ICT Growth Trends & Cloud Computing

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Agenda

- ICT Development Trends
- ITU Standards on Cloud Computing & Cloud Security
- ICT Applications & Services
- Conclusions

ITU: A Brief Overview

Founded in **1865**

A specialized agency of the UN with focus on Telecommunication / ICTs

193 Member States
567 Sector Members
159 Associates
60 Academia

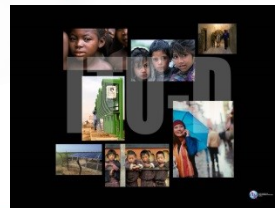Headquartered in Geneva,
4 Regional Offices
7 Area Offices.

ITU-R: ITU's Radio-communication Sector globally manages radio-frequency spectrum and satellite orbits that ensure safety of life on land, at sea and in the skies.

ITU-T: ITU's Telecommunication Standardization Sector enables global communications by ensuring that countries' ICT networks and devices are speaking the same language.

ITU-D: ITU's Development Sector fosters international cooperation and solidarity in the delivery of technical assistance and in the creation, development and improvement of telecommunication/ICT equipment and networks in developing countries.
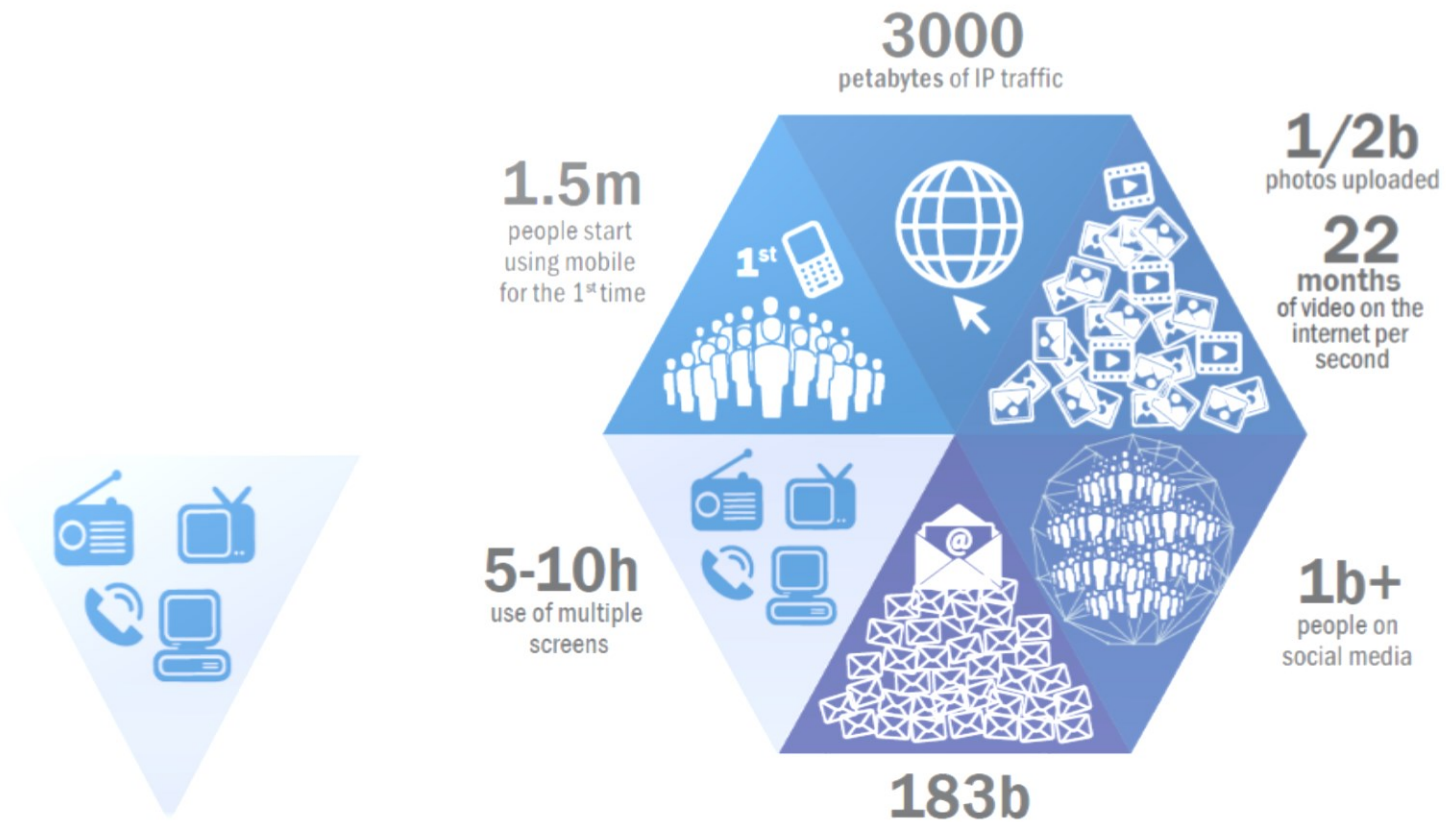
A Day in Digital World

1994 → 2014

1.5m
people start using mobile for the 1st time

1st

3000
petabytes of IP traffic

1/2b
photos uploaded

22
months
of video on the internet per second

5-10h
use of multiple screens

183b

1b+
people on social media

ICT Services Uptake

Global, 2014

Mobile cellular subscriptions:
- Almost 7 billion

Mobile broadband penetration:
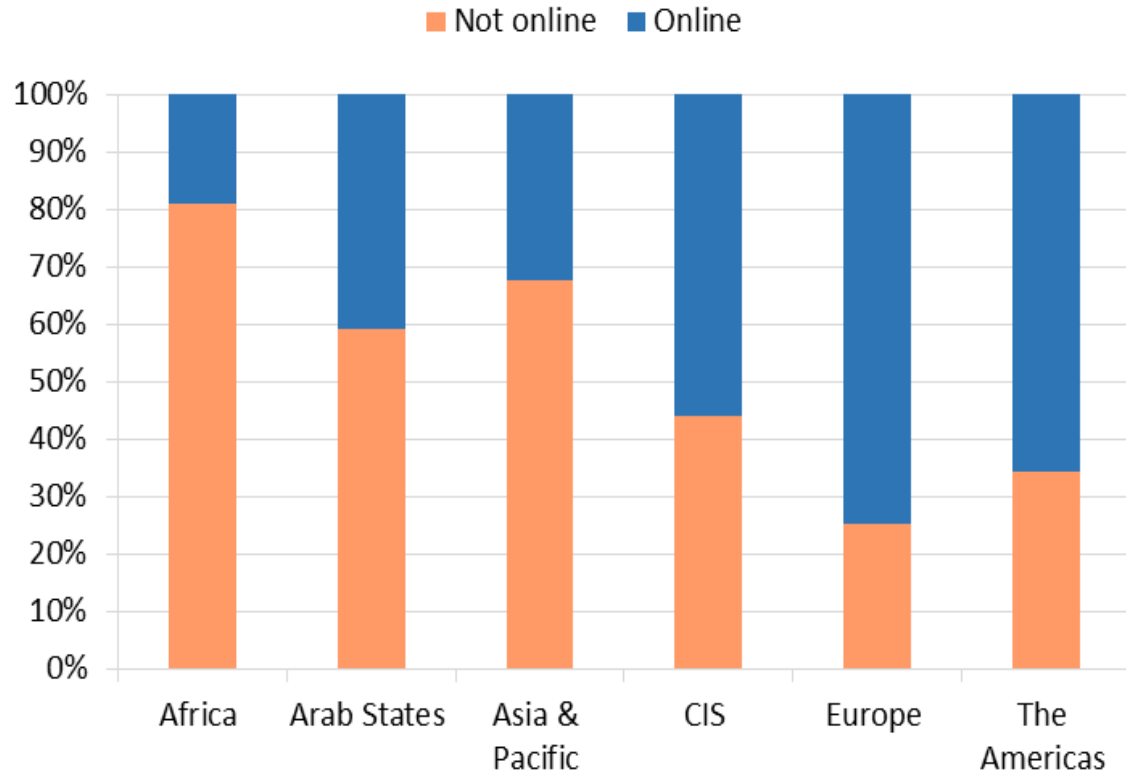- 84% developed countries
- 21% developing countries

Fixed broadband penetration:
- 27.5 % developed countries
- 6 % developing countries

- Almost 3 billion **people online** (individuals using the Internet)
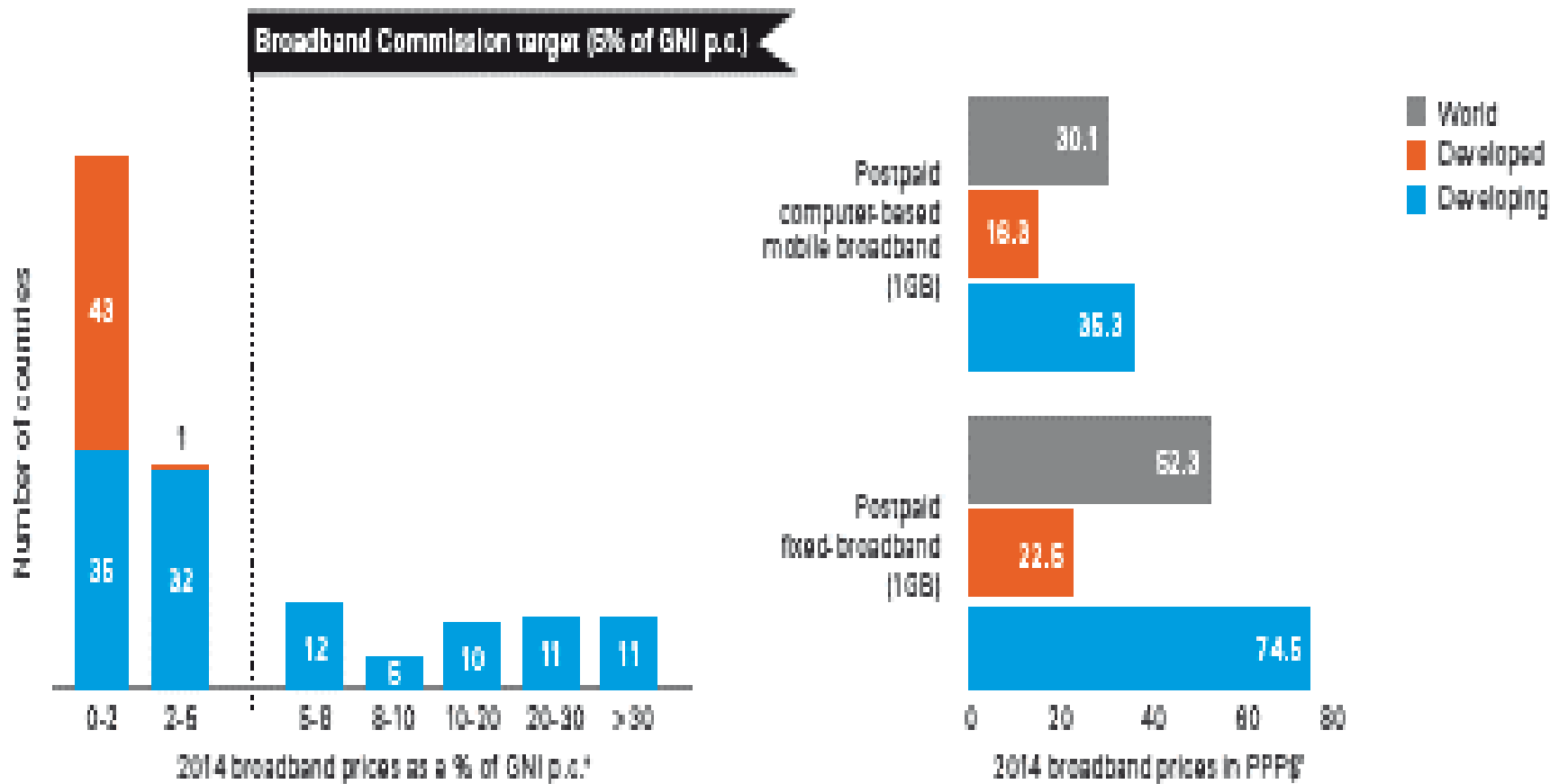
Who's online?

By region, 2014

Legend: ■ Not online ■ Online

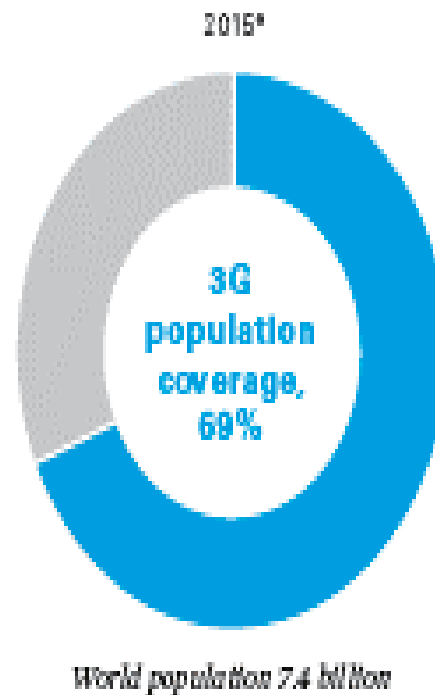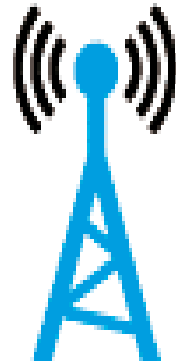Regions (x-axis): Africa, Arab States, Asia & Pacific, CIS, Europe, The Americas

Broadband now affordable in 111 countries
MBB less expensive than FBB

3 G Mobile Broadband Coverage: Extending in Rural Areas

2011

3G population coverage, 45%

World population 7 billion

2015*

3G population coverage, 69%

World population 7.4 billion
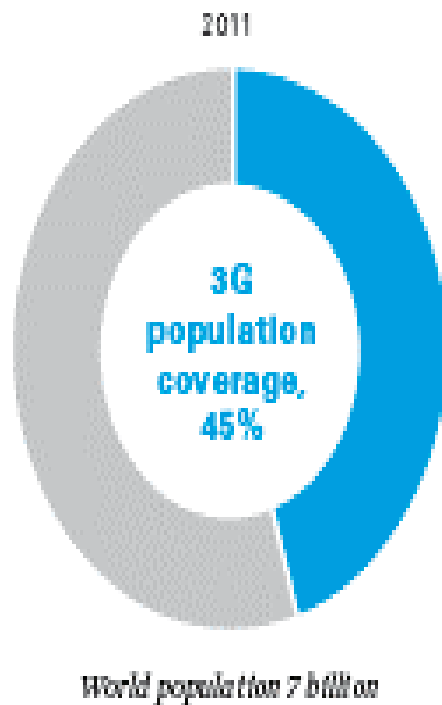
No 3G population coverage
3G population coverage

2015*

3G rural population coverage, 29%
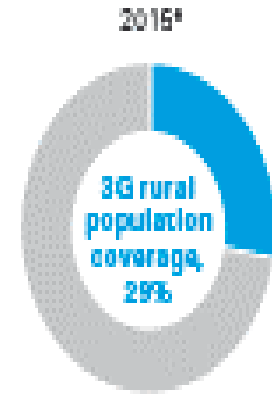
World rural population 3.4 billion

3G urban population coverage, 89%
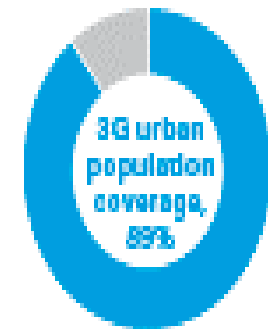
World urban population 4 billion

Source: ITU.
Note: * Estimate.

Mobile Traffic Forecasts Toward 2020
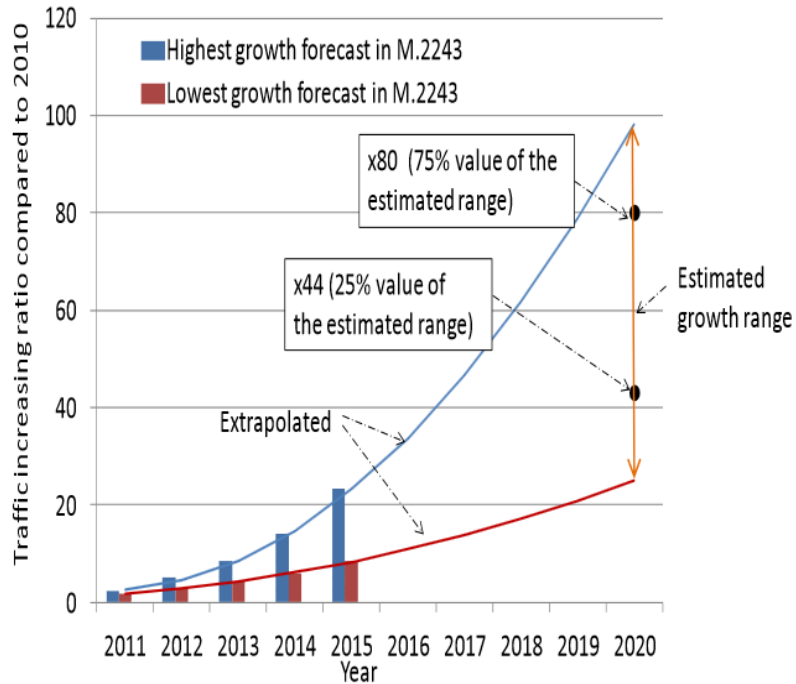
37% of Internet traffic during prime time is online video

Chart labels:
- Highest growth forecast in M.2243
- Lowest growth forecast in M.2243
- Traffic increasing ratio compared to 2010
- x80 (75% value of the estimated range)
- x44 (25% value of the estimated range)
- Estimated growth range
- Extrapolated
- Year

Video
~ 70% of internet traffic **by 2014**

Smartphones
2.5 billion devices **by 2015**
32x increase per km^2

Mobile Internet
~ 70% of mobile traffic **by 2014**

Machine-to-Machine
3x growth in the **next five years**

Broadband as key driver for development of consumer service.

Envisioning Smart Societies

Emergency

Education

Health

Electricity

National Disaster Management Authority, Military, Internal Affairs

Ministry of Education, Education Boards, Local Government

Ministry of Health, Local Government

Ministry of Power, Regulator Local Government

Governance

City, Municipal, provincial, Central Government Agencies

Transport

Universal Broadband

Sensor Networks

Green ICT & E-Waste

Competition Authority

Standardization Bodies

Security Agencies

Sector Regulators

Ministry of ICT

Infrastructure Security

Local Government, Department of Transport

Water

Ministry of Finance, Banking Regulator

Teleworking

Spectrum Management

Standards, Conformity & Interoperability

Finance & Payment

SMART SUSTAINABLE CITIES

Maturity of Regulation

Beginning of 2014

Better Regulation – Greater Growth?

Legend: G1, G2, G3, G4

Chart: Regulation maturity by region (Africa, Arab States, Asia & Pacific, CIS, Europe, The Americas), percentages 0%–100%.
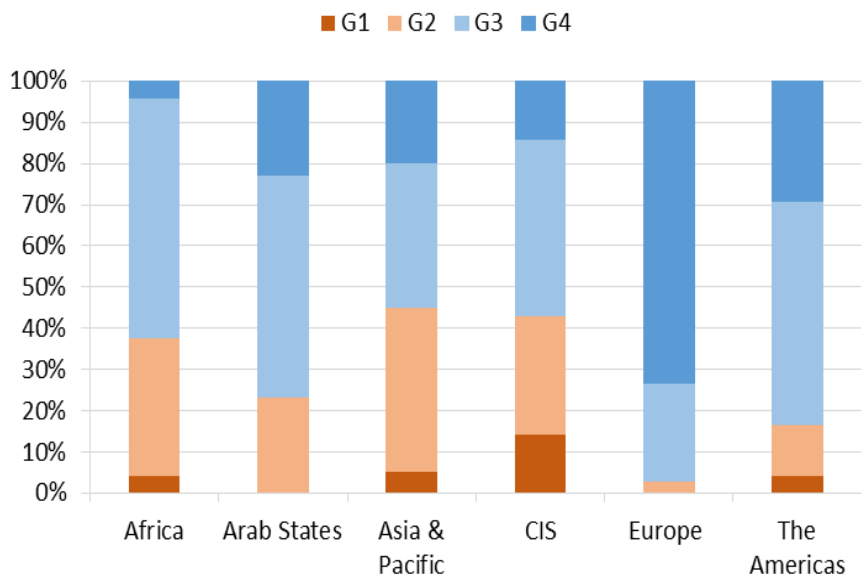
G4: Integrated regulation – led by economic and social policy

G3: Enabling investment, innovation and access – dual focus on stimulating competition in service and content delivery, and consumer protection

G2: Basic reform – partial liberalization and privatization across the layers

G1: Regulated public monopolies – command and control approach

Mobile Broadband Penetration per Generation of Regulation

Per 100 inhabitants (y-axis: 0, 10, 20, 30, 40, 50, 60)
Years: 2009, 2010, 2011, 2012, 2013
Legend: G1, G2, G3, G4

Source: ITU

Evolution of mobile broadband penetration by generation of regulation, 2009-2013

Source: ITU.

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Agreed Global Telecommunication/ICT Targets - 2020

Goal 1 Growth : Enable and foster access to and increased use of telecommunications/ICTs

55%
of households should have access to the Internet

60%
of individuals should be using the Internet

40%
Telecommunications/ICTs should be **40%** more affordable

GROWTH

Goal 2 Inclusiveness – Bridge the digital divide and provide broadband for all

50%
of households should have access to the Internet in the developing world; **15%** in the least developed countries

50%
of individuals should be using the Internet in the developing world; **20%** in the least developed countries

40%
affordability gap between developed and developing countries should be reduced by **40%**

5%
Broadband services should cost no more than **5%** of average monthly income in the developing countries

INCLUSION

90%
of the rural population should be covered by broadband services

Gender equality among Internet users should be reached

Enabling environments ensuring accessible ICTs for persons with disabilities should be established in all countries

Goal 3 Sustainability – Manage challenges resulting from the telecommunication/ICT development

40%
improvement in cybersecurity readiness

50%
reduction in volume of redundant e-waste

30%
decrease in Green House Gas emissions per device generated by the telecommunication/ICT sector

SUSTAINABILITY

Goal 4 Innovation and partnership – Lead, improve and adapt to the changing telecommunication/ICT environment

Telecommunication/ICT environment conducive to innovation

Effective partnerships of stakeholders in telecommunication/ICT environment

INNOVATION

150
ITU
1865
2015

ITU

ITU: Asia-Pacific Regional Initiatives (2015-2018)

Initiative #1	Special Consideration For LDCs*, SIDSs**, Including Pacific Island Countries, And Landlocked Developing Countries
Initiative #2	Emergency Telecommunications
Initiative #3	Harnessing The Benefits of New Technologies
Initiative #4	Development of Broadband Access and Adoption of Broadband
Initiative #5	Policy And Regulation

*   LDC: Least Developed Countries
** SIDS: Small Island Developing States

ITU Standards on Cloud Computing & Cloud Security

History of Cloud Computing

- 2010, February:
    - Establishment of the FG Cloud by TSAG
        - ✓ In operation 2/2010 – 12/2011
        - ✓ Delivered 7 Technical Reports
- 2012, January:
    - ✓ TSAG entrusted the lead SG responsibility for cloud computing to SG13
    - ✓ TSAG established JCA-Cloud with SG13 as parent
- 2012, February:
    - ✓ Extraordinary SG13 meeting focused on cloud computing work organization
    - ✓ France, CT, China Unicom and ZTE proposed to start new Questions on cloud computing in SG13
    - ✓ Proposal to set up a dedicated WP in SG13 to concentrate on the cloud computing work
    - ✓ First meeting of JCA-Cloud
- 2012, April:
    - ✓ First meetings of cloud computing Questions of SG13 (in Geneva)

Cloud Computing: Definition (ITU-T Y.3500)

"<u>paradigm</u> for enabling network access to a scalable and elastic pool of <u>shareable physical</u> or <u>virtual resources</u> with <u>self-</u>service provisioning and administration on-demand"

NOTE – Examples of resources include servers, operating systems, networks, software, applications, and storage equipment.

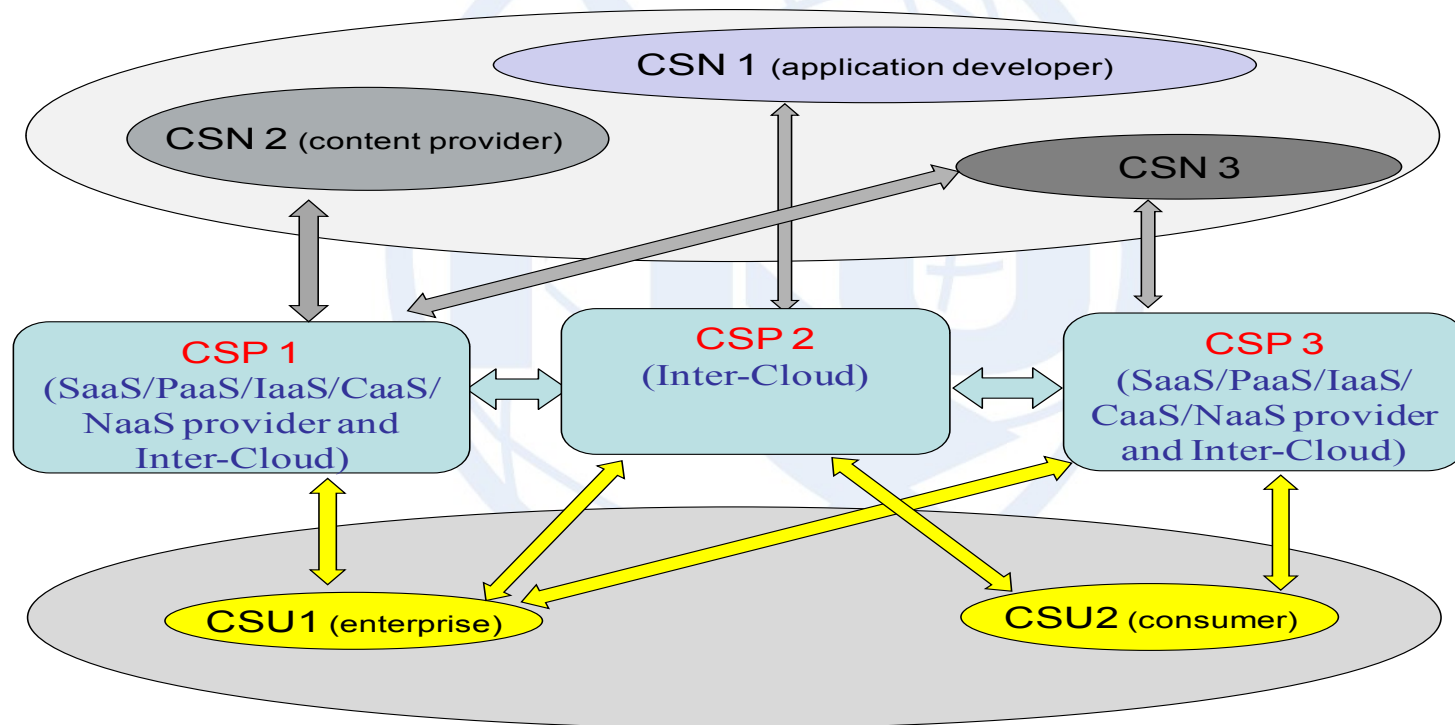# Cloud ecosystem: definitions, taxonomies use cases & high level requirements

1. Cloud Computing related definitions & taxonomies: 5 Cloud service categories (SaaS, CaaS, PaaS, IaaS, NaaS) with 2 new categories for Communication (real time) and network (transport & inter-cloud)

2. Cloud ecosystem actors (provider, partner & user) and roles

3. Inter-cloud Scenarios : Peering, Federation & Service Broker

4. Telecommunication centric use cases: Service Delivery Platform, Desktop as a Service, Call center, Cloud migration and portability, Inter-cloud (SLA, performance, availability...)

5. High level requirements:

   ▪ For cloud infrastructure accessibility, massive data processing, portability, responsiveness...

   ▪ For cloud services: SLA support, management, Inter-cloud
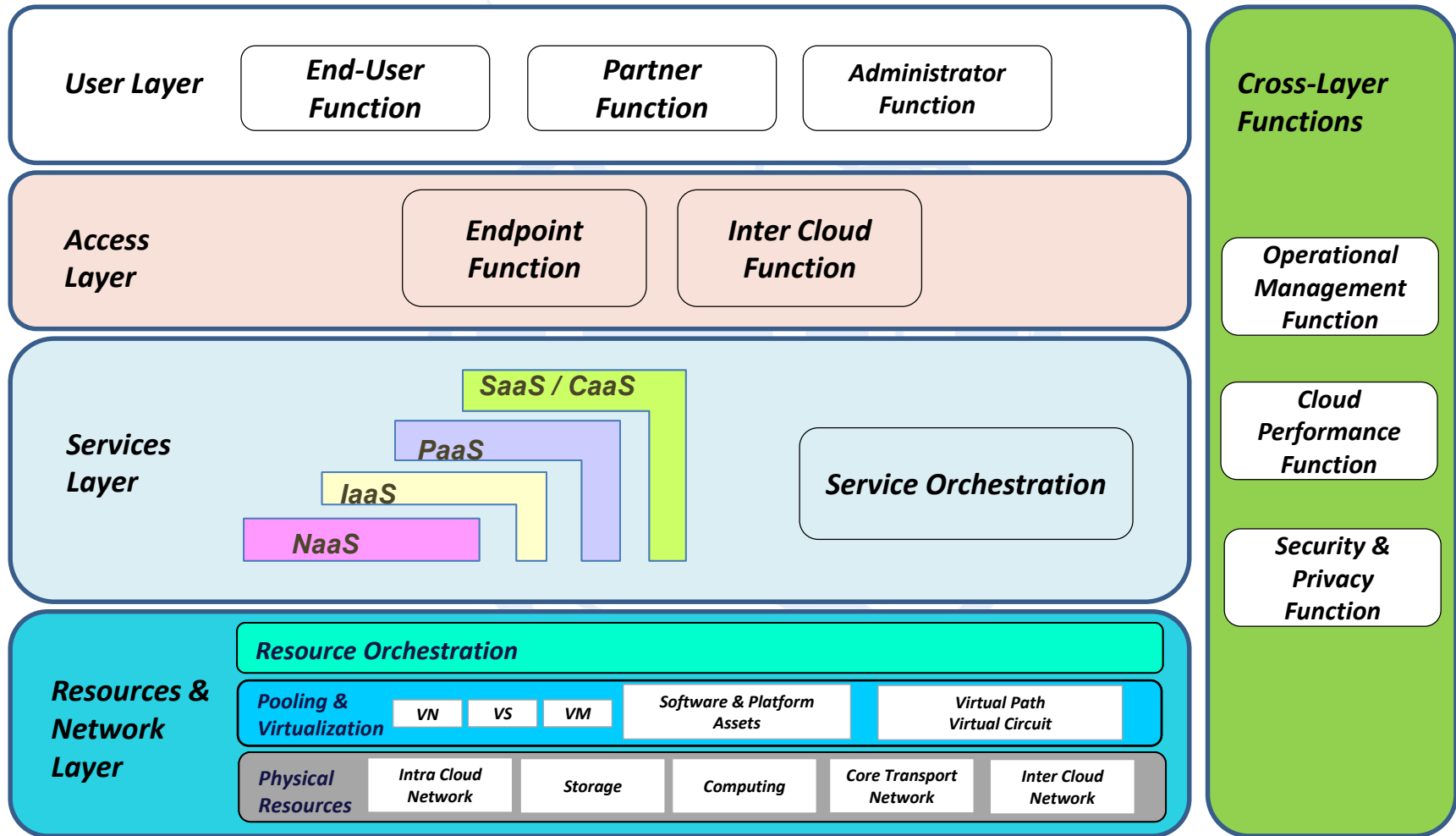
Cloud Ecosystem

Three actors playing different roles:
1. Cloud Service Provider CSP: XaaS Provider, Inter-Cloud…
2. Cloud Service User CSU: Consumer, Enterprise…
3. Cloud Service Partner CSN: Application Developer, Integrator…

Cloud Functional Architecture
First Cloud ICT Architecture

User Layer
- End-User Function
- Partner Function
- Administrator Function

Access Layer
- Endpoint Function
- Inter Cloud Function

Services Layer
- SaaS / CaaS
- PaaS
- IaaS
- NaaS
- Service Orchestration

Resources & Network Layer
- Resource Orchestration
- Pooling & Virtualization
  - VN
  - VS
  - VM
  - Software & Platform Assets
  - Virtual Path Virtual Circuit
- Physical Resources
  - Intra Cloud Network
  - Storage
  - Computing
  - Core Transport Network
  - Inter Cloud Network

Cross-Layer Functions
- Operational Management Function
- Cloud Performance Function
- Security & Privacy Function

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Study Group 13 Mandate

Per WTSA-12 Resolution 2

Title: Future networks including **cloud computing**, mobile and next generation networks

Responsibility:

- ✓ studies relating to **cloud computing technologies** such as virtualization, resource management, reliability and security

Lead SG on (among others): **Cloud Computing**

SG13 at a glance

- o Participants: 205 delegates from 37 countries
- o Around 230 contributions

Study Group 13, structures for Cloud Computing

- **WP2/13 as a center of CC study** (including various Qs)
- Collaborative Teams with ISO/IEC JTC1 SC38
  - CT-CCVOCAB (terminated in July 2014)
  - CT-CCRA (terminated in July 2014)
- JCA-Cloud
- JRG-CCM: Joint Rapporteur Group on cloud computing management (with ITU-T SG2)
- SG13RG-AFR

WP2/13

Cloud Computing and Common Capabilities

- Q17:Cloud computing ecosystem, general requirements, and capabilities

- Q18:Cloud functional architecture, infrastructure and networking

- Q19:End-to-end Cloud computing service and resource management

SDN and networks of future

- Q14:Software-Defined Networking and Service-aware networking in future networks

Virtualization

JCA-Cloud

- JCA-Cloud "Joint Coordination Activity on Cloud Computing":

  - ✓ Distributed the FG Cloud deliverables to the ITU-T SGs

  - ✓ Looks after coordination within ITU-T and relevant SDOs

  - ✓ Maintains the cloud computing standards roadmap

    https://extranet.itu.int/sites/itu-t/Roadmaps/SitePages/JCA-Cloud-Standard.aspx

  - ✓ Reports to its parent group, SG13

FG on Aviation Applications of Cloud Computing for Flight Data Monitoring (FG AC)

- First meeting: **1-3 Dec. 2014, Kuala Lumpur, Malaysia** –

- **Cloud computing and big data:** definitions; taxonomy; architecture; general use cases; security; data protection; privacy; performance requirements; regulatory aspects --- based on existing material, e.g., ITU-T Y.3500/3501/3502

- **Aviation use cases for cloud computing and big data**, e.g., flight management system, engine monitoring system, integrated flight information system: functional / performance / security requirements; benefits; challenges

- Details at http://itu.int/en/ITU-T/focusgroups/ac/

Cloud Computing Security related Works in ITU-T SG17

SG17 mandate by World Telecommunication Standardization Assembly (WTSA-12)

- Title: Security

  Responsible for building confidence and security in the use of information and communication technologies (ICTs). This includes studies relating to cybersecurity, security management, countering spam and identity management. It also includes security architecture and framework, protection of personally identifiable information, and security of applications and services for the Internet of things, smart grid, smartphone, IPTV, web services, social network, cloud computing, mobile financial system and telebiometrics. Also responsible for the application of open system communications including directory and object identifiers, and for technical languages, the method for their usage and other issues related to the software aspects of telecommunication systems, and for conformance testing to improve quality of Recommendations.

- Lead Study Group for:
  – Security
  – Identity management
  – Languages and description techniques

- Responsible for specific E, F, X and Z series Recommendations
- Responsible for 12 Questions

SG17 Structure

WP1：Fundamental security	Q1：Telecommunication/ICT security coordination
	Q2：Security architecture and framework
	Q3：Telecommunication information security management
WP2：Network and information security	Q4：Cybersecurity
	Q5：Countering spam by technical means
WP3：Identity management and cloud computing security	Q8：Cloud computing security
	Q10：Identity management architecture and mechanisms
WP4：Application security	Q6：Security aspects of ubiquitous telecommunication services
	Q7：Secure application services
	Q9：Telebiometrics
WP5：Formal languages	Q11：Generic technologies to support secure applications
	Q12：Formal languages for telecommunication software and testing

SG17 Cloud Computing Security related Questions

1. Security architecture/model and framework
2. Security management and audit technology

Q3/17

3. BCP/disaster recovery and storage security
4. Data and privacy protection
5. Account/identity management

Q10/17

6. Network monitoring and incidence response
7. Network security

Q4/17

8. Interoperability security
9. Service portability

Q8/17

Management   *CyberSecurity*   *(Main)cloud*   *IdM/Bio*

SG17 cloud computing security work items

X.1601: Security framework for cloud computing

X.1631: Information technology – Security techniques – Code of practice for information security controls for cloud computing services based on ISO/IEC 27002

X.sfcse: Security functional requirements for SaaS application environment

X.goscc: Guideline of operational security for cloud computin

**X.CSCdataSec**: Guidelines for cloud service customer data security

Published in 2014.1

Common text with ISO/IEC

Established work item in 2014-09 SG17 meeting
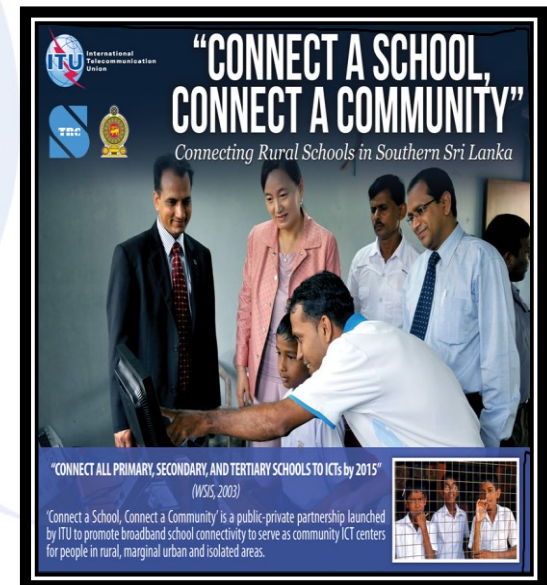
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ICT Applications & Services

Broadband Applications: e-Health

- About 7 billion mobile users, over 96 % coverage, 1/3rd of world population on Internet and 2 billion broadband users
- ITU WHO
    - ✓ Commission's on Information & Accountability for Women & Children's Health
    - ✓ National e-Health Strategy toolkit
    - ✓ Mobile technologies prevention cure & awareness of NCD , Manila, Philippines
- Interoperable standards on e-Health Study Group 16 : Q 28/16: "Multimedia Framework for e-health Applications."
- Telemedicine / e Health: Nepal
- Mobile Applications : Nepal , Bhutan
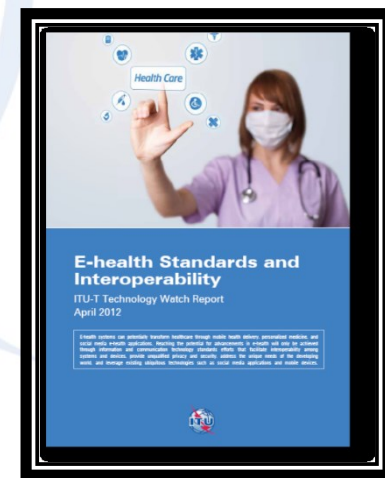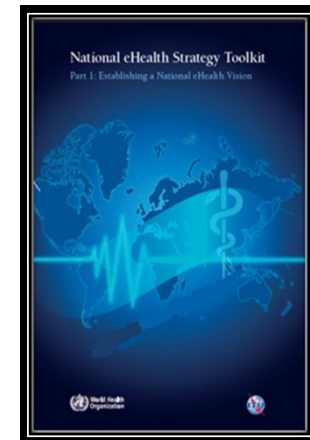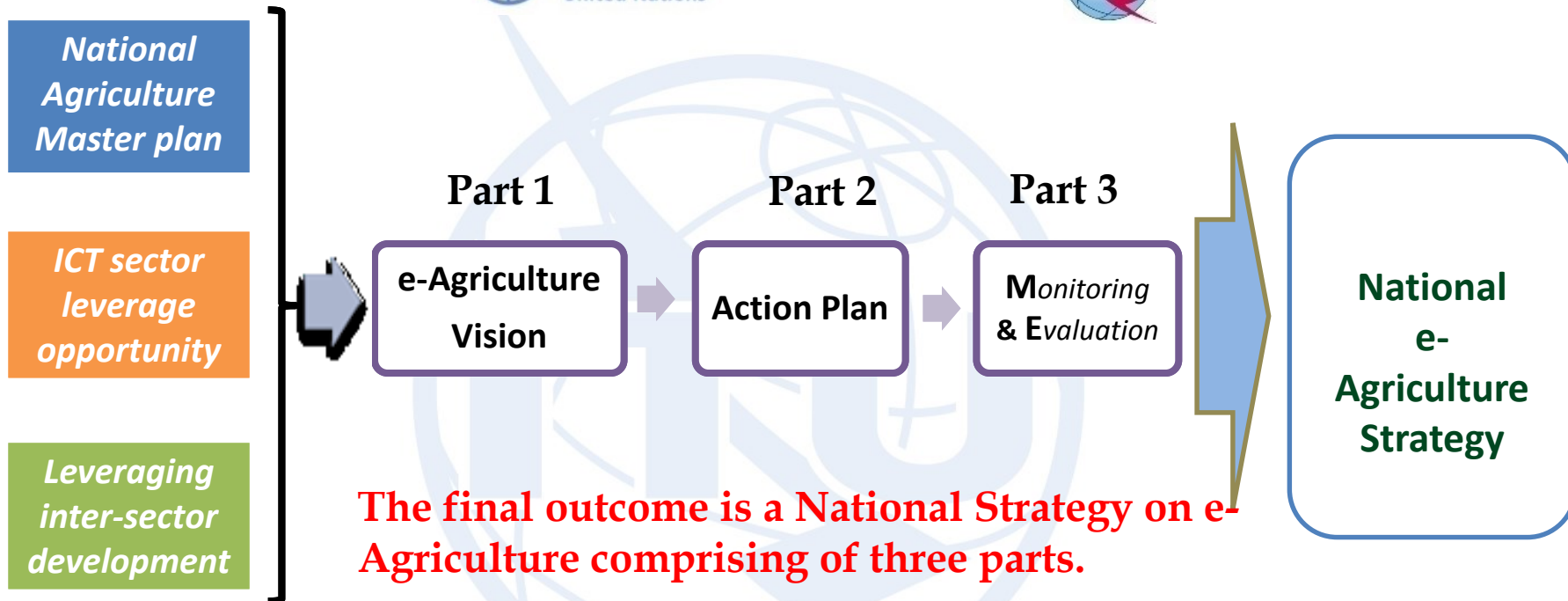
Broadband Applications: e-Education

- Connect a School, Connect a Community Initiative
- Why Connect Schools?
- Best practices in using ICTs for persons with disabilities
- Best practices in using ICTs for women's empowerment
- Best practices in providing ICTs for indigenous persons
- Connected all districts with wireless broadband in partnership with TRCSL, Ministry of Education, Intel etc.
- Final inauguration in Sri Lanka in December 2013

Connect a School,
Connect a Community

"CONNECT A SCHOOL,
CONNECT A COMMUNITY"
Connecting Rural Schools in Southern Sri Lanka

"CONNECT ALL PRIMARY, SECONDARY, AND TERTIARY SCHOOLS TO ICTs by 2015"
(WSIS, 2003)

'Connect a School, Connect a Community' is a public-private partnership launched by ITU to promote broadband school connectivity to serve as community ICT centers for people in rural, marginal urban and isolated areas.

Broadband Applications: e-Agriculture

National Agriculture Master plan

ICT sector leverage opportunity

Leveraging inter-sector development

Part 1
e-Agriculture Vision

Part 2
Action Plan

Part 3
Monitoring **& E**valuation

National e-Agriculture Strategy

The final outcome is a National Strategy on e-Agriculture comprising of three parts.

Ongoing assistances to Bhutan and Sri Lanka on development of e-Agriculture Strategy / Masterplan

Implementation ongoing in Bhutan, Sri Lanka, Philippines, PNG

Conclusions

- Cloud computing is emerging technology which will bring about innovations in terms of business models and applications
- Increased focus on standards for interfaces would enable clouds and grids to be commoditized and would ensure interoperability
- The global dimension of cloud computing requires standardized methodologies and technical solutions to enable stakeholders to assess privacy risks and establish adequate protection levels.
- Cloud offers opportunities for introduction of affordable ICT applications and services
- ITU along with the partners have an enabling role to play in developing technical standards, guidelines and methodologies for implementing privacy by design principles, including assessment of risks to personal information in the cloud
- Let's work towards interoperable safe secure standards for cloud facilitating innovative services for

ITU : I Thank U

SG13 Regional Group for Africa

The main objective: encourage national authorities and operators from countries in Africa to work together and better contribute to ITU-T SG 13 activities in general and to Cloud Computing (CC) in particular in line with SG 13 mandate.

Terms of Reference:

a) To encourage participation in the SG 13 and to report SG 13's outcomes and deliverables.

b) To establish an electronic forum on **CC implementation** challenges incl. regulatory issues.

c) To establish **training needs on CC** and future networks in Africa and coordinate the organization of technical tutorials in the region on such topics with SG 13.

f) To encourage African countries to the development of new/revised ITU-T Recommendations on CC and future networks.

g) To disseminate relevant information provided by ITU-T on CC and future networks standards and document relevant use cases of CC architectures and services including emerging mobile services.

h, i) To provide the **focal points identified on CC** issues and future networks in African countries and to collaborate with African Telecommunication Union (ATU).

j) **Act as a liaison body** between administrations, operators, regulators and ITU-T in matters relating to CC and future networks.

Outcomes – 2013-2014

- 3 Questions in WP2/13 produced 9 Recs
  - Y.3500: Cloud computing - Overview and Vocabulary*
  - Y.3501: Cloud computing framework and high-level requirements
  - Y.3502: Cloud computing - Reference architecture*
  - Y.3503: Requirements for Desktop as a Service
  - Y.3510: Cloud Computing Infrastructure Requirements
  - Y.3511: Framework of inter-cloud computing
  - Y.3512: Cloud computing - Functional requirements of NaaS
  - Y.3513: Cloud Computing - Functional requirements of IaaS
  - Y.3520: CC framework for e-2-e resource management

* Common text with ISO/IEC JTC1 SC38/WG3

Workshops: 2012-2014

SG13 organized

- Algiers, Algeria, 8 September 2013 "ITU Workshop on Standardization on IMT, M2M, IoT, Cloud Computing and SDN"

- Tunis, Tunisia, 28 April 2014 "2nd SG13 Regional Workshop for Africa on "Future Networks: Cloud Computing, Energy Saving, Security & Virtualization"

Other Workshops on Cloud Computing in ITU-T

- **ITU Workshop on Cloud Computing**: Tunis, Tunisia, 18-19 June 2012

- **Workshop on Cloud Computing and Smart Grid**: Geneva, Switzerland, 9 January 2012

Meetings: SG13

Past:

- Geneva, 18 February - 1 March 2013, SG13

- Geneva, 28 June 2013, WPs/13

- Kampala, Uganda, 4-15 November 2013, SG13

- Geneva, 28 February 2014, WPs/13

- Geneva, 7-18 July 2014, SG13

- Geneva, 21 November 2014, WP1/13 and WP3/13

- Geneva, 20 April-1 May 2015, SG13

Future:

- Geneva, 30 November – 11 December 2015, SG13

Recs by other SGs – work in progress

✓ Draft Recommendations

- SG16 Recommendation H.248.Cloud "Gateway control protocol: Cloudification of packet gateways", http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=10200

- SG2 (JRG-CCM) Recommendation M.occm "Overview of Cloud Computing management", http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=8846

- SG2 (JRG-CCM) Recommendation M.rcsm "Requirements for Cloud Service Management", http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=9621 and

- SG2 (JRG-CCM) Recommendation M.mivrcc "Requirements and analysis for management interface of virtualized resources in cloud computing", http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=9623

Supplements and Recs by other SGs

✓ Supplements and Recommendations

– SG11 Supplement 65 to Q.39xx-series Recommendations "Cloud computing interoperability activities", http://www.itu.int/rec/T-REC-Q.Sup65-201407-P/en

– SG17 Recommendation ITU-T X.1601 "Security framework for cloud computing", http://www.itu.int/rec/T-REC-X.1601/en

✓ Reports

– ITU-T Technology Watch report: Privacy in Cloud Computing (March 2012)

   http://www.itu.int/en/ITU-T/techwatch/Pages/cloud-computing-privacy.aspx

– ITU-T Technology Watch report: Distributed Computing: Utilities, Grids & Clouds (March 2009)

SG17 cloud computing security
Recommendation structure

Overview	X.1601: Security framework for cloud computing		
Security design	**X.1602-X.1605** Security requirements (e.g. X.sfcse), Security capabilities	**X.1606-X.1610** Trust model Security architecture/functions	**X.1611-X.1615** Security controls (e.g. X.cc-control)
Security implementation	**X.1616-X.1625** Security solutions Security mechanisms	**X.1626-X.1630** Incident management, disaster recovery Security assessment and audit	
Best practices and guidelines	**X.1631-X.1640** Best practices / guidelines (e.g. X.goscc)		