

Cloud Computing in Developing Countries

Opportunities and Challenges

The number of fixed and mobile broadband subscribers, Internet users and cellular service consumers is on the rise globally. **Figure 1** indicates positive trends in the use of broadband and mobile phone technology, while subscriptions for fixed telephone lines are decreasing.¹

Advanced countries are the first to explore and utilize the opportunities provided by technological breakthroughs such as cloud computing. As a result of higher information and communications technology (ICT) penetration rates in affluent markets, the adoption of breakthroughs in shared computing is relatively fast, especially by the private sector. In addition, the public sector of wealthier economies is showing a positive trajectory in the adoption of cloud-based solutions. The availability of infrastructure, sound legal systems, higher capital investment appetite and the constant urge to minimize the cost of service delivery have acted as a catalyst in the process of espousing cloud services. However, this does not mean that developing countries are not taking advantage of contemporary IT innovations.²

Figure 2 shows a reversal in the number of total broadband subscriptions (mobile and fixed) for developing economies. Although advanced economies had a higher number of fixed and mobile broadband subscribers than emerging economies in 2007, the circumstances had entirely reversed by 2015.³ In addition to broadband services, developing countries are also embracing innovations such as cloud computing to improve business and service deliveries in different areas.⁴ This positive trend in the adoption of contemporary ICT breakthroughs in emerging economies offers various opportunities to exploit and creates certain challenges to overcome.

The Opportunities Cloud Computing Provides Developing Countries

On-demand access to scalable data and computing resources can enhance productivity, boost innovation and improve service delivery in both the public and private sectors of emerging economies. The cloud provides an attractive opportunity for the fiscally constrained governments of developing regions to improve access to health care, education,

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Figure 1—Global Information and Communications Technology Indicators

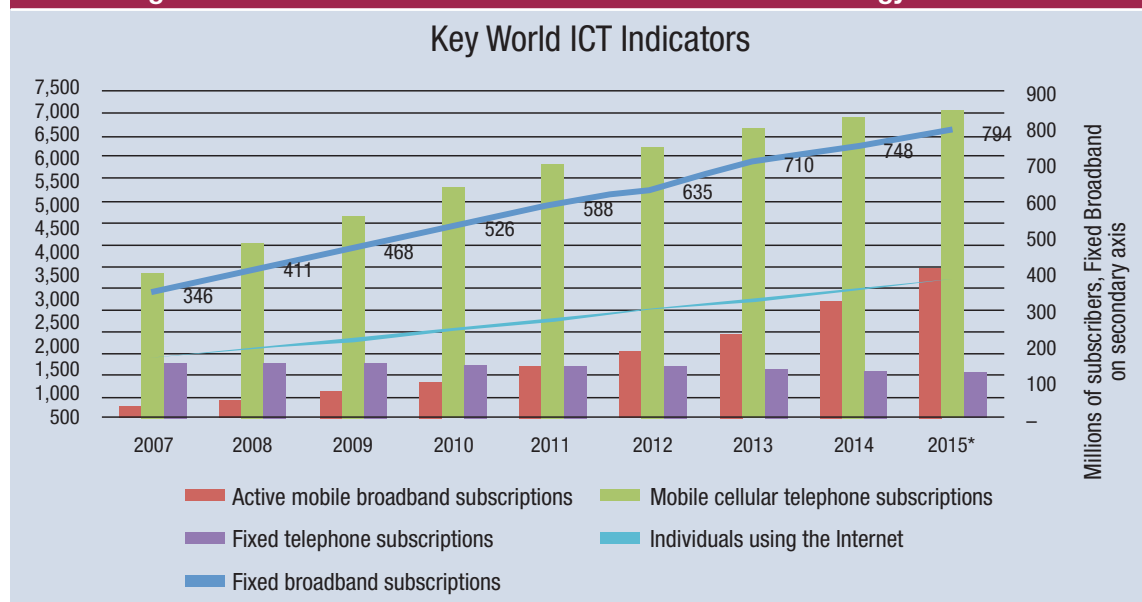
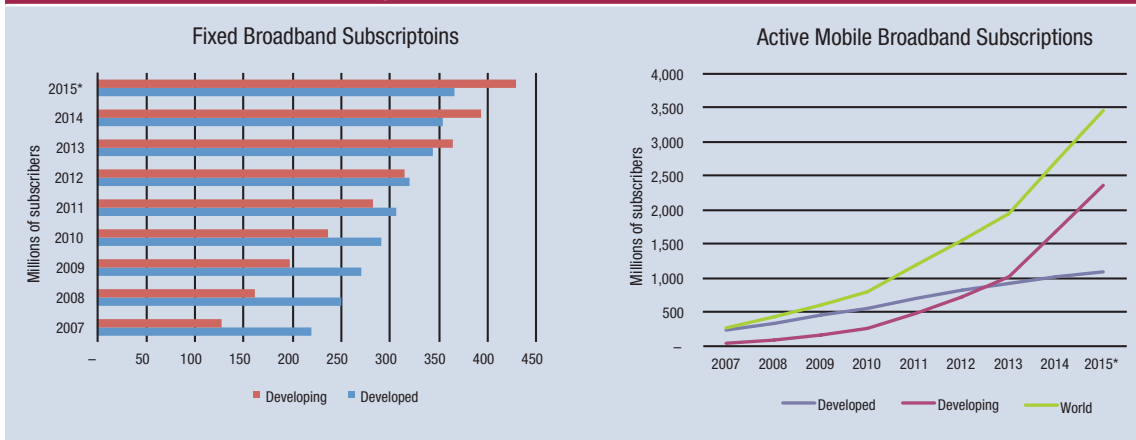


Figure 2—Broadband Subscriptions



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commerce and finance through initiatives such as mobile health care, mobile education, e-commerce and mobile banking.^{5, 6, 7, 8}

“ The workforce in developing states may capitalize on the versatile ICT landscape by cultivating the right skill sets. ”

The availability of shared computing services and the surge in demand for global ICT skills provides bounteous prospects for business communities operating in emerging regions. For instance, businesses no longer need to source and maintain expensive hardware, software and personnel.⁹ Similarly, entrepreneurs can develop innovative business models using technology as a core value

driver. In addition, the workforce in developing states may capitalize on the versatile ICT landscape by cultivating the right skill sets in areas such as cybersecurity, privacy, incident management and service availability.

As the process of economic development transforms the structural dimensions of evolving economies, the ICT sector provides an attractive avenue for service-sector development and exports. **Figure 3** shows evidence of the ICT sector's contribution to service export. India, the Philippines, Brazil and China are some of the countries that have benefited from global growth in ICT service demands. These countries not only have a higher ICT service share as a percentage of total service exports, but also have a reasonable share of services sector in their total GDP.

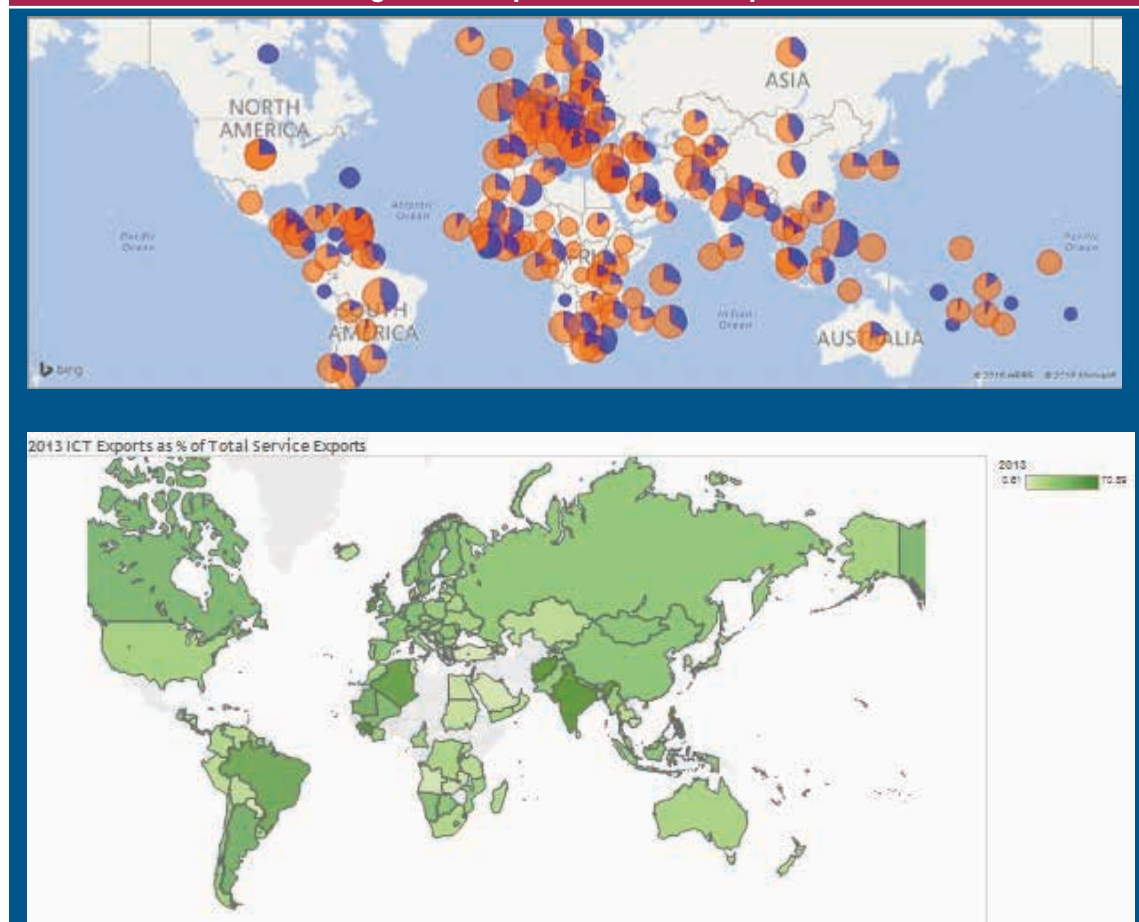
Cloud technologies also have the potential to reverse the threat of climate change posed by transitioning economies. Advanced economies have already caused enough corrosion of the environment, and the problem now needs to be tackled through collective efforts. The trends highlighted in **figure 4** reflect that as upper-middle-income economies grow, their per capita carbon emissions seem to deteriorate. A similar pattern will materialize as lower-income economies follow

the path of development. Cloud technologies, if embedded in sustainable infrastructure designs, may provide a means to achieve an environmentally friendly economic development process.

Approximately 55 percent of Internet of Things (IoT) developers link devices through the cloud.¹⁰ Cloud and IoT, commonly referred to as the CloudIoT paradigm, provide an exceptional launchpad to build smart cities in developing countries, which may

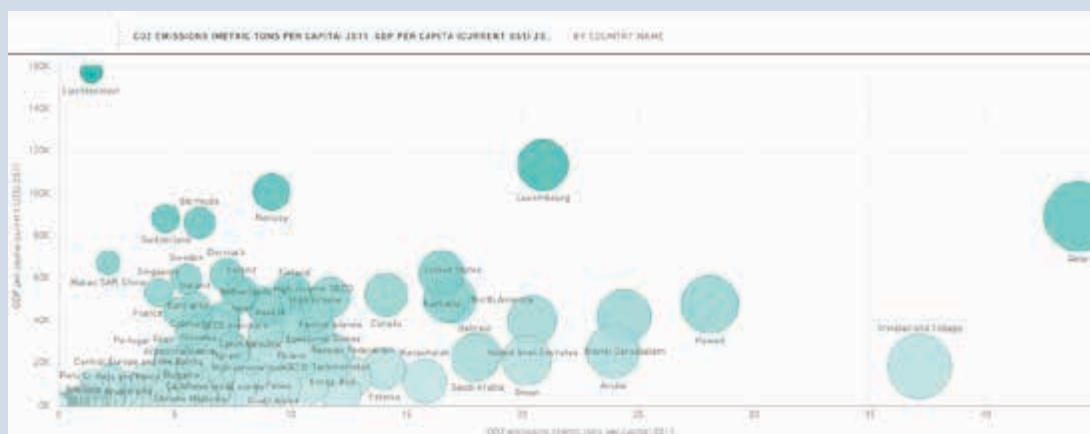
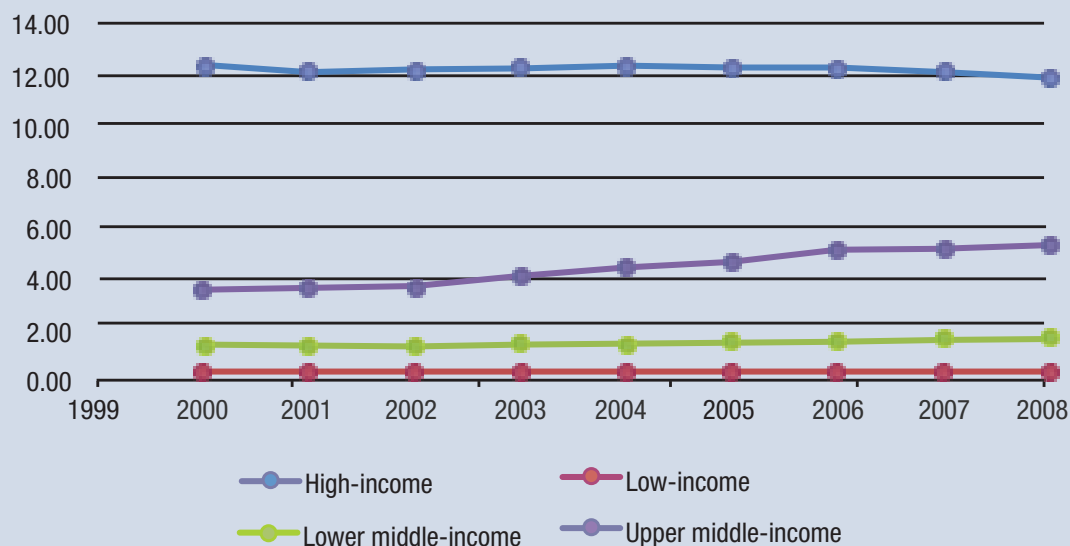
help improve living conditions. As infrastructure in emerging economies is still in the blossoming stages, the application of CloudIoT solutions in infrastructure designs may limit the adverse consequence of increased carbon emissions of emergent economies. Innovations such as sensor-based traffic management, smart energy conservation systems and technologically controlled public transport systems are just some of the many possible ways in which the cloud can assist in controlling carbon emissions.

Figure 3—Map of ICT Service Exports



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Figure 4—Carbon Dioxide Emissions Per Capita



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Challenges for Developing Countries Posed by the Evolution of Cloud Computing

While the paradigm of shared computing services is growing rapidly, it is still a small component of the global ICT sector. Having said that, larger economies have the key ingredients to expedite a relatively smooth transition toward the evolving ICT landscape. Developed countries have the required infrastructure and principal institutional frameworks

that stimulate and nurture ICT novelties. Evidence indicates that cloud-based services cannot sustainably operate in isolation from the business environment, institutional systems, infrastructure and human resources (HR) capabilities.¹¹ **Figure 5** shows that developing countries are far behind advanced economies in the area of enabling the new businesses. This constriction, if not addressed by developing countries, may restrain their ability to embrace the contemporary IT modernizations.

It is true that actualizing the optimal potential of cloud-based technologies in developing countries will be fairly challenging. ICT infrastructure bottlenecks, shortage of skills, start-up controls, and institutional and regulatory constraints are just some of the setbacks that the developing countries need to overcome so that the right prospects of the cloud can be exploited.^{12, 13, 14} The role played by governments will determine the cloud's ease of adoption and transition in developing economies.

“ Cloud computing provides remarkable prospects for developing countries to improve their public service and spur sustainable socioeconomic development. ”

The Way Forward

Governments of developing nations should evaluate country-level cloud readiness; develop a national cloud strategy; enhance the national broadband and

storage infrastructure; attract migrated talent back to their countries; adopt best practices; and strengthen the institutional, political and legal capacity to reap the benefits of shared computing. Addressing the concerns of data privacy, regulating cybersecurity, enforcing cybercrime laws and providing a strong framework of institutional oversight can be pivotal in facilitating the acceptance of cloud services.^{15, 16}

Businesses should also understand the prospects provided by the cloud and be aware of its potential hazards. On one hand, the cloud provides cost-effective ICT solutions, multiplicity of business models and flexible capacities to innovate service delivery. On the other hand, shared computing reduces the control of businesses over the flow and storage of information assets. Every technology comes with advantages and disadvantages, so the decision to be part of the cloud ecosystem should ultimately be based on a sensible assessment of the positive and negative consequences of joining the cloud services.¹⁷

Conclusion

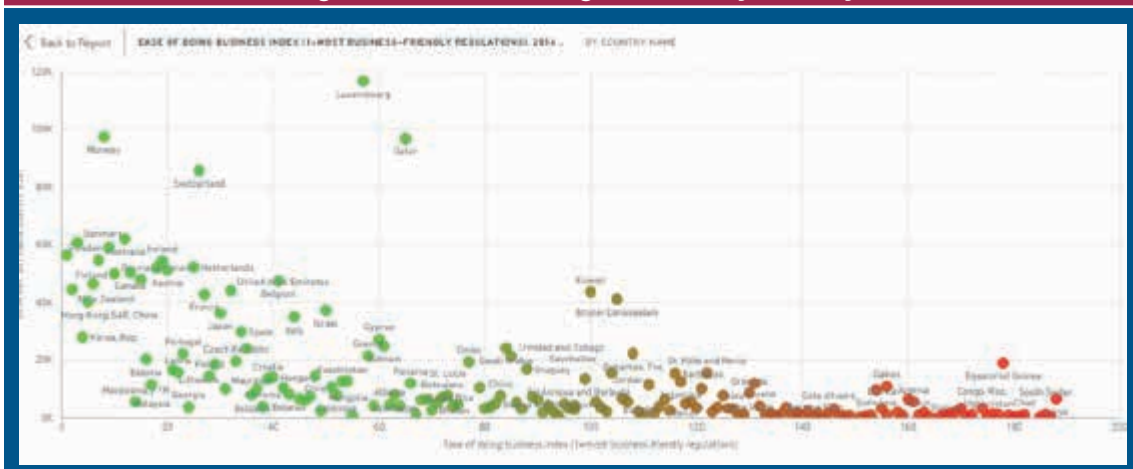
Cloud computing provides remarkable prospects for developing countries to improve their public service and spur sustainable socioeconomic development. However, emerging economies and businesses need to be aware of their institutional gaps, infrastructure weaknesses and the cloud's potential pitfalls to prudently tap the opportunities it provides. National governments of developing countries need to foster an environment that facilitates the safe migration toward cloud-based technologies.

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Figure 5—Ease of Doing Business by Country



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Endnotes

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