Measuring Emerging ICT Trends

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Transforming emerging technologies into economic and societal opportunities

1	2	3
Document the new ICT value system	Inform policy and governance	Develop next generation of ICT indicators

Documenting the new ICT value system

Digital transformations

- Four key technologies
  - Internet of Things (IoT)
  - Big data (analytics)
  - New computing architectures
  - Artificial Intelligence (AI)
- Tremendous opportunities to contribute to the 17 Sustainable Development Goals
- New challenges to establish supportive policy and governance frameworks

Global Market for Emerging Technologies (2015-2025*, US$ billion)

Technology	2015	2025*	Change
Internet of Things (IoT)	193.5	640.0	+331%
Big Data	27.3	88.5	+324%
Public Cloud	75.3	278.2	+369%
Artificial Intelligence (AI)	0.6	36.8	+5717%
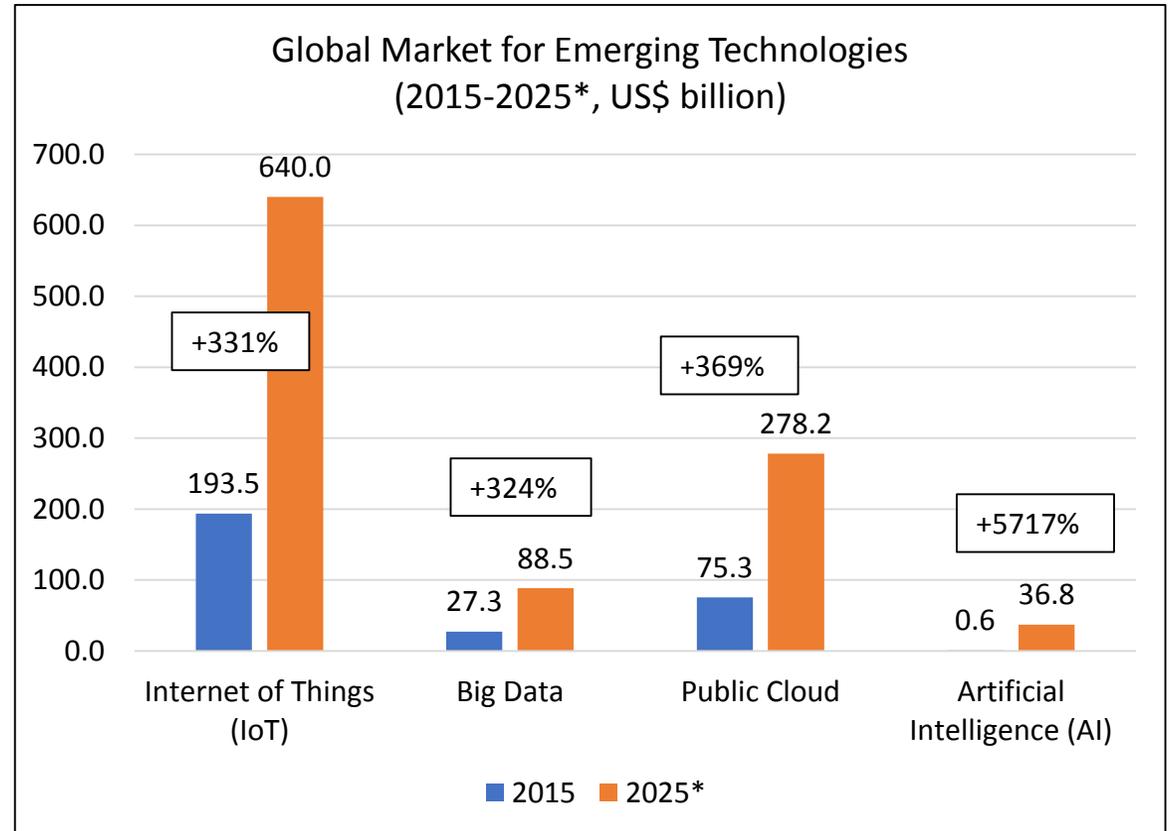
Source: MISR 2017; * … estimated

Technological and economic forces

- Exponential performance increases of ICTs (e.g. Moore's Law, Cooper's Law)

- Rapidly improving fixed and wireless connectivity (speeds, QoS)

- Ubiquitous, distributed computing power in smart devices and objects

- Massive growth of user- and machine-generated data ("Zettabyte Era")

- Transition from "pipeline" to "platform" economy accelerates value generation

Global IP Traffic in Exabytes per year 2016-2021

Legend:
- Latin America
- Middle East & Africa
- Central & Eastern Europe
- Western Europe
- North America
- Asia Pacific

21%
42%
22%
22%
20%
CAGR 26%
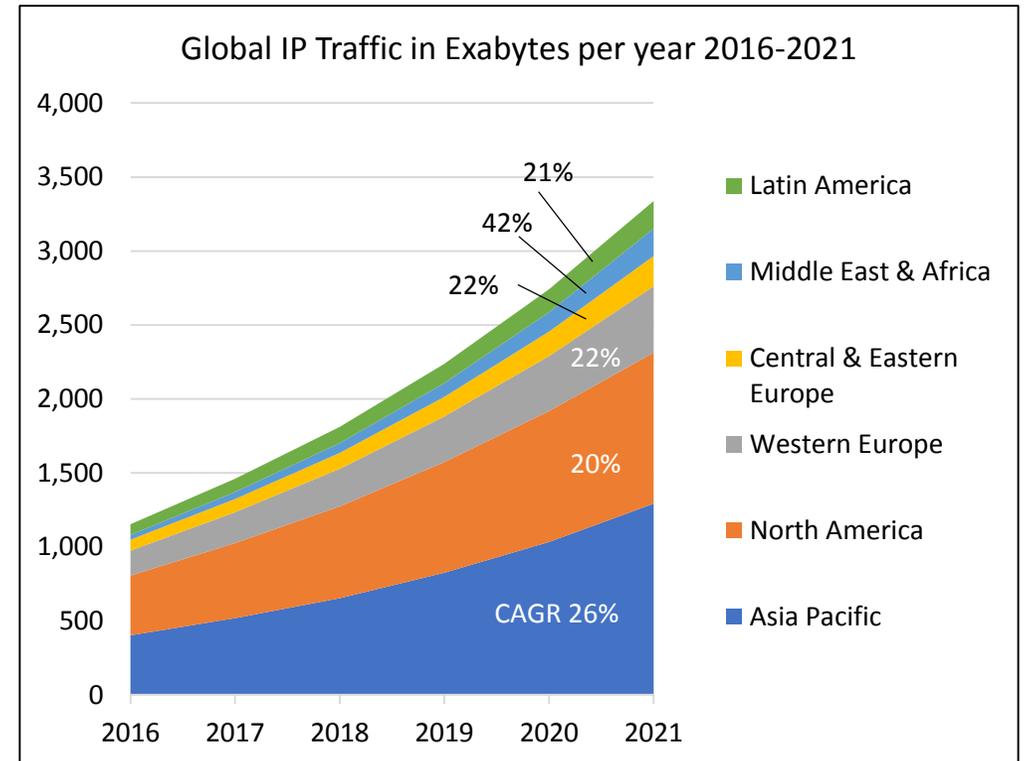
Source: Cisco, VPI, 2017

Enabling technologies

- The Internet of Things (IoT) extends connectivity to physical objects, sensors, and actuators to create cyber-physical systems (e.g. precision agriculture, health monitoring)

- Big data analytics mines, analyzes and visualizes the continuous stream of structured and unstructured data generated by digital communications (e.g. transportation, energy, services)

- Cloud computing flexibly deploys data processing, storage, and analysis capability to enable access anytime, anywhere, from any capable device

- Artificial intelligence (AI) uses machine learning (neural networks, deep learning) to make routine decisions or to augment the human capability to make difficult decisions (e.g. diagnostics, predictice maintenance)

Non-linear, dynamic value generation

Fixed — Voice, data; SS7, SONET, SDH; Copper, fiber

Wireless — Voice, data; GSM, LTE, CDMA; Antenna towers, spectrum

Content, applications, service

Development platforms

Networks

Devices

A fast-paced digital innovation system
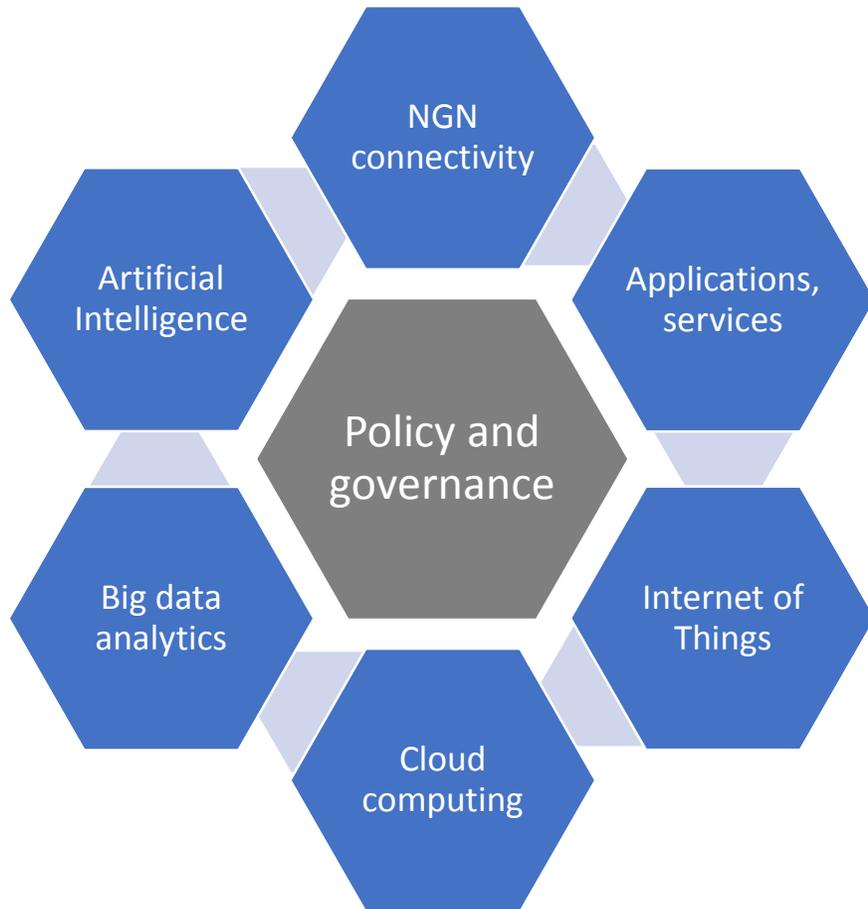
- Innovation unfolds among many interdependent players
- Rapid experimentation, real-time feedback, market selection, replication of successful solutions
- Disruption of existing industries and new "Blue Ocean" opportunities
- Requires adaptive policy making and regulation (both too little and too much regulation is bad)

Informing
policy and governance

ICTs are neither good nor bad …

- Effects of unfolding digital transformations are not yet fully known
- Advanced ICTs promise enormous benefits for Sustainable Development Goals (SDGs) and human rights, including
    - Smart agriculture, smart cities, environmental stewardship
    - Individual empowerment, better government, improved education
- They also bring new challenges and potential risks
    - Replacement of human labor by robots and artificial intelligence
    - Next-generation digital divides, ambiguous effects on income inequality
    - Surveillance and control by supposed "technologies of freedom"
- Policy appropriate to national conditions is critical (there is no single "best model") and dependent on reliable indicators

… they need the right policy conditions

- Network infrastructure
  - Availability of fixed and mobile broadband, smart devices
  - National and international bandwidth, data centers
  - Differentiated infrastructure quality of service (speed, latency, jitter)
- All-IP seamless connectivity
  - Fixed and mobile broadband, LPWANs, NB-IoT, LTE-M
- Complementary user skills
  - Digitally literate workforce, data scientists, computer scientists
  - Increasingly powerful software empowers users with appropriate skills and mindset
- Policy responses that enable digital entrepreneurship and innovation
  - Differentiated based on assessment of national strengths and deficits
  - Based on good statistical evidence and models (stimulation, foresight)

Next generation of
ICT indicators

Knowledge for sustainable development

- The power of emerging technologies is best harnessed using a human-centered design approach
- Requires reliable and continuously updated information
    - Agreed conventions on data definitions and measurement
    - Improved accessibility of data to users and entrepreneurs
- Machine-generated data collection and processing
    - Harvesting of data directly form the digital infrastructure and services
    - Networks or sensors and devices could generate trusted database
- Roles for the public sector and intergovernmental organizations
    - Collector of critical, standardized information that is of broad importance
    - Facilitator of data collection (open algorithms) and availability (open data)
    - Curator and archiver of data and analytical models (open repositories)

Indicators and models

- Focus on objectives (SDGs, other economic and social goals)
- Development of an enhanced system of indicators
  - Direct indicators of emerging technologies
    - Hardware (e.g. # of devices, % of installed base with certain capabilities, revenues)
    - Basic services and software (e.g. M2M, big data analysis software)
    - Applications and services (e.g. % of businesses using cloud solutions, AI)
  - Indicators for enabling conditions
    - Network infrastructure (e.g. % coverage, quality)
    - Skills (e.g. % digital literacy, # of data scientists)
    - Policy arrangements (e.g. % unlicensed spectrum, open data policies)
  - Effects on outcomes (e.g. income, employment, equality)
- Descriptive, explanatory, predictive, and prescriptive uses/models

Indicator matrix (see MISR 2017)

	Internet of Things (IoT)	Big Data/Analytics	Cloud computing	Artificial Intelligence (AI)
Direct measures				
Hardware	# of connected devices; Revenues in IoT device markets	% data center capacity dedicated to big data analytics; Investment in data analysis centers	# of data centers; Information processing capacity of data centers; Investment in cloud facilities	# of cognitive computing/deep learning installations; # of robots; Revenue of AI sectors
Basic services and software	# of M2M subscriptions	Revenues for big data analysis software	Revenues for IaaS, SaaS, PaaS	share of small, medium and large businesses using cognitive computing
Applications, services	# of smart homes; # of smart city applications; Revenues generated by IoT applications and services	% of businesses and government organizations using big data analytics; Revenues generated by data analytics services	% of businesses and government organizations using cloud computing; Revenues in cloud computing	% of businesses and organizations using AI applications Revenues of the AI sector
Enabling conditions				
Connectivity	% of population covered by mobile broadband, % of population covered by fixed broadband, available bandwidth, quality of connectivity, access to cloud resources, adoption of broadband, share of small, medium and large businesses using cloud resources, % of population using cloud resources			
Human capital	# of data scientists, # of computer scientists, % of schools with broadband connectivity			
Policy arrangements	Flexible spectrum policy, policies toward bottlenecks and market power, interoperability requirements, standardization, promotion of experimentation and innovation, open data policies			
Effects on SDGs and wellbeing				
Welfare effects	Efficiency gains, improvements in service quality, better service/price relationship, improvements in health, education, safety, care of elderly, empowerment, environmental stewardship, etc.			

Recommendations

1. Short-term: use existing processes and data collection (e.g. EGTI, Partnership on ICT for Development) to develop an enhanced system of ICT indicators for IoT, big data analytics, cloud computing, and AI

2. Medium-term: develop a "System of Digital National Accounts" in which publicly collected and curated, machine-generated, crowdsourced, and case-specific big data complement each other in a coherent framework

Thank you!