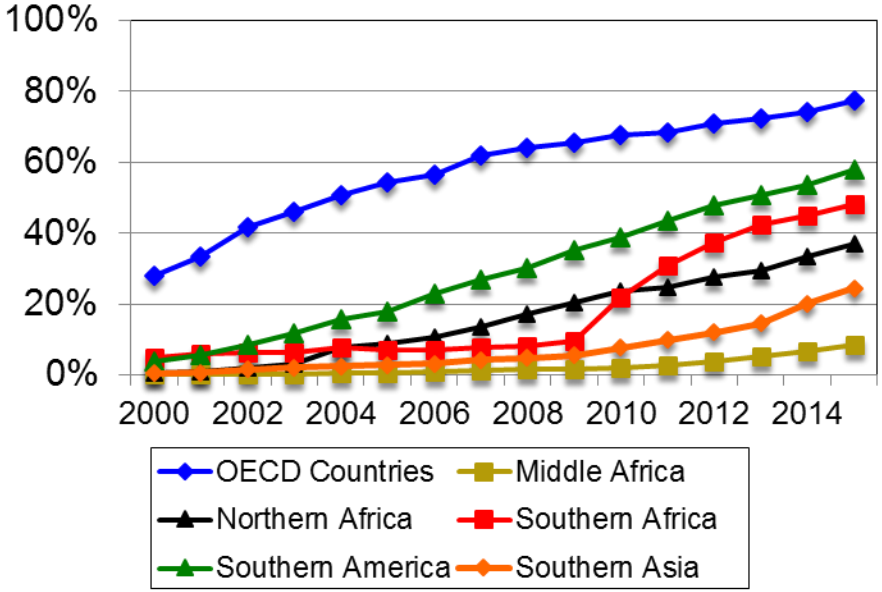
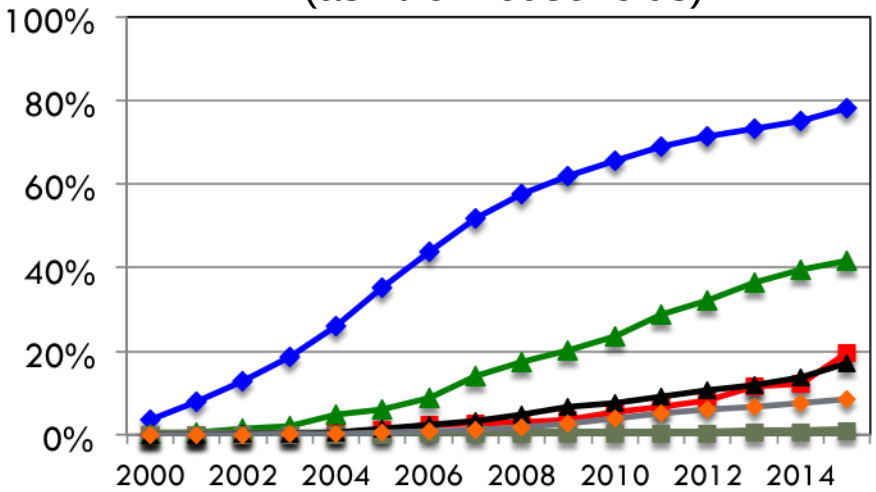
BROADBAND GROWTH IS DRIVEN BY THE INCREASE IN THE WORLD POPULATION ACCESS TO THE INTERNET

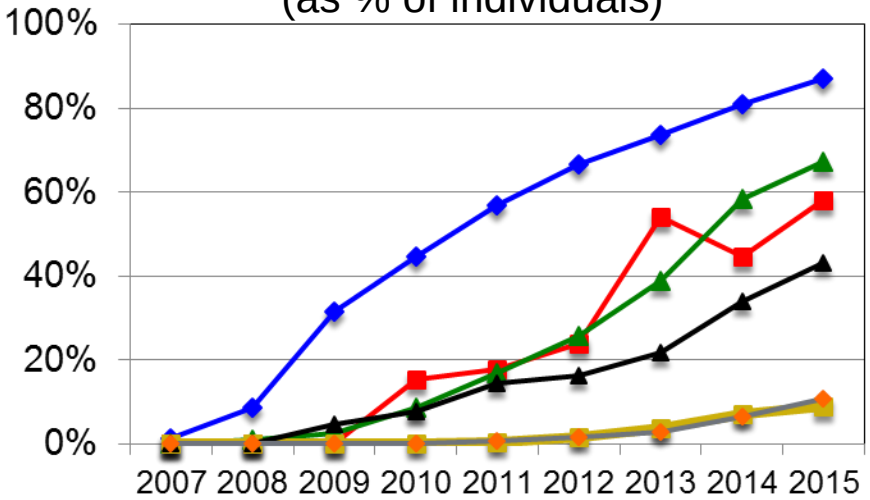
INTERNET PENETRATION
(as % of population)



FIXED BROADBAND PENETRATION
(as % of households)



MOBILE BROADBAND PENETRATION
(as % of individuals)



Source: International Telecommunications Union; Telecom Advisory Services analysis

DRIVERS OF INTERNET TRAFFIC GROWTH

Annual global Internet traffic: 88.7 billion GB per month

- Growing at 30% since 2010 and expected to increase at 22% (in MENA and Africa 27%)

Increase in the number of devices (smartphones, IoT, etc.)

- In 2015 2.2 per capita
- In 2020 3.4 per capita

Increase in the traffic per device

- In 2013 smartphone: 529 MB monthly
- In 2018 smartphone: 2,700 MB

Shift In usage

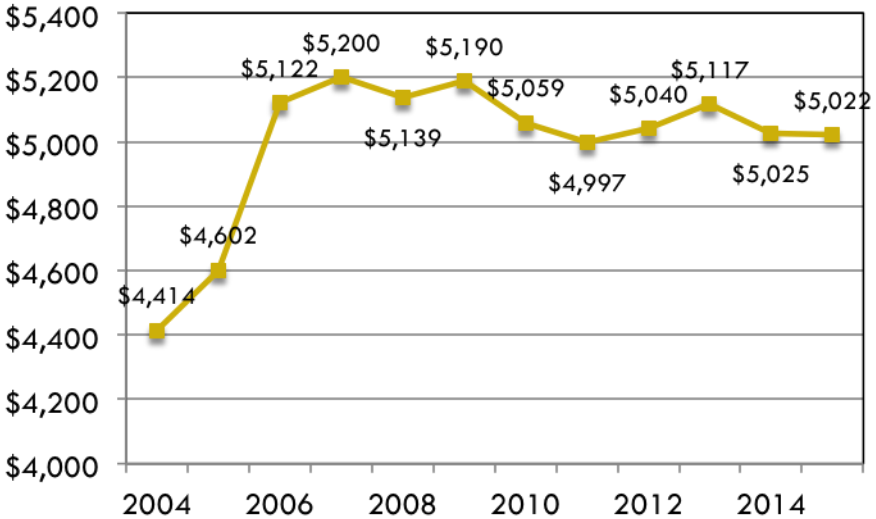
- In 2020 46% of the installed base will be IoT devices
- Video usage (particularly ultra-HD) incresing exponentially
- Migration to OTT video streaming

Source: Cisco Visual Networking Index; Telecom Advisory Services analysis

THE GROWTH IN INTERNET TRAFFIC NEEDS TO BE SUPPORTED BY DEPLOYMENT OF HIGH-CAPACITY NETWORKS, REQUIRING AN EVER INCREASING AMOUNT OF CAPITAL BY OPERATORS

STAGNATING TELECOMMUNICATIONS INDUSTRY REVENUES SINCE 2006

TELECOMMUNICATIONS REVENUES (US$ per capita PPA)



RISING TELECOMMUNICATIONS INVESTMENT SINCE 2004

INVESTMENT IN TELECOMMUNICATIONS (US$ per capita PPA five year accumulated)

Source: Sum of prorrated regional averages for 74 countries according to International Telecommunications Union data; Telecom Advisory Services analysis

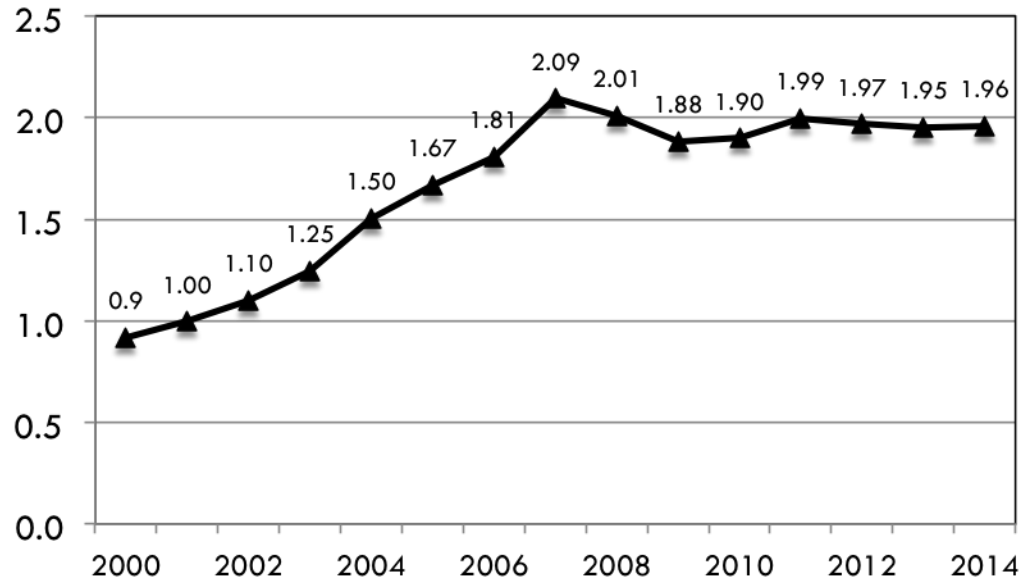
HOWEVER, AFFECTED BY COMPETITION AND DECLINING PRICE REALIZATION, THE TELECOMMUNICATIONS INDUSTRY IS WITNESSING A STAGNATION OF AGGREGATE REVENUES

OTT COMPETITION

Skype (owned by Microsoft) already represents, at 214 billion annual minutes, the largest international telecommunications carrier

A 10% reduction in the volume of voice calls in Western Europe is expected between 2016 and 2021, largely driven by substitution to WhatsApp

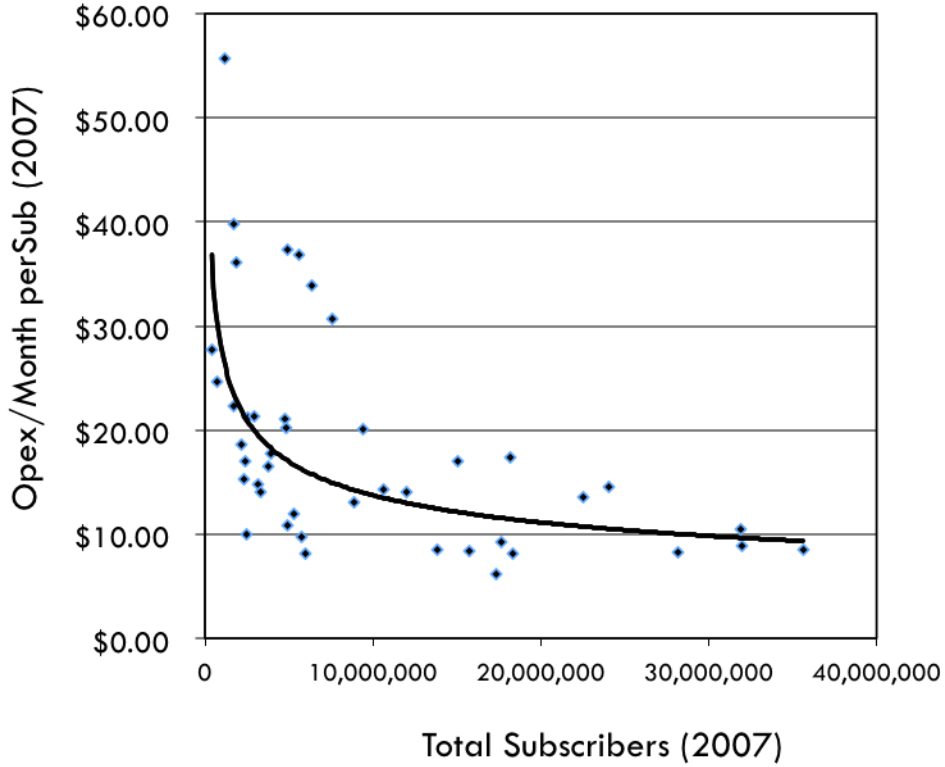
WORLD TELECOMMUNICATIONS INDUSTRY REVENUES (in trillion US$) (2000-2014)



Source: International Telecommunications Union; Telecom Advisory Services analysis

IN THIS CONTEXT, GROWING CONSOLIDATION AND PORTFOLIO RATIONALIZATION REPRESENT AN APPROACH TO LEVERAGE ECONOMIES OF SCALE

ECONOMIES OF SCALE IN THE WIRELESS INDUSTRY



Sources: Merrill Lynch; Telecom Advisory Services analysis

GLOBAL PRESENCE OF MULTINATIONAL BROADBAND PROVIDERS (2016)

	Africa	Asia	Europe	L. America
Orange	Guinea-Bissau, Botswana, Cameroon, Central African Republic, Cote d'Ivoire, Egypt, Guinea, Equatorial Guinea, Kenya, Mauritius, Senegal, Mali, Niger, Tunisia, Madagascar	Jordan, Iraq	France	
MTN	Ghana, Cameroon, Uganda, Cote d'Ivoire, Sudan, Nigeria, Rwanda, Zambia, South Sudan, Botswana, Swaziland, Benin, Congo, Liberia, Guinea, Guinea-Bissau	Syria, Iran, Yemen, Afghanistan, Cyprus		
Telefonica			Spain, UK, Germany	Argentina, Chile, Uruguay, Peru, Colombia, Venezuela, Mexico, Brazil, Ecuador, Costa Rica, El Salvador, Nicaragua
Etisalat	Morocco, Mauritania, Burkina Faso, Gabon, Cote d'Ivoire, Egypt, Nigeria, Niger, Benin, Central African Republic, Mali	Afghanistan, Pakistan, Sri Lanka, UAE, Saudi Arabia		
Vodafone	Egypt	Qatar, Turkey	Albania, United Kingdom, Spain, Italy, Germany	
Airtel	Burkina Faso, Chad, Gabon, Niger, Nigeria, Sierra Leone, Uganda	Bangladesh		
Zain		Kuwait, Saudi Arabia, Jordan, Sudan, South Sudan, Iraq, Lebanon, Bahrain, Morocco,		

CONCLUSIONS ON BROADBAND SUPPLY GLOBAL TRENDS

- Growth in broadband penetration is driven by the increase in Internet adoption (World Internet penetration: 43.84%, fixed broadband adoption: 36.5%, mobile broadband adoption: 44.14%) (2015)
- Increase in penetration is compounded by traffic growth (Annual global Internet traffic: 88.7 billion GB per month, increasing at 30% since 2010 and expected to grow at 22%)
- The growth in Internet traffic needs to be supported by deployment of high-capacity networks, requiring an ever increasing amount of capital by operators
- However, affected by competition and declining price realization, the telecommunications industry is witnessing a stagnation of aggregate revenues
- In this context, growing consolidation and portfolio rationalization represent an approach to leverage economies of scale
- Implications of broadband supply trends are numerous
  - If OTT competition is affecting the broadband industry sustainability, how can policies and regulation define a level-playing field?
  - If consolidation is an important trend, how do we ensure sufficient competitive intensity?
  - If service providers are under financial pressure, how do we create enough incentives to ensure deployment of new technologies?

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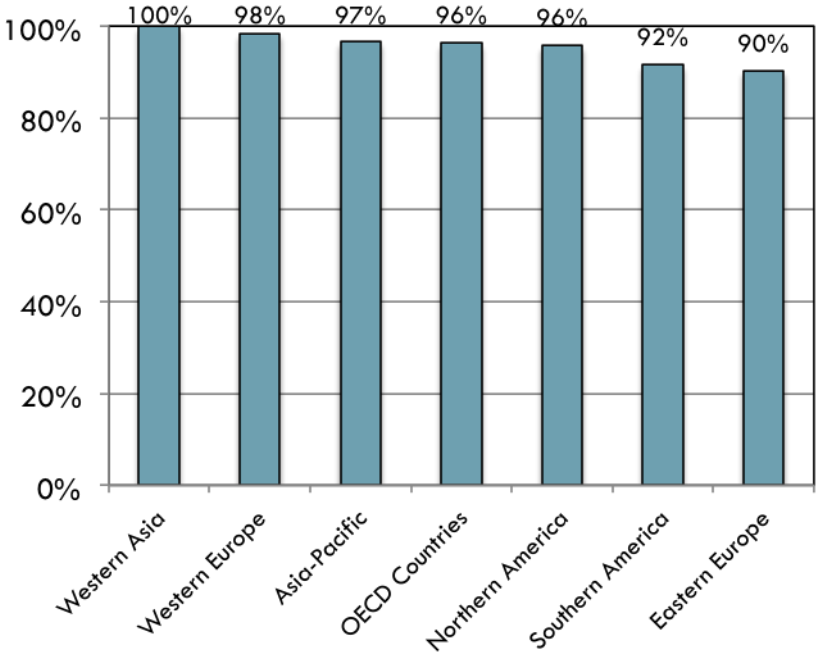
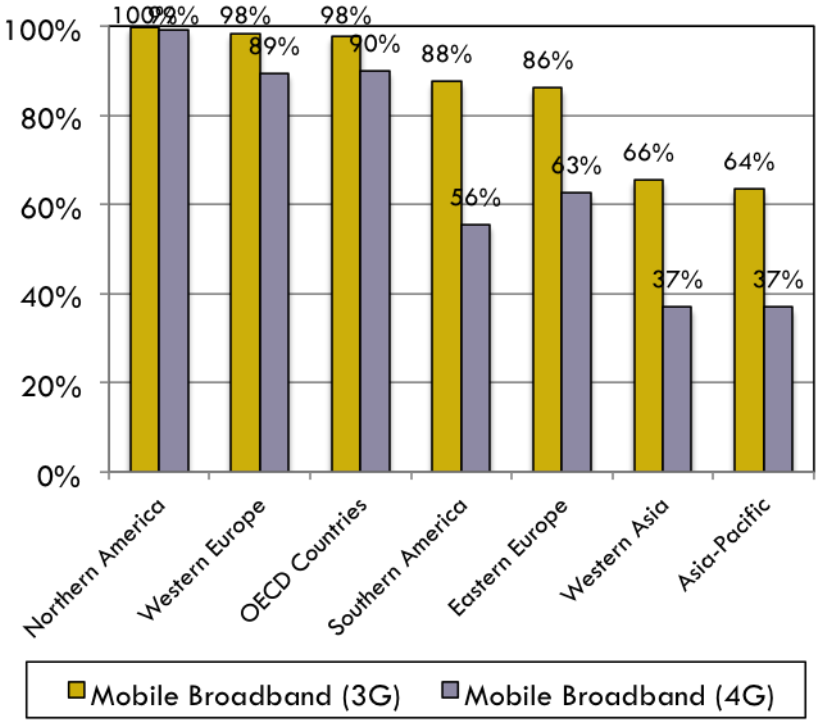
BROADBAND ADOPTION IS FIRST CONSTRAINED BY SERVICE COVERAGE: THIS IS LESS OF AN ISSUE IN FIXED BROADBAND

BROADBAND COVERAGE (2015)
(as % of population)

Fixed broadband
(primarily ADSL)



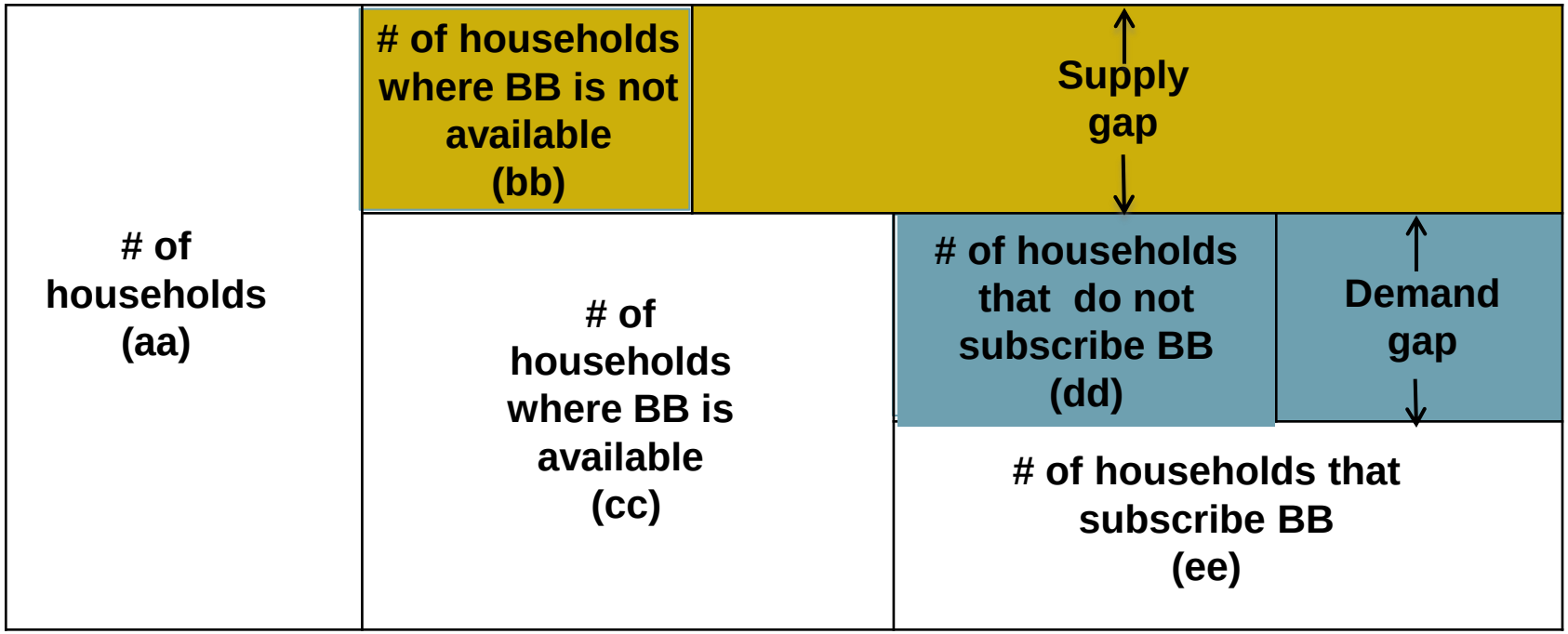
Mobile broadband



Source: International Telecommunications Union; Telecom Advisory Services analysis

HOWEVER, NON ADOPTION IS NOT ONLY EXPLAINED BY A SUPPLY GAP BUT ALSO BY A DEMAND GAP: POPULATION THAT CAN ACQUIRE BROADBAND BUT DO NOT

CONCEPTUAL FRAMEWORK OF BROADBAND SUPPLY AND DEMAND GAP

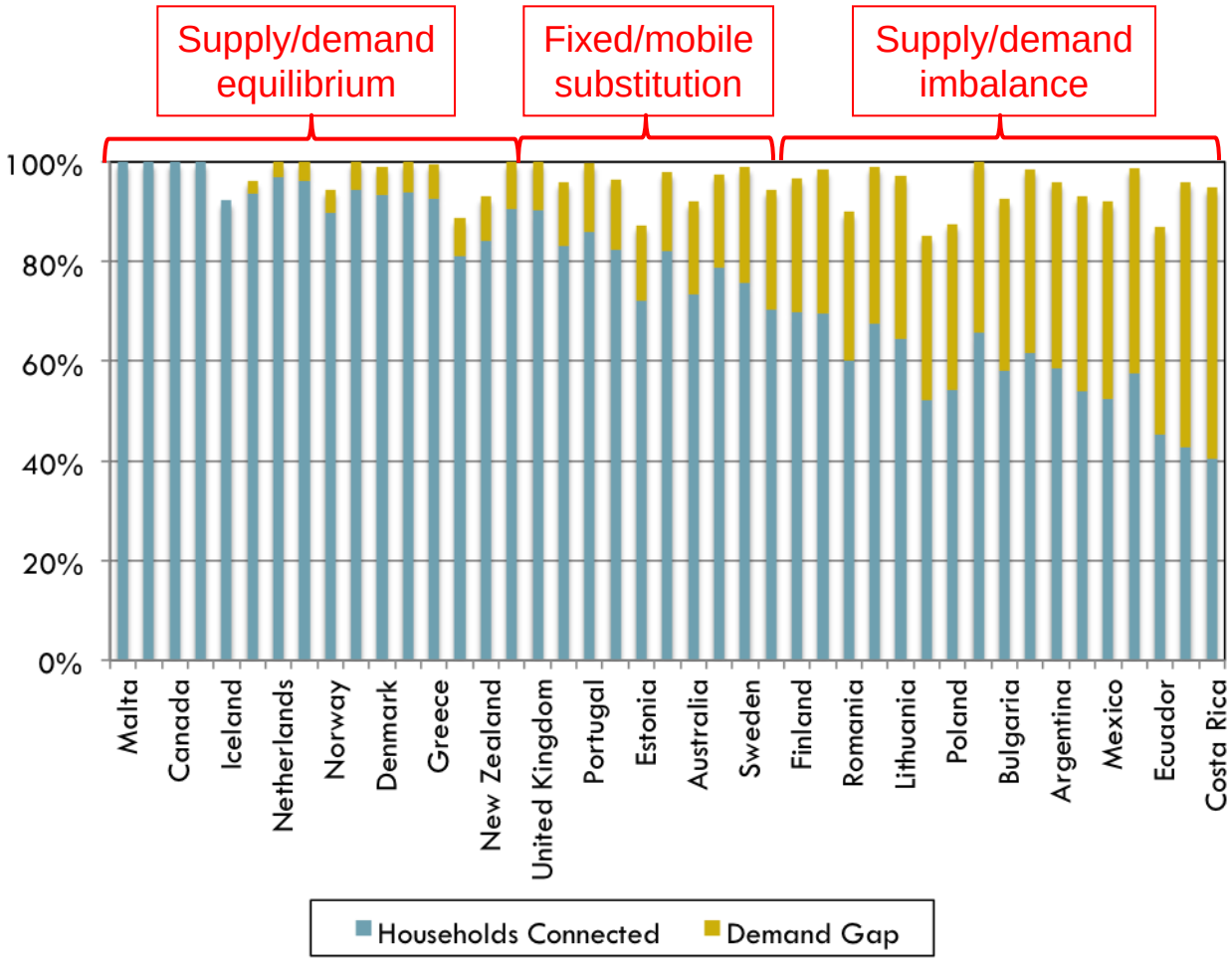


Network deployment rate: cc/aa
Broadband penetration rate: ee/aa (or ee/cc)
Digital divide: bb+dd

Source: Telecom Advisory Services

THREE CONDITIONS EXPLAIN THE RELATIONSHIP BETWEEN FIXED BROADBAND SUPPLY AND DEMAND ACROSS COUNTRIES

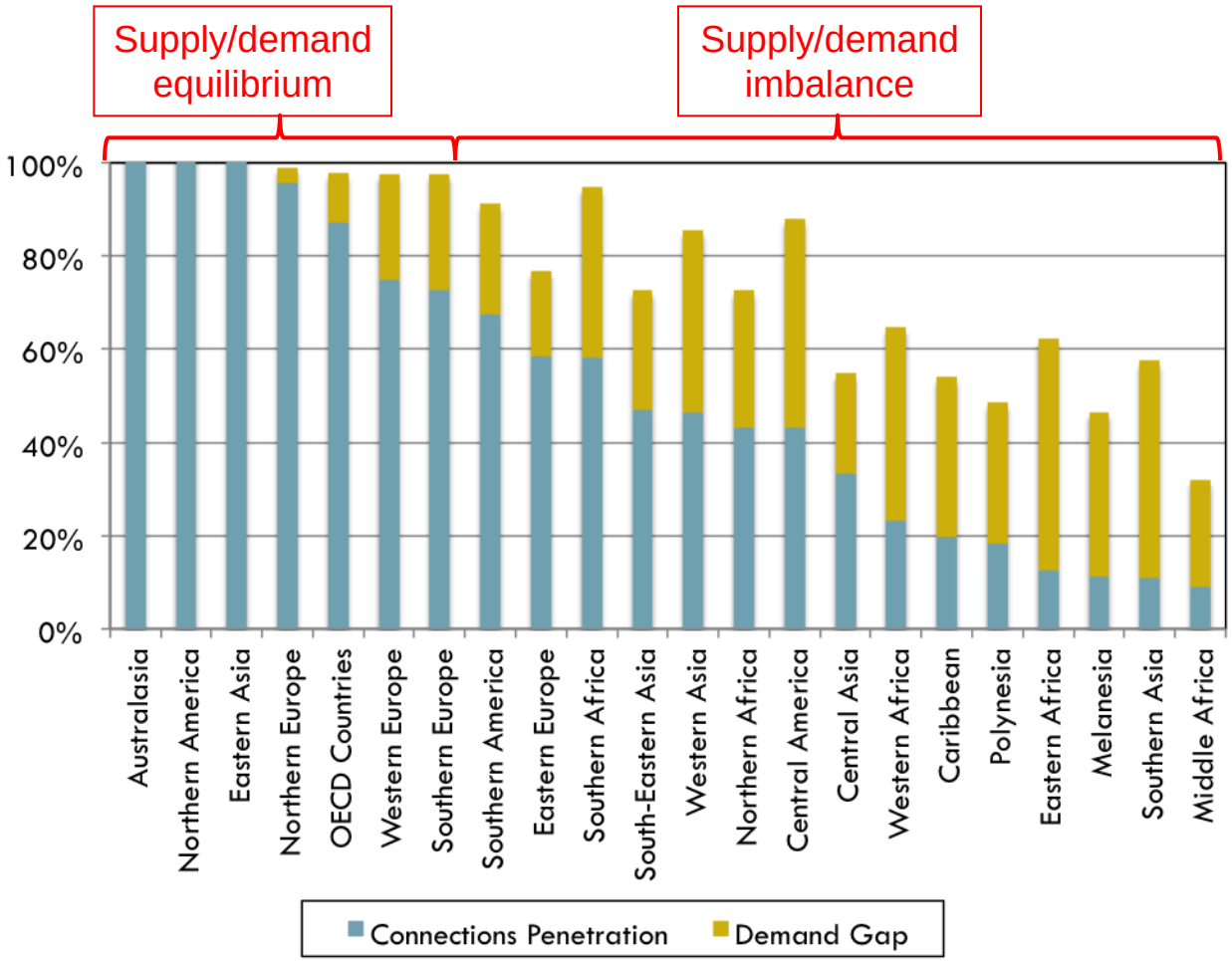
FIXED BROADBAND DEMAND GAP (2015)



Source: International Telecommunications Union; Telecom Advisory Services analysis

IN THE CASE OF MOBILE BROADBAND, THE SUPPLY/DEMAND RELATIONSHIP HIGHLIGHTS TWO BARRIERS IN THE EMERGING WORLD: (1) LIMITED COVERAGE, AND (2) LARGE DEMAND GAP

MOBILE BROADBAND DEMAND GAP (2015)



Source: International Telecommunications Union; Telecom Advisory Services analysis

THREE PRIMARY REASONS EXPLAIN THE DEMAND GAP: (1) LIMITED AFFORDABILITY, (2) NO DIGITAL LITERACY, AND (3) LACK OF CULTURAL RELEVANCE

LIMITED AFFORDABILITY

Certain portions of the population cannot acquire a device or purchase a subscription due to low income or high end user pricing

- Typically impacts the bottom five income deciles of population
- Either high prices or high taxes

LACK OF DIGITAL LITERACY

Certain portions of the population lack the ability to use digital technology, or communicate to use the Internet

- Correlated with education
- Relevant in certain social groups (unemployed, older generations, some gender influence)

LACK OF CULTURAL RELEVANCE

Certain portions of the population perceive the Internet as unsuited to meet ttheir cultural/ religious needs or lack the language to use it

- Also correlated with education
- Linguistic/ethnic barriers
- Lack of cultural affinity
- Religious/ethical concerns

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PERCENTAGE OF NON-ADOPTING HOUSEHOLDS MENTIONING AFFORDABILITY BARRIER

Country	Percentage
Costa Rica	60%
Mexico	43%
Colombia	40%
Brazil	37%
Australia	26%
United States	24%
Portugal	20%
Argentina	18%
United Kingdom	16%
Puerto Rico	16%
Hungary	15%
Chile	13%
Estonia	13%
Spain	11%
France	8%

Source: Compiled by Telecom Advisory Services

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PERCENTAGE OF NON-ADOPTING HOUSEHOLDS MENTIONING DIGITAL LITERACY BARRIER

Country	Percentage
Nicaragua	58%
Chile	47%
Colombia	46%
Brazil	41%
Guatemala	38%
Mexico	33%
South Africa	20%
Argentina	19%
Switzerland	9%
Russia	5%
Singapore	4%

Source: Compiled by Telecom Advisory Services

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PERCENTAGE OF NON-ADOPTING HOUSEHOLDS MENTIONING NO CULTURAL RELEVANCE OR LACK OF NEED

Country	Percentage
Argentina	72.00 %
Brazil	47.00%
Mauritius	1.60 %
South Africa	0.20 %
Guatemala	57.00%
Mexico	51.00%
Colombia	49.00%
Chile	36.10%
Nicaragua	31.00%
Panama	27.00%
Russia	20.50%
South Africa	18.60%
Switzerland	14.40%
Singapore	5.80%
Korea	1.30%

Source: Compiled by Telecom Advisory Services

CONCLUSIONS ON DEMAND GLOBAL TRENDS

- Broadband adoption is first constrained by service coverage: this is less of an issue in fixed broadband
- However, more importantly, non adoption is not only explained by a supply gap but due to a demand gap: population that can acquire broadband but do not
- Three primary reasons explain the demand gap
  - Limited affordability
  - Limited digital literacy
  - Lack of cultural and/or linguistic relevance of Internet contentand applications
- Implications of broadband demand trends are also abundant
  - Reasons for non-adoption are not technological but driven by economic, sociological, and behavioral factors
  - Responsibility for addressing them requires intervention of several governments entities (ministries of education, labor, culture) in combination with the private sector (operators, equipment manufacturers) and civil society (foundations, NGOs)
  - Tackling the demand gap is more complex and requires more time than deploying networks

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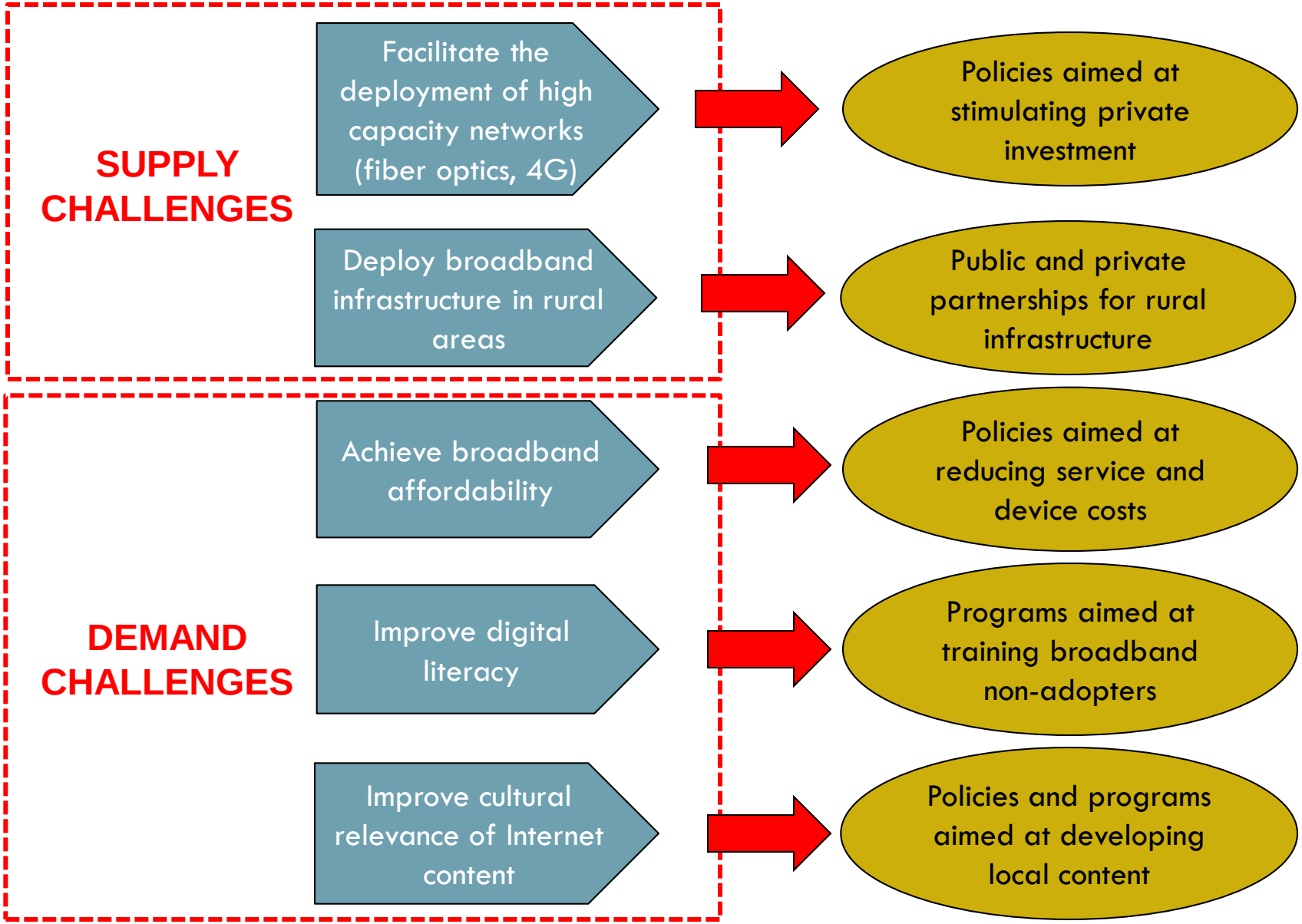
TO SUM UP, ASSUMING THAT BROADBAND IS A CRITICAL COMPONENT OF DEVELOPMENT POLICY, GOVERNMENTS HAVE TO FACE FIVE CRITICAL CHALLENGES



POLICY APPROACHES AIMED AT STIMULATING PRIVATE INVESTMENT IN NEXT GENERATION NETWORK INFRASTRUCTURE

Define sustainable market structures

- As a capital intensive sector, unrestricted market entry reduces the incentives for capital spending
- Governments and regulators need to consider that industry structures not exceeding four players(maybe three) represent the optimal configuration to stimulate capital spending in the deployment of new networks
- Infrastructure based competition has higher probability to stimulate capital spending
- Beware the risks of disruptive market restructuring interventions

Consider the enactment of temporary holidays and subsidies

- Ensure proper alignment of incumbent operator(s) to make sure it deploys network infrastructure
- Exempt fiber infrastructure access from the market analysis process and competitive access policies (focused on either geographies or type of service)
- Tax exemption from the purchase of network equipment
- Low-cost long term loans

Develop partnerships with municipalities

- Aggregate demand to render deployment business case attractive
- Ease right of way permit procedures and reduce fees
- Potentially implement municipality-funded networks, and syndicated community networks

Implement open access services and regulations

- Duct sharing, co-location, LLU, SLU, and bitstream
- Infrastructure-sharing

THE DEPLOYMENT OF BROADBAND INFRASTRUCTURE IN RURAL AREAS IS A PARTICULAR CASE REQUIRING SPECIFIC POLICIES

Universal Service Funds

- Funds collected as contributions from private operators to support projects targeted to the unserved population
- Responsibility for deployment assigned to private operators selected through public bids that receive the public funds to support the deployment
- Subsidy can be complemented with additional incentives such as reduced taxes or elimination of permits

Govenment-sponsored deployment

- If a publicly owned carrier exists in the country, the government might enforce an initiative to deploy broadband in rural geographies even if conventional economic analysis renders this unattractive
- Conducted under the assumption that government-owned broadband service providers operate under "public service guidelines" rather than the profit imperative

Alleviate constraints of the rural broadband business case

- Deploy publicly owned backbone networks with the objective of reaching remote locations
- Since traffic backhauling represents approximately 30% of the operating costs of running a broadband network, the network represents an opportunity of cutting transit costs to subsidize rural broadband network operations

Rely on unlicensed spectrum to construct wireless networks

- Utilize unlicensed spectrum bands (Wi-Fi, white spaces) to build small regional focused operators
- Alternative is to assign shared spectrum bands to operators
- Operator business model akin to a cooperative provider of electricity or water

MOVING TO THE DEMAND SIDE, FOUR POLICY APPROACHES CAN BE IMPLEMENTED TO REDUCE BROADBAND END-USER PRICING

Reduce taxes on service acquisition

- Final price of devices is affected by a set of different taxes (VAT, service specific), which vary by country and year
- Taxes can, in some cases, add a significant burden to the retail price
- Numerous countries, intent on fostering adoption, have eliminated service taxes

Eliminate import taxes on devices

- Import taxes for smartphones can reach 21%, while some countries tax tablet and PC imports between 22% and 30%
- Since high taxation increases the total cost of ownership of wireless devices, it is correct to consider that higher import taxes will raise the affordability barrier and reduce adoption
- Several countries exempt import taxes on wireless devices with the objective of stimulating broadband adoption

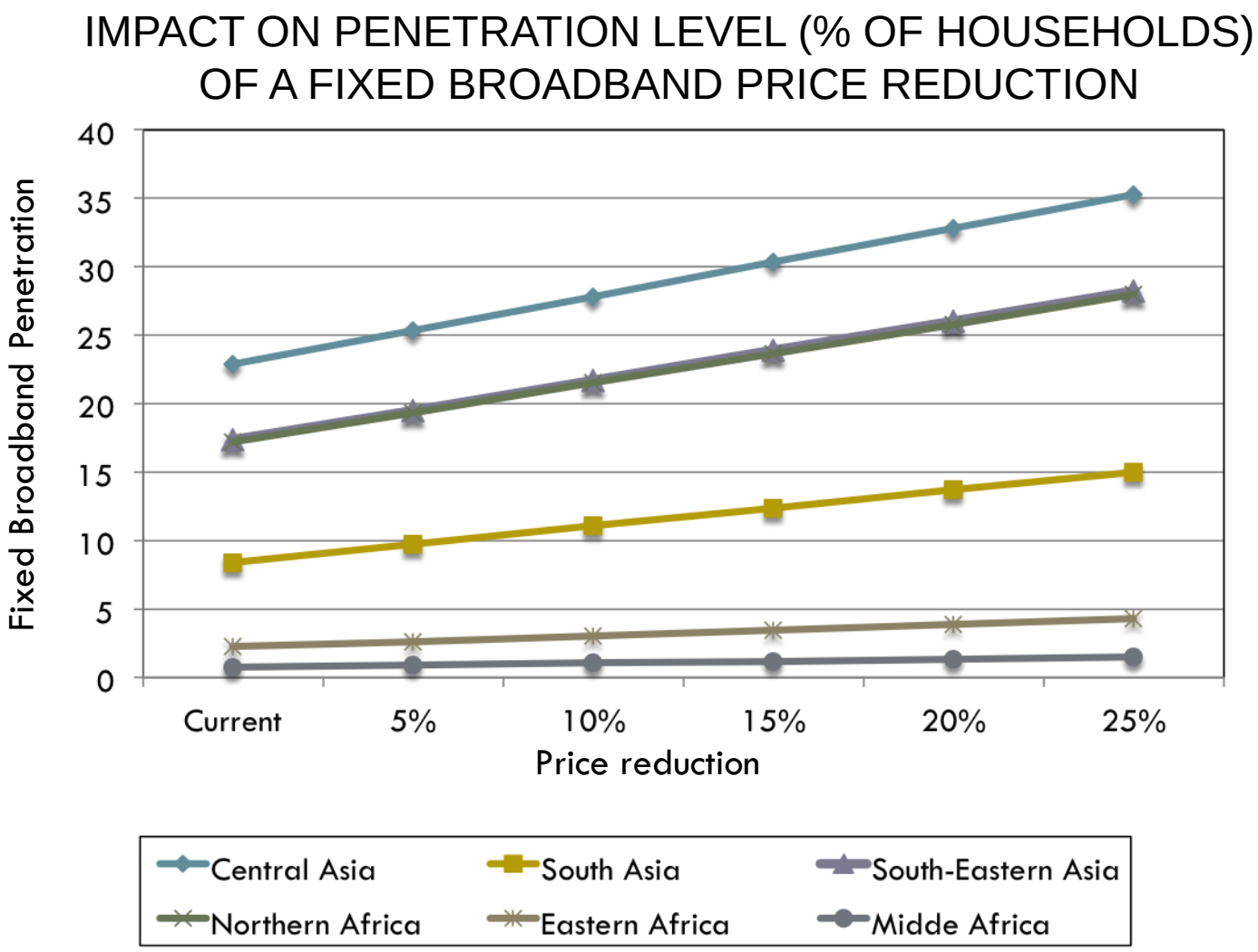
Provide subsidies to low income population

- The government offers a subisidy on the cost of broadband access
  - Provide subsidies to low income households to reduce the acquisition price of devices
  - Public school students receive computers free of charge
  - Eliminate or decrease taxes paid at time of purchasing

Introduce "social" broadband plans

- State-owned telecommunications operators offers, under their public service imperative, a low-priced broadband service
- The offering can act as an incentive for other private operators to launch their own more affordable service
- Alternatively, the government can negotiate with private sector operators the offering of a low-priced broadband service targeted for disadvantaged segments of the population

AS EXPECTED, A CHANGE IN END-USER BROADBAND PRICE HAS A POSITIVE IMPACT ON PENETRATION, AS A RESULT OF ELASTICITIES



Source: Estimates by Telecom Advisory Services based on ITU 2015 data

BUILDING DIGITAL LITERACY INVOLVES EMBEDDING PROGRAMS IN THE FORMAL EDUCATION SYSTEM AND TARGETING NON-FORMAL INITIATIVES TO SPECIFIC SOCIAL GROUPS

Embedd ICT training in formal education programs

- Formal educational system should be large scale and centrally driven, generally hosted within ministries of education
- While providing access infrastructure, programs tend to generally focus on improving usability
- Initiatives emphasize the use of IT and broadband access within course material by leveraging e-learning platforms and social networking

Group-specific training delivered through public access centers

- Programs structured around conventional continuing education courses, as extension programs of universities, or organized under economic development efforts focused on specific regions of a country
- Programs should focus on the development of ICT skills with "real world" applications, including, but not limited to e-mail, Internet search, Job search, and CV creation

Training programs focused on rural isolated areas

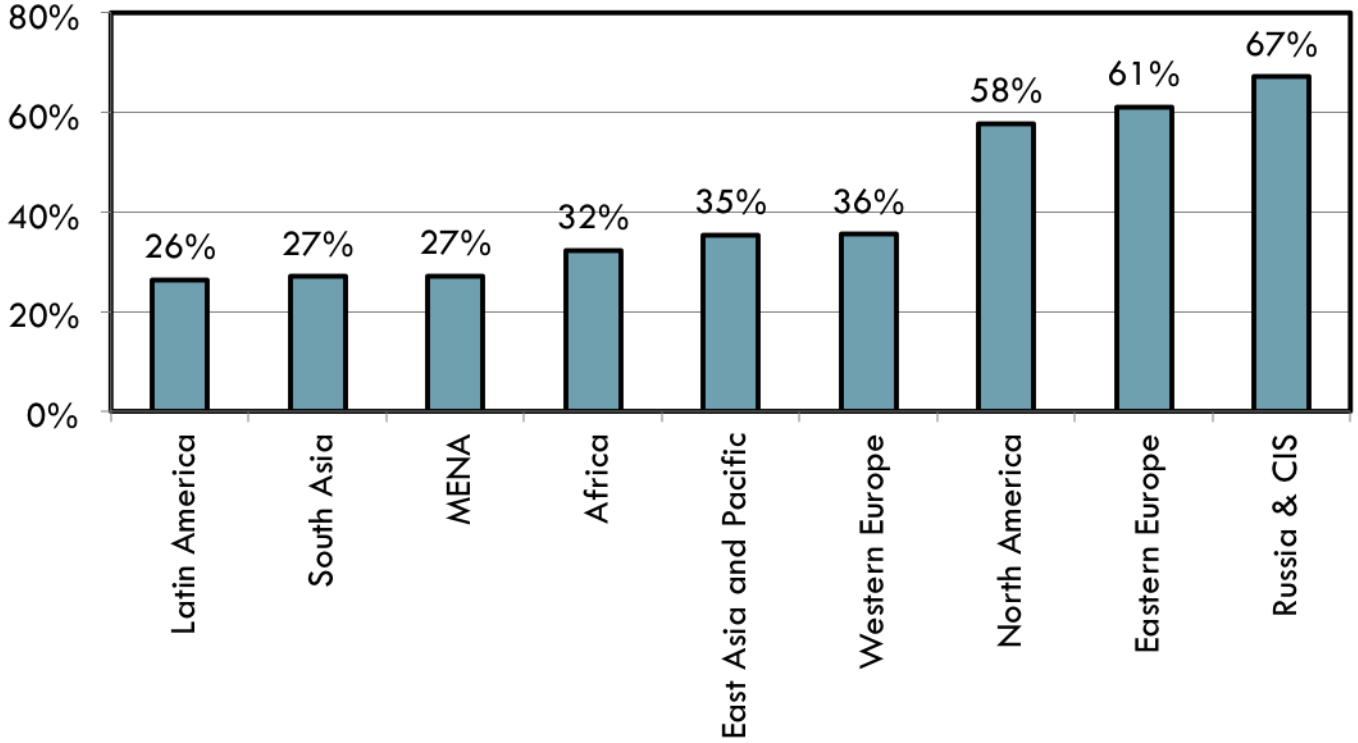
- Primary focus of these programs is bridging the digital divide and enhancing the employability profile of the targeted population
- Initiatives tend to be large scale and centrally managed and focus on accessibility
- While the central government plays a prominent role in program management, it is not unusual to find private sector participants or NGOs

Programs to improve social inclusion of the elderly population

- Primary content delivered in this type of programs are standard computer courses, tailored specifically to the needs of the elderly (e.g. email to communicate with the family, photo sharing, use financial applications, purchasing tickets online, etc.)
- In addition, digital literacy courses for the elderly give seniors an opportunity to meet people and develop a social network.

FINALLY, UNLESS POLICIES ARE IMPLEMENTED FOR DEVELOPOING INTERNET LOCAL CONTENT, EMERGING REGIONS WOULD NOT BE ABLE TO OVERCOME AN ADOPTION BARRIER

PERCENTAGE OF LOCAL INTERNET CONTENT BY REGION (2013)



Source: Katz (2013) based on Alexa data

IN ORDER TO IMPROVE INTERNET CONTENT CULTURAL RELEVANCE AND STIMULATE BROADBAND ADOPTION, THE PRIMARY OBJECTIVE IS TO DEVELOP LOCAL APPLICATIONS

Select applications and platforms for local development

- Social messaging platforms
- OTT video-streaming with an emphasis on local content
- Mobile apps that facilitate access to government services
- Local language apps for education and health services

Launch Centers of excellence focused on local content development

- Develop innovation centers focused on development of local Internet applications
- Introduce acceleration methods to stimulate development of local content
- Attract mentors and managers to support local content development teams

Human capital development focused on Internet platforms

- Human capital development requires (1) increase "top performing" achievers in secondary education,(2) introduce educational tracking to steer "top performers to science technology and engineering careers, (3) coordinate priorities in higher education to increase STEM graduates, (4) introduce short training programs to increase the number of trained programmers and (5) promote international mobility to attract talent

Programs to promote public and private investment

- Create public investment funds focused on development of local apps and Internet content
- Create the right conditions to stimulate the entry of private venture capital, seed capital, and angel investors

TO SUM UP, PUBLIC POLICIES AIMED AT DEVELOPING BROADBAND NEED TO BALANCE THREE ESSENTIAL DRIVERS

- Implement a conducive environment for infrastructure investment and sharing
  - Facilitate the deployment of high capacity networks (fiber optics, 4G)
  - Deploy broadband infrastructure in rural areas
- Implement demand stimulation mechanisms
  - Implement policies to increase affordability
  - Put in place initiatives to address digital illiteracy in key social segments of the population
  - Improve cultural and linguistic relevance of Internet content and applications
- These efforts require the coordination of multiple government institutions and the collaboration between the public and private sectors

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