Seminar on ITU-T Standardization Activities and other Key ITU Activities

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Connectivity trends and issues

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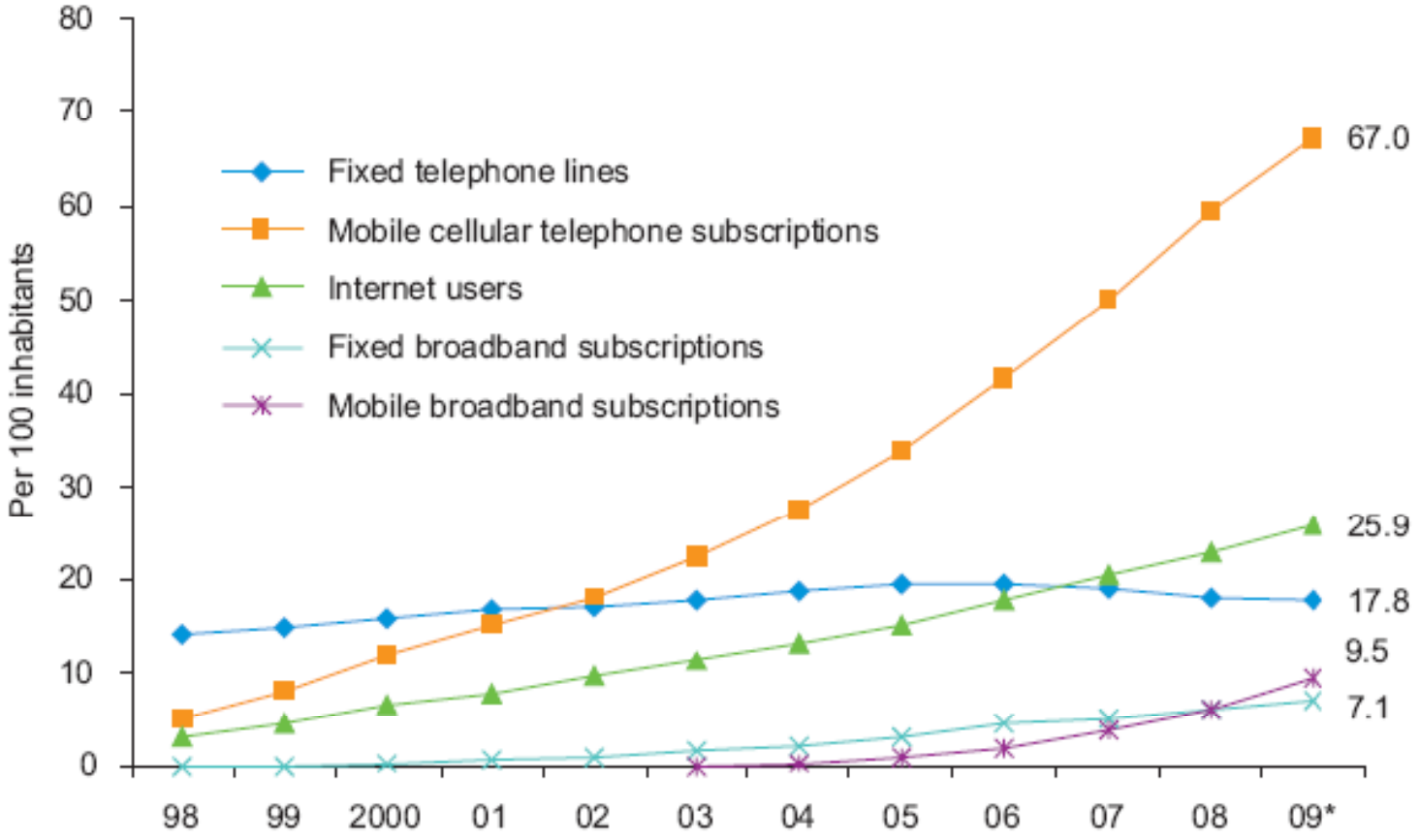
Objectives

- To present current trends in global IP connectivity & data growth & in ICT trends & innovations that affect Internet bandwidth growth
- To understand drivers of this growth and these trends
- To point out some challenges

Global ICT development, 1998-2009 (ITU)



Note: *Estimate.
Source: ITU World Telecommunication/ICT Indicators database.

Trends in ICT development that generate bandwidth (1)

- Digitization & dematerialization
- Microprocessors
- Internet diffusion
- IPv6
- Broadband
- Cloud computing

Trends in ICT development that generate bandwidth (2)

- Nanotechnology
- Wireless & mobile device uptake
- The IOT
- Sensor technology
- Social networking

Trends: digitization & dematerialization

- Digitization & dematerialization
  - More digitization (e-government, e-commerce, etc.) more traffic
  - More downloads: video, music, P2P, etc.
  - Video is a major driver of Internet growth & e-commerce encourages this

Trends: microprocessors (1)

- 11 nm dies now, with 1 nm in future
- Smarter and more energy efficient
- Parallel processing CPUs and GPUs
- Moore's law still works
- 45 nm Intel Core i7 processor:
  - Peak data throughput of 50 GB /sec. vs. 64 MB / sec. for Intel 386
  - 8 cores per microprocessor die

Trends: microprocessors (2)

- The Internet of Things
- Dual / quad core for mobile devices:
  - Smartphones more powerful than netbooks & as powerful as desktops →
  - ...Powering transition to mobile over desktop computing as main computing platform

Trends: IPv6

- IPv6:
  - Will allow the Internet of Things
  - Will push IP to the edge of the network
- More efficient that IPv4
- More support for:
  - Data / user authentication
  - Data integrity
  - Data confidentiality
  - Etc.

Trends: Broadband (1)

- Passive networking:
  - Background streaming and downloading from ambient video sources: nannycams, petcams, home security cams, etc.
- Real time HD video:
  - Internet TV
  - Video communications: telepresence,...
  - Ambient video

Trends: Broadband (2)

- High definition video
- Transference: from TV to live HD video on demand over the Internet
- Silicon photonics and hybrid silicon lasers:
  - Low cost, high bandwidth optical communications will affect all connected devices and networks

Trends: Broadband (3)

- Wireless broadband:
  - Exponential growth in traffic
  - Will outstrip the increased revenue required to make it profitable
  - Technical solutions:
    - Offloading content to the Internet

Trends: Cloud computing

- Computing on demand increasing in popularity as broadband speeds rise
- Can reduce energy use of a company by moving cost to provider of Cloud services
  - Can favour green energy sources as fiber connected Cloud service centres
- Linked to the Internet of Things

Trends: Nanotechnology

- Greater transistor density
- More energy efficient chip designs
- Enabling Moore's Law for many years to come
- Will "increase transistor speed, enhance energy efficiency, and provide more functionalities"
- Has allowed the miniaturization of computer memory.
  - This has made the Apple iPOD a reality.

Trends: wireless (1)

- Digitization of broadcasting signals will open more spectrum:
  - Many new wireless channels, devices and services
- Near field communication & medium and longer range technologies to operationalize the Internet of Things
  - ZigBee, 6LowPAN, WirelessHART, etc.
- c. Location aware (sometime GPS enabled) mobile devices or objects

Trends: wireless (2)

- Augmented reality that is facilitated through the use of wireless devices
- The proliferation of wireless devices enables social networking & vice versa

Trends: wireless (mobile)
Data from Cisco 2011 (Cisco® Visual Networking Index (VNI))

- Mobile Data Traffic Nearly Tripled in 2010
- Accelerated adoption of smartphones → higher usage profile
- Other high-usage devices increased their presence on the mobile network
  - →mobile-connected laptops grew by 63 percent in 2010
- Mobile for fixed substitution is NOW!

Global Mobile Data Traffic by region 2010–2015 (Cisco VSN 2011)

	2010	2011	2012	2013	2014	2015	CAGR 2010–2015
By Region (TB per Month)							
North America	48,959	118,084	235,411	416,025	674,579	986,039	**82%**
Western Europe	64,407	145,685	325,518	634,869	1,072,665	1,631,953	**91%**
Asia Pacific	54,919	128,445	269,218	529,806	996,624	1,836,842	**102%**
Japan	40,245	86,478	172,112	289,322	425,161	577,998	**70%**
Latin America	11,687	25,997	60,486	127,206	257,463	487,784	**111%**
Central Eastern Europe	10,312	24,617	55,733	110,011	200,927	346,296	**102%**
Middle East and Africa	6,147	16,744	44,473	90,324	178,570	387,078	**129%**
Total (TB per Month)							
Total Mobile Data Traffic	236,676	546,050	1,162,950	2,197,563	3,805,989	6,253,991	**92%**

Source: Cisco VNI Mobile, 2011

Cisco. 2011. *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015*.
http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

Devices with High Usage Profiles Are Growing in Number on the Mobile Network (Cisco VSN 2011)

Device	Millions in Use 2009	Millions in Use 2010	Usage Multiplier Relative to Nonsmartphone	Usage Multiplier Relative to Smartphone
Smartphones	1,129	1,494	24 Nonsmartphones	1 Smartphone
iOS and Android phones	128	349	96 Nonsmartphones	4 Smartphones
Mobile-connected tablets	0.3	3.0	122 Nonsmartphones	5 Smartphones
Mobile-connected laptops	58	94	515 Nonsmartphones	22 Smartphones

Source: Informa Telecoms and Media, Strategy Analytics, Cisco VNI Mobile, 2011

Cisco. 2011. *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015*.
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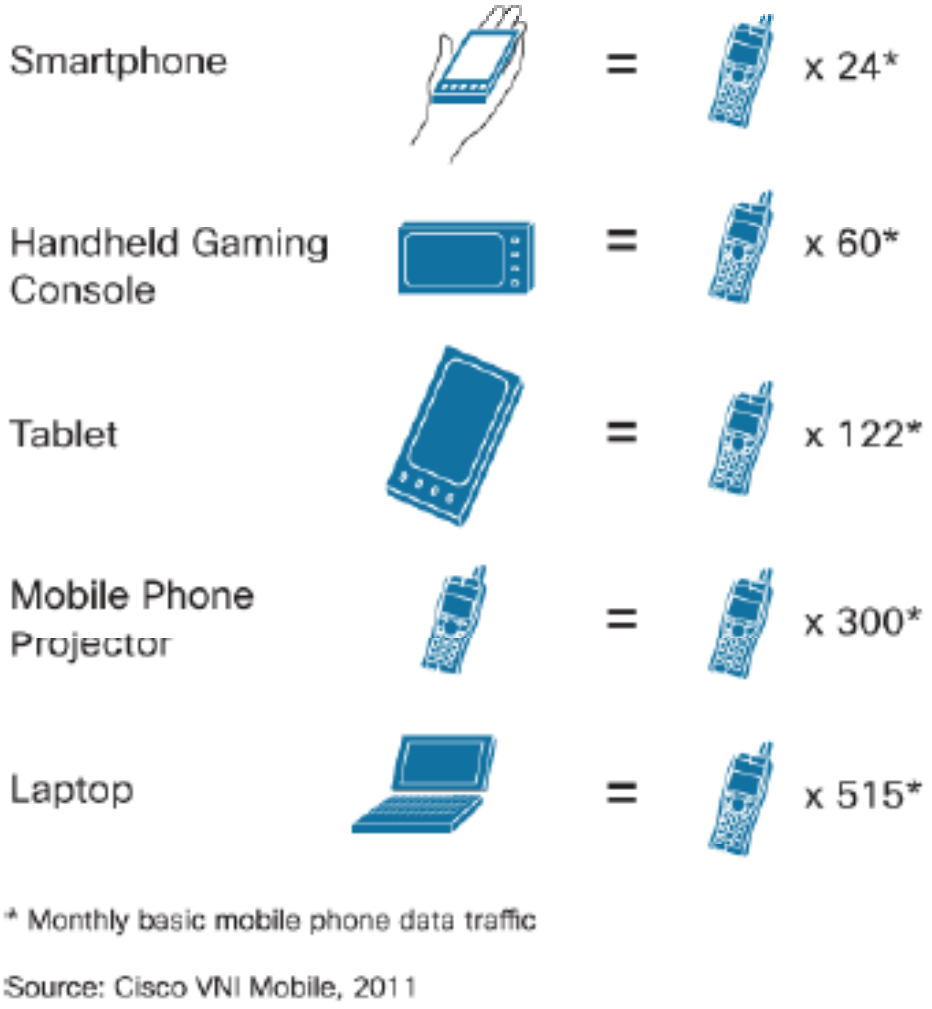
High-End Devices Can Multiply Traffic



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Trends: wireless (mobile) Data from Cisco 2011

- Mobile beyond the power grid
  - Selling off grid charging: car batteries, solar powered, etc.
- Off-grid, on-net population will reach 137 million by 2015
- Mobile network will break the electricity barrier in 4 major regions and more than 40 countries
  - Honduras in Latin America

Trends: the Internet of Things (1)

- Growth in machine to machine (M2M) communications - a significant opportunity for MNOs
  - M2M is driving exponential growth in connections
- Revenue from services to embedded modems in M2M applications to grow exponentially until at 2014

Trends: the Internet of Things (2)

- GSM Association (GSMA) has launched an “embedded SIM” initiative to support the IOT
  - To speed up development of M2M services
  - Make it easier to bring mobile broadband to non-traditional devices: cameras, MP3 players, navigation devices and e-Readers & smart meters

Trends: the Internet of Things (3)

- 87 million embedded mobile M2M connections last year
  - … will reach 428 million by 2014
- Embedded SIM cards in mobile phones / smartphones:
  - Allow users direct control over their connections: ability to select carrier networks of choice, bypassing MNOs,
  - Allow to connect to the Internet of Things without MNO.

Trends: the Internet of Things (4)

- Global revenues from IOT:
  - 30 x higher than the Internet in the smart transportation sector alone (Forrester Research)
- Governments have made significant investments in IOT: EU, Japan, South Korea, China, USA
- In China: revenues from IOT will reach 750 billion RMB (USD 112 billion) by 2015

Trends: the Internet of Things (5)

- The number of devices connected to the Internet: > 5 billion @ Aug. 2010
- In an online presentation, an IBM researcher reports that there will be a trillion Internet connected devices by 2011
- A VP at Ericsson predicted that "*50 billion connected devices are coming to cellular networks in the next decade*"

Trends: sensor technology (1)

- Radio-frequency identification (RFID) tags
- Low power operating sensors (energy harvesting motes)
- Able to withstand harsh environments
- Self organizing, self configuring, self-healing

Trends: sensor technology (2)

- Low or zero maintenance
- Bandwidth efficient
- High data capacity
- Many open standards are used, but not all standardized. Many corporate, i.e. proprietary technologies in the market place
- Efforts to standardize on IPv6 compliant IP (Contiki operating system) micro stack

Trends: sensor technology (3)

- Sensors embedded in devices and sensor nets (motes)
  - Smartphone / mobile device
- Types of sensors:
  - Physical: T, P (altitude), density, motion (accelerometers), light (cameras and wavelength sensors – infra red – thermal sensors, etc.), gravity, etc.

Trends: sensor technology (4)

- Types of sensors:
  - Chemical sensors evolving as well: wet chemistry sensors more difficult (unless in aqueous environment), gaseous sensors easier to implement
- Motion imagery surveillance
  - Wide Area Motion Imagery (WAMI)
  - Security application with environmental uses

A commercially available sensor node from Libelium

Libelium. 2011. *Waspmote – The sensor device for developers*. 20110202. http://www.libelium.com/products/waspmote

Sensing applications (commercial: Libelium)

Smart Metering

Applications

- Energy measurement
- Water consumption
- Pipe leakage detection
- Liquid storage management
- Tanks and silos level control
- Supplies control in manufacturing
- Industrial Automation
- Agricultural Irrigation

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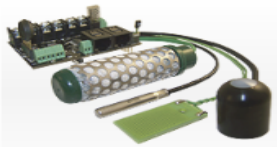
Sensors

- Current
- Water flow
- Liquid level
- Load cell
- Ultrasound
- Distance Foil
- Temperature
- Humidity
- Luminosity

Agriculture



Applications

- Precision Agriculture: leaf temperature, fruit diameter
- Irrigation Systems: soil moisture, leaf wetness
- Greenhouses: solar radiation, humidity, temperature
- Weather Stations: anemometer, wind vane, pluviometer

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Sensors

- Air Temperature / Humidity
- Soil Temperature / Moisture
- Leaf Wetness
- Atmospheric Pressure
- Solar Radiation - PAR
- Ultraviolet Radiation - UV
- Trunk Diameter
- Stem Diameter
- Fruit Diameter
- Anemometer
- Wind Vane
- Pluviometer

Gases

Applications

- City pollution: CO, CO2, NO2, O3
- Emissions from farms and hatcheries: CH4 ,H2S , NH3
- Control of chemical and industrial processes: C4H10 ,H2, VOC
- Forest fires: CO, CO2

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Sensors

- Carbon Monoxide – CO
- Carbon Dioxide – CO2
- Oxygen – O2
- Methane – CH4
- Hydrogen – H2
- Ammonia – NH3
- Isobutane – C4H10
- Ethanol – CH3CH2OH
- Toluene – C6H5CH3
- Hydrogen Sulfide – H2S
- Nitrogen Dioxide – NO2
- Ozone – O3
- Hydrocarbons – VOC
- Temperature
- Humidity
- Pressure atmospheric

Events

Applications

- Security: vibration, hall effect (doors and windows), person detection PIR
- Emergencies:: presence detection and water level sensors, temperature
- Control of goods in logistics: vibration and impact sensors

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Sensors

- Pressure/Weight
- Bend
- Vibration
- Impact
- Hall Effect
- Tilt
- Temperature (+/-)
- Liquid Presence
- Liquid Level
- Luminosity
- Presence (PIR)
- Stretch

[1] Libelium. 2011. *Sensor boards*. 20110202 http://www.libelium.com/products/waspmote/sensors

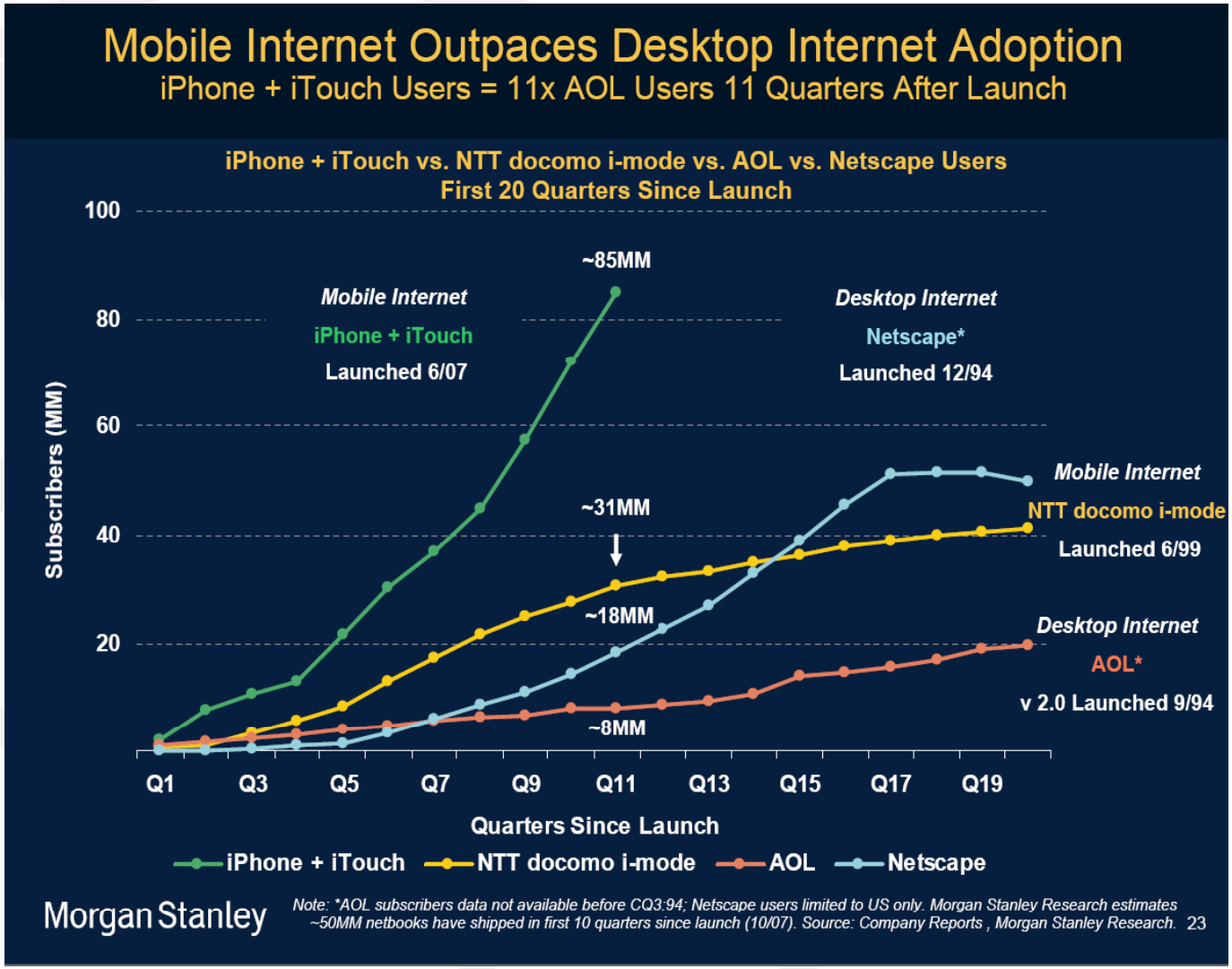
Trends: social networking (1)

- 3 types:
  - Imagery social nets
  - Gaming driven social nets
  - Interaction driven social nets.
- Facebook, Twitter, chat, blogs and other social networking applications
- User generated content
- Online content sharing including video blogging (vlogging)

Trends: social networking (2)

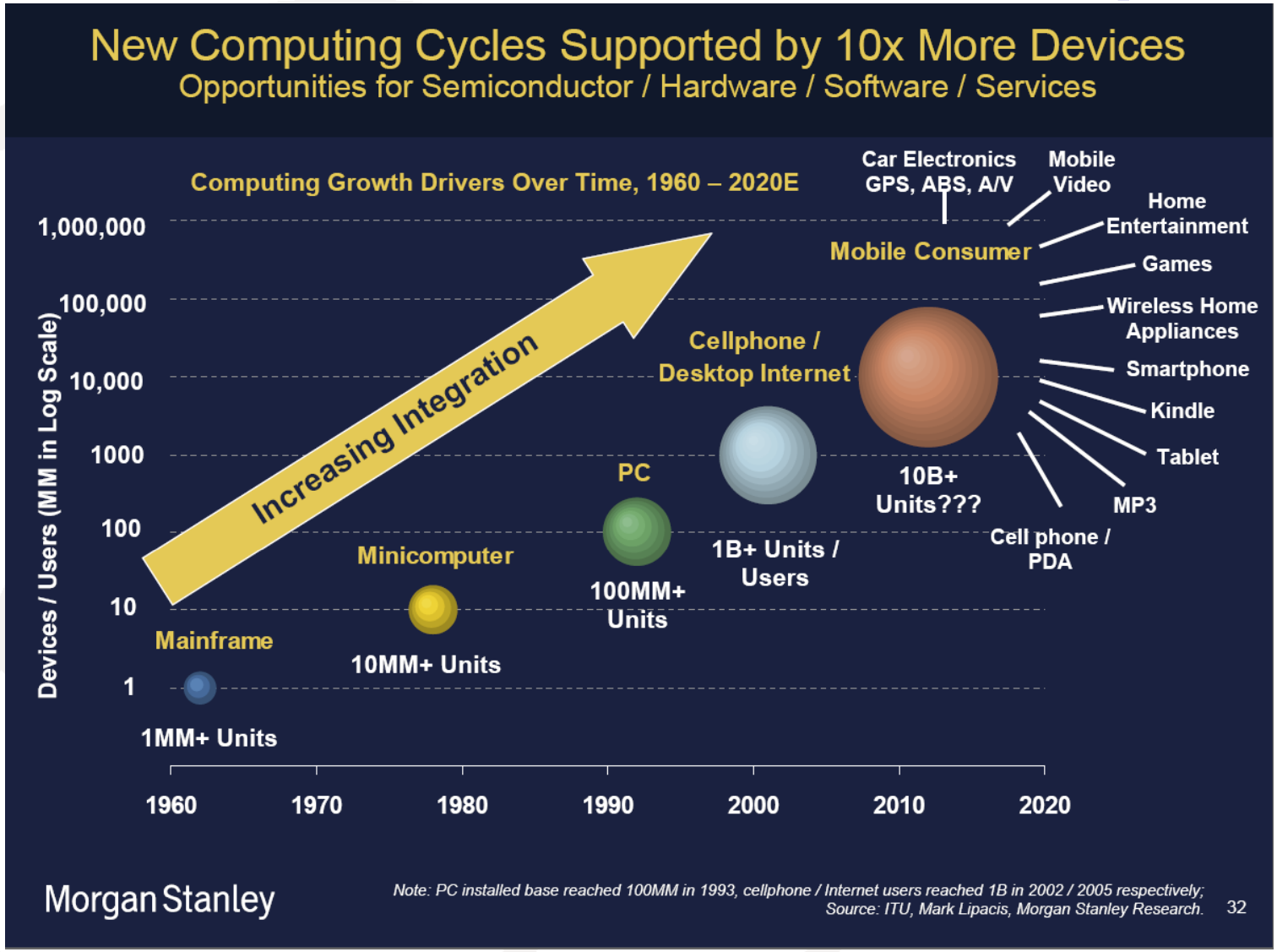
- Human based computation :
  - Human flesh search (HFS) engine: people powered search
  - Crowdsourcing for soliciting public feedback using ICTs

Mobile Internet Outpaces Desktop Internet Adoption



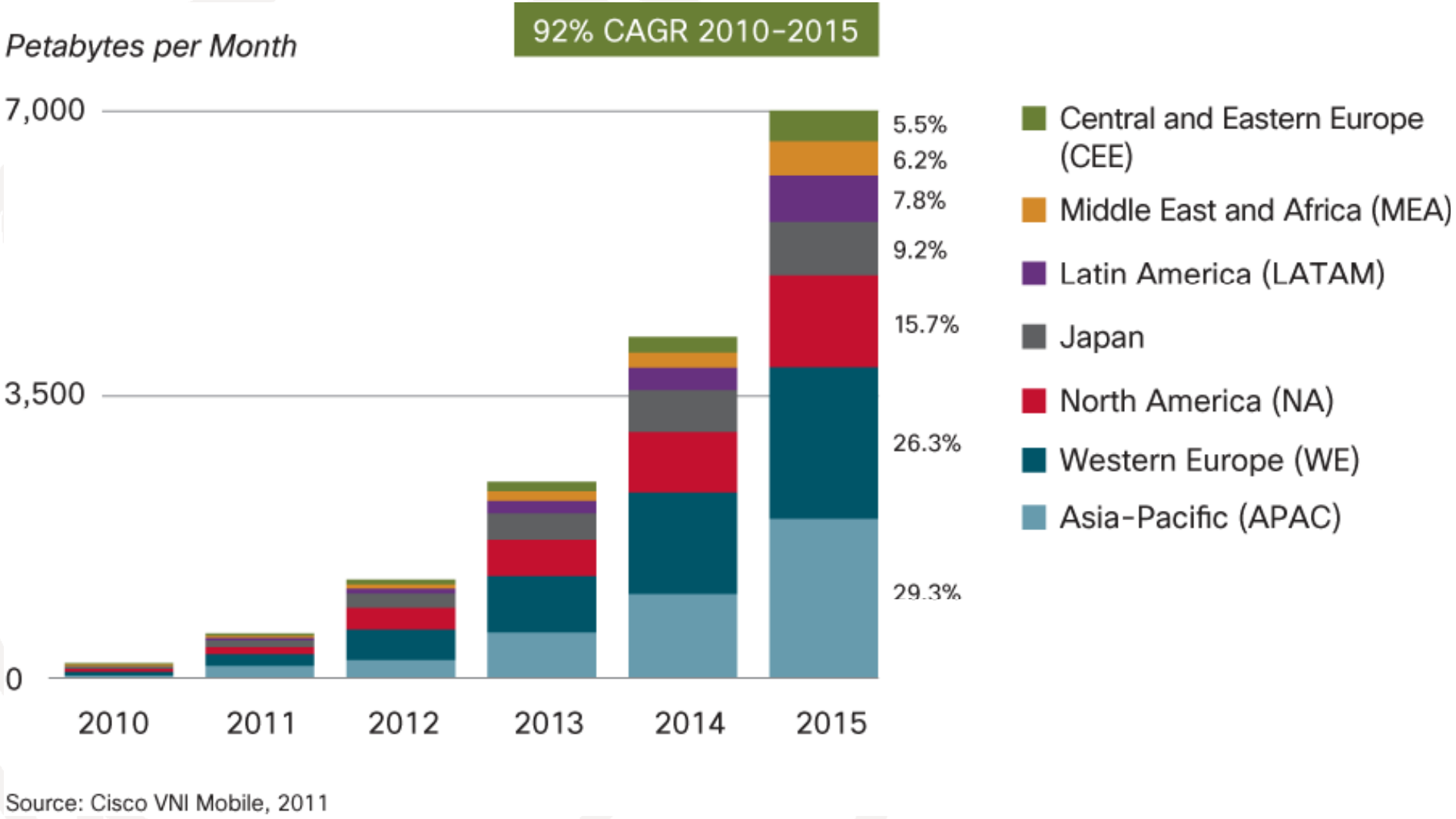
[1]Morgan Stanley. 2010. *Internet trends*. http://www.morganstanley.com/institutional/techresearch/internet_trends042010.html

The shift towards mobile computing



[1] Morgan Stanley. 2009. *Economy + Internet Trends October 20, 2009*. Web 2.0 Summit – San Francisco. mary.meeker@ms.com / scott.devitt@ms.com / liang.wu@ms.com www.morganstanley.com/techresearch

Global mobile data traffic forecast by region (Cisco)



Source: Cisco VNI Mobile, 2011

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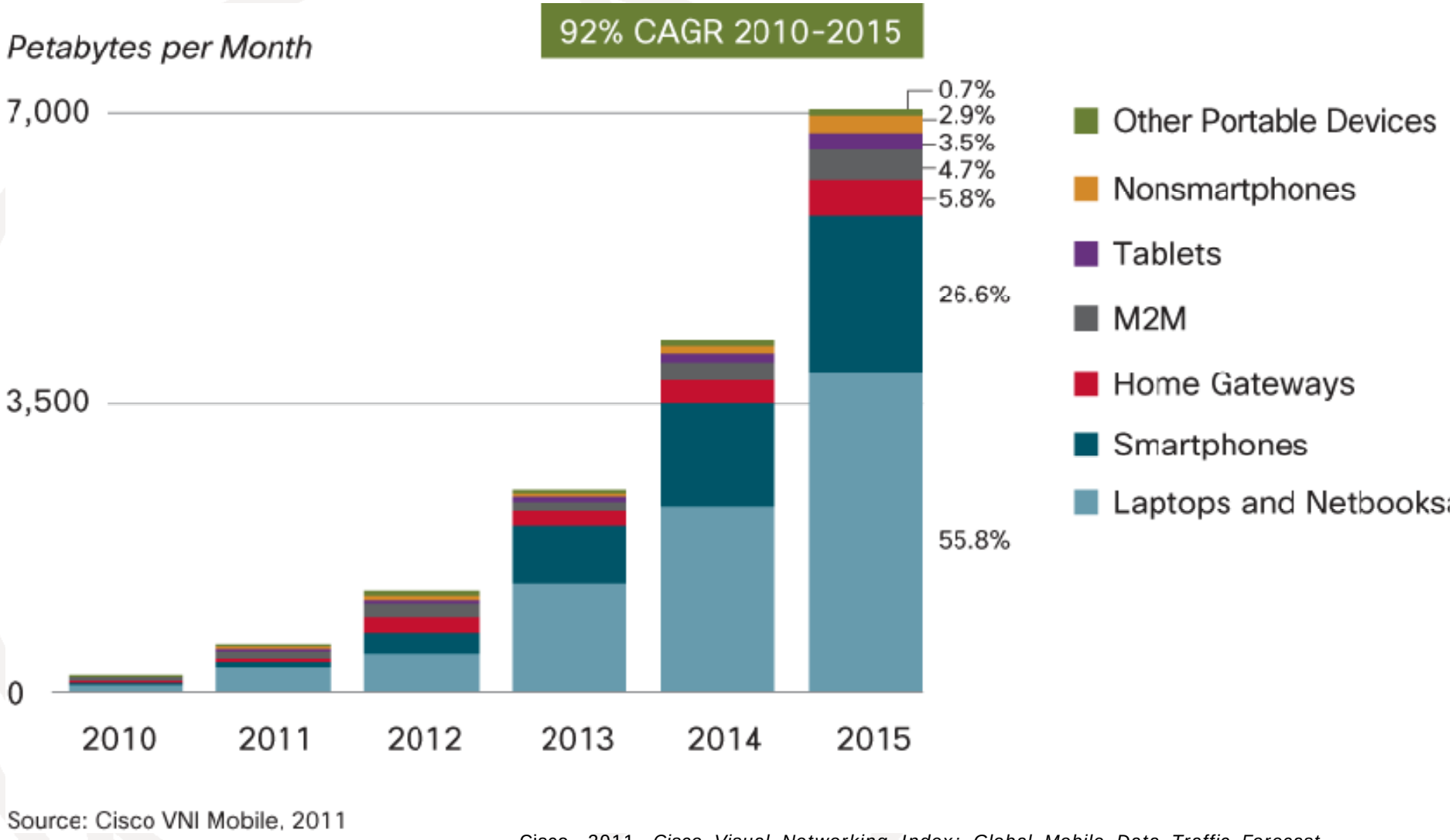
Intelligent devices such as notebooks and laptops lead traffic growth



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Conclusions (1)

- Mobile use by consumer & enterprise markets in developed & emerging economies increasing
- Bandwidth demand from data & video increasing
- M2M connections increase
- Backhaul capacity must increase to meet demand
- More portability and interoperability

Conclusions (2)

- New businesses & models emerging:
  - New forms of advertising, media and content partnerships, mobile services
  - Including M2M, live gaming and looking into the future, augmented reality
- Off grid in some countries
  - A cottage industry
  - Driving use of renewables (solar) for charging & powering beyond the electrical grid

Conclusions (3)

- Tendency is total integration of "desktop" with the Cloud
  - High bandwidth, low latency connectivity
    - FTTx
    - 4G, 5G…
  - This means speed of IP / Cloud access ~= to speed of computer buses
  - Massive data flows
  - With social nets: everyone is a user and provider of massive amounts of info.

Challenge

- How to monetize video traffic & other services while investing in infrastructure (i.e. fiber)?
- Innovate rapidly as new Web 3.0 services appear
- Meet demand in mobile for equivalent to wired experience
- Leave no one behind!
  - What for developing countries?.

Notes

- Some of the data in this presentation comes as a result of research undertaken for ITU in the preparation of an upcoming report on the use of mobile technologies for abating climate change and promoting Green Growth and sustainable development

Notes

- The Cisco VNI info comes from the Cisco VSN 2011 (Cisco® Visual Networking Index (VNI)), which is available online (see references in presentation)
- The report will be published online by ITU and includes detailed references supporting all points made above.

Notes

- Many thanks to the ITU for making my participation possible
- Thanks to the Govt. of Cuba for hosting this seminar.

Muchas gracias