



# The Next Generation of the Internet

## Revolutionizing the Way We Work, Live, Play, and Learn

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### Revolutionizing the Way We Work, Live, Play, and Learn

Former U.S. Senator Ted Stevens (Alaska) provided comedians plenty of fodder when, in 2006, he described the Internet as a “series of tubes.” But, that’s what it is.<sup>1</sup> There are tubes under the ocean, connecting the world’s financial centers of London and New York. There are tubes that connect Google to Facebook. There are buildings filled with tubes that connect data centers and virtual private networks. There are hundreds of miles of tubes buried beside roads and railroad tracks. And, this network of tubes is expanding at a phenomenal rate, connecting most parts of the world. In fact, there are close to 1.5 million kilometers (920,000 miles) of fiber-optic cables spanning the world’s oceans and circling the globe.<sup>2</sup> Marshall McLuhan, a Canadian philosopher of communication theory, could never have imagined the power of the interconnected, global network that exists today when he coined the famous term “Global Village.”

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“The new electronic interdependence re-creates the world in the image of a global village.”

**Marshall McLuhan**  
Philosopher of Communication Theory

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No one could have imagined the fundamental impact the Internet would have on both society and the economy—changing our lives forever. There are countless examples of how the Internet has transformed the way that we work, live, play, and learn. Take, for example, the ability to work from virtually anywhere—whether on the beach, in a different country, or even from the comfort of our homes.

Our hyperconnected lives have breached face-to-face and telephone communications. We are now connected to the network, spending a great deal of time online—doing everything from dating, researching products, shopping, and chatting with friends, to taking courses from leading institutions such as the Massachusetts Institute of Technology. We play games online with others across town, across the country, and even across the world. Video, music, and other forms of entertainment are just a click away.

There seem to be no limits to Internet usage. The Cisco Visual Networking Index (VNI) projected that global IP traffic will increase nearly fourfold from 2011 to 2016, reaching roughly 110 exabytes per month.<sup>3</sup> That amount of monthly traffic is equivalent to nearly 27 billion DVDs, 26 trillion MP3 songs, or 780 quadrillion text messages. It is almost impossible to project this phenomenal growth with any level of accuracy. The difference between the number of exabytes projected in the 2012 VNI forecast and the number of exabytes projected in VNI updates for 2013 is more than 200 exabytes, or the equivalent of more than all of the global IP traffic generated in 2010.

Technology *supply* and consumer *demand* are colliding, driving phenomenal growth in the number of Internet connections and Internet-enabled devices. People now own multiple

devices (almost all of which are connected to the Internet), creating more than 19 billion connections worldwide.<sup>4</sup> And, more people are coming online each day: there are currently more than 3.4 billion Internet users globally.<sup>5</sup> Technologies such as DOCSIS 3.0, fiber optics, and 3G/4G mobile access are significantly increasing broadband speeds. The YouTube generation is driving consumers' hunger for online entertainment—two years of video minutes are now consumed every second over the Internet.<sup>6</sup>

The extraordinary growth and transformation of the Internet is unprecedented, but what does the future of technology hold, and where is the Internet heading? Business executives, technologists, and policymakers are not only asking these questions—they also are looking for a framework that will help them assess changes in the Internet, and the possible outcomes and implications of those changes for business, national policy, and regulation. Key questions include:

- What are the key drivers or disruptors that will shape the Internet's future?
- What will the Internet and the Internet economy look like?
- How will this future change the information and communications technology (ICT) industry?
- What are the implications of the next generation of the Internet on national policies and regulations?

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“Prediction is very difficult, especially about the future.”

Niels Bohr  
Physicist and Nobel Laureate

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## Ten Technology Trends Changing the World

Technology innovation and invention are accelerating at an unprecedented rate. In fact, it is virtually impossible for anyone to stay abreast of everything. The Cisco® Internet Business Solutions Group (IBSG) has identified 10 major trends that we believe are shaping the direction of the Internet today and, most certainly, will change its direction in the future.

### 1. A World Gone Mobile

The number of mobile global subscriptions has exploded: close to 80 percent of the world's population has access to a mobile phone.<sup>7</sup> In 97 countries around the world, there are more mobile devices than there are people. Many people no longer own a wired or landline phone, only a mobile one. Mobile has become an extensive part of the Internet: people use smartphones, tablets, laptops, and a growing number of new mobile devices to connect to the Internet. Furthermore, they are using their mobile devices increasingly to watch videos and access the web. The Cisco 2012 VNI also predicted that two-thirds of all mobile traffic will be video by 2015, and an additional 20 percent of this traffic will be devoted to both the mobile web and mobile data.

### Implications of Growth in Mobile Usage

- A large portion of the future Internet will be mobile.
- Mobile will be the key means of expanding the Internet to more people, particularly those in developing countries and hard-to-wire places.
- Networks, devices, applications, and other core technologies will need to be built with mobile in mind, rather than retrofitted.

## 2. Cloud: A New Way of Delivering Technology

The trend toward cloud computing is more of an “evolution” than a “revolution.” From the 1960s mainframe computers, to the client server computers of the 1980s, to the web, to (more recently) virtualization, the cloud is fundamentally changing the way that technology is delivered, giving rise to a host of new, previously unimaginable services. Simply put, cloud is the practice of using a network of remote servers hosted on the Internet—rather than a local server—to store, manage, and process data connected over fast and increasingly mobile Internet connections.

Cloud is fundamentally changing the type of traffic that traverses the Internet. From 2000 to 2008, peer-to-peer file sharing dominated Internet traffic. Because of this, the majority of this traffic did not touch a data center; it was communicated directly among Internet users. Since 2008, most Internet traffic has originated from or terminated at a data center—increasingly driven by the rise in cloud computing.<sup>8</sup> Cloud holds the key to realizing the technologist’s dream of accessing “content anywhere, anytime, on any device, over any network.” With this outlook, it is easy to see why analysts are projecting a US\$100 billion market for cloud by 2015.<sup>9</sup>

### Implications of the Rise in Cloud Computing

- There will be fundamental shifts in the type of traffic that traverses the Internet, from the data center to the cloud.
- The Internet will provide the “glue” that combines multiple devices, networks, and data.
- The Internet will enable new cloud services.

## 3. Everything Can Be Delivered Over-the-Top

Many of the companies shown in Figure 1 are probably familiar to most people who likely use one or more of these services on a daily basis. Such services are frequently referred to as being delivered “over the top” of traditional networks, or OTTs, and typically are replacements for traditional services such as landline phones, cable TV, short message service (SMS), CD, or DVD. OTTs are usually less expensive, more convenient, and of greater value to consumers versus the traditional network services they replace.

Figure 1. A World of Over-the-Top Services.



Source: Cisco IBSG, 2013

The impact of OTTs on traditional services is astounding. For example:

- **Voice**—The global market for international voice traffic grew by only 4 percent in 2011, according to a report from TeleGeography.<sup>10</sup> This figure would have been 13 percent had the report included Skype voice traffic.
- **Messaging**—Operators lost \$13.9 billion, or 9 percent, of messaging revenues to social messaging apps in 2011.<sup>11</sup> Since the launch of KakaoTalk<sup>12</sup> in South Korea, SMS usage is down by 40 percent and messaging revenues are down by 28 percent.<sup>13</sup>
- **Video**—Netflix subscribers in the United States consumed 30 GB per month (80 GB per month for the Xbox 360) in 2012, resulting in 30 percent of peak-hour Internet traffic.<sup>14</sup> A 2012 survey by *Consumer Reports* found that 25 percent of people who used streaming video reduced or eliminated their TV service.<sup>15</sup>
- **Conferencing**—Forty-two percent of all Skype calls include video, equating to 300 million minutes of Skype video per day.<sup>16</sup>
- **Music**—Globally, online music sales accounted for 32 percent of record-companies' profits in 2011; 3.4 million consumers subscribe to music services.<sup>17</sup>

#### Implications of OTT Services

- OTT traffic will drive huge volumes of traffic over the Internet.
- Lucrative services of established ICT businesses will continue to be under threat.
- Traditional providers and OTT players will need to improve the economic model, aligning revenues and costs.

#### 4. Big Data: The New Oil

Big Data—the sophisticated analysis and insights that can be derived from the mountains of digital information created daily—is a huge trend that is impacting all parts of business and society, and it is only going to increase. Figures from the McKinsey Global Institute emphasize the power of Big Data<sup>18</sup>:

- Facebook has more than 2.5 billion pieces of content and ingests more than 500 terabytes of new content daily.
- Enterprises around the world stored more than 7 exabytes of new data in 2010, while consumers stored more than 6 exabytes (1 exabyte is equivalent to four times the entire content of the U.S. Library of Congress).
- For less than \$600, consumers can buy a disk drive that can store all of the world's music.
- McKinsey estimates that U.S. healthcare providers can save more than \$300 billion annually through Big Data—more than double Spain's annual health spending.
- Big Data could help retailers increase their operating margins by 60 percent.

Data demand and supply are almost in perfect equilibrium, creating the right conditions for Big Data. The economy, global competition, runaway costs, and increasing customer demand are forcing businesses and governments to find new ways to increase value, improve customer experience, and become more efficient. Getting smarter with Big Data is key to addressing these issues.

On the supply side, the power of technology has increased dramatically, while costs have decreased. Flexible databases and analytical tools—and the ability to create and capture mountains of data—are making the world of Big Data a reality.

Networks and the Internet have a critical role to play in the future of Big Data. First, they are the **collectors and disseminators of data**, gathering it from the millions of Internet-enabled devices, applications, and sensors, and storing it in the right place for analysis and further action. Second, they are **creators** of critical information on location, presence, device type, application, and more.

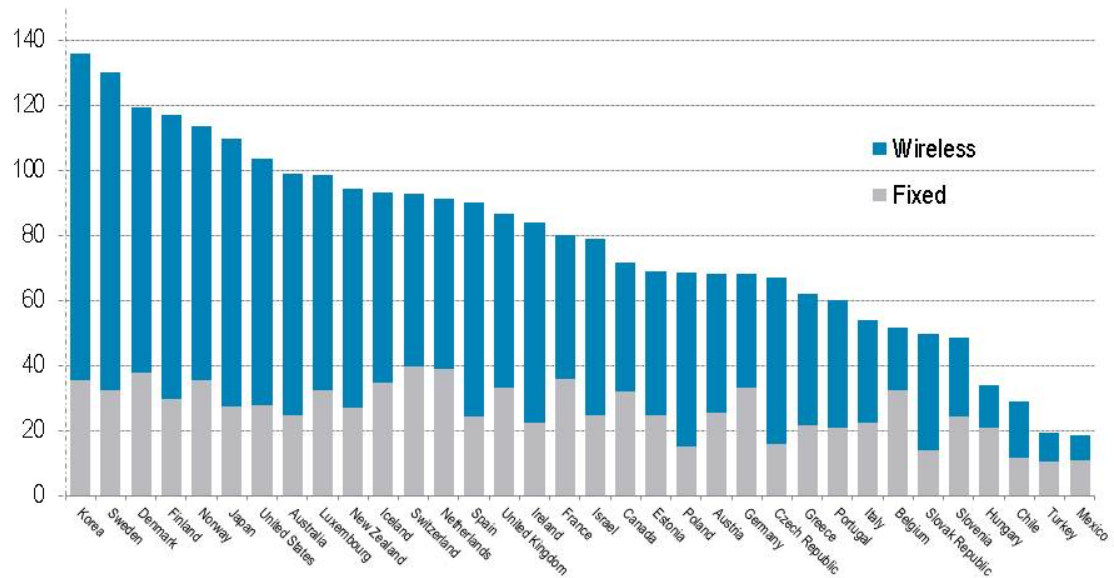
##### Implications of Big Data

- The Internet will become the ultimate source of Big Data, “seeing” all of the data and linking it to the intelligence embedded in the network.
- Businesses and governments will have to establish key policy issues on privacy, security, intellectual property, and liability.

#### 5. A Global Village: Connecting the Unconnected

While we still have a long way to go, the world is becoming increasingly connected. Between fixed and wireless broadband, most people in many countries have some type of Internet connection (see Figure 2). Global network infrastructures are being put in place, and mobile is filling in many of the connectivity holes around the globe. Equally, many governments now realize that broadband connectivity is essential for their country's economic growth and prosperity, and they are implementing progressive policies.

Figure 2. Broadband Subscribers per 100 Inhabitants (by country).



Note: In Figure 2, "Korea" refers to South Korea.

Source: Organisation for Economic Co-operation and Development, December 2011

### Implications of Connecting the Unconnected

- Markets will become more global in regard to services, applications, and technology.
- Governments and businesses will need to navigate diverse and possibly complex legal, regulatory, and policy environments.
- The Internet will become a global service delivery platform for increasing the efficiency and effectiveness of business, learning, and government services.

## 6. Powerful Devices: The World in the Palm of Your Hand

When consumers think of most services, it is the device associated with those services that grabs their attention, drives their usage, and influences their perceptions. In fact, in many instances, most consumers consider the device and the Internet as one and the same. Although it may be hard to make money in the device business, devices—and their attributes—are important to driving and shaping the market. Cisco calls these major attributes the "5 Cs of devices." Devices are getting:

- **Cleverer.** More features are being added to new devices, and many of these features are hardly used. Just look at the number of jacks on the back of a new television set or the complexity of the menu on a new digital camera.
- **Connected.** Most new devices are no longer stand-alone products that have some form of network connectivity, such as Wi-Fi, Bluetooth, or a local access network (LAN).
- **Converged.** Most new devices do several things once performed by stand-alone devices. For example, telephones no longer just make phone calls: smartphones

enable users to send and receive email, listen to music, surf the web, and take quality photos. Tablets, for example, take multitasking even further, allowing such capabilities as easy video conferencing.

- **Cooler.** Devices now have incredibly short lifecycles. A typical cell phone, for instance, is good for 12-18 months—not because of inadequate technology or poor manufacturing, but because devices have become a fashion and status statement.
- **Cheaper.** Inexpensive manufacturing and modularity are driving down device costs. For example, DVD players and home routers that once sold for hundreds of dollars can now be bought for as little as \$50.

### Implications of Powerful Devices

- Devices will drive demand and shape the requirements for the next generation of the Internet.
- Most consumers will equate the Internet with “devices.”
- The technical, political, and economic structure of a future Internet must support multiple, previously unimaginable devices.

## 7. Bring Your Own Device: The Consumerization of Enterprise IT

Smartphones and tablets have revolutionized the workplace, as will the next “newest” mobile device. Recent research by Cisco IBSG found that business users typically each have more than three mobile devices, while non-business mobile users typically own two devices.<sup>19</sup> Furthermore, business users generally own devices that are more sophisticated, such as smartphones and tablets. The research also found that employees do not necessarily want a company-issued device; they want their own “cool” and powerful device for everyday use. Additionally, Cisco IBSG’s research on mobile cloud revealed that two-thirds of business users are interested in a “dual persona” service that enables them to combine their personal and professional lives seamlessly across their portfolio of devices.<sup>20</sup>

Cisco IBSG conducted an extensive global survey on the “bring your own device” (BYOD) phenomenon.<sup>21</sup> Based on feedback from survey respondents, a number of key highlights revealed the transformational impact of BYOD on enterprise IT:

- 60 percent of knowledge workers use a mobile device at work
- 42 percent of employees own the smartphones they use for work
- 84 percent of IT leaders are seeing BYOD growth in the enterprise
- 89 percent of companies enable BYOD in some form
- Number-one demand among employees: they want an “any device, anywhere” work style

### Implications of BYOD

- BYOD is blurring the lines between public and private enterprise networks.
- Public networks will need to be similar to private networks in terms of security, reliability, and availability.
- The Internet will be at the core of enterprise IT architectures.



## 8. The Internet of Things Is Already Evolving

The Internet of Things (IoT)—the connection of a vast array of devices, sensors, and machines to the Internet—did not exist a decade ago because the number of connected devices was relatively small. Cisco IBSG predicts that there will be 25 billion devices connected to the Internet by 2015 and 50 billion by 2020.<sup>22</sup> This growth is the equivalent of 3.5 devices (those that we know of today) for every person on the planet. As these “things” add capabilities such as context-awareness, increased processing power, and energy independence—and as more people and new types of information are connected—IoT is quickly becoming the Internet of Everything (IoE).<sup>23</sup>

The Internet of Everything creates an unprecedented opportunity to connect not just devices (things), but people, data, and processes as well—making networked connections more relevant and valuable. Currently, 99.4 percent of physical objects that may one day be part of IoE are still unconnected.

This exploding world of connected people, processes, data, and things includes:

- **Smart grids**—Smart utility grids are increasing efficiency in energy distribution.
- **Intelligent vehicles**—Examples include cars that self-diagnose, communicate with service centers, inform other vehicles of their existence, monitor safety, and have the latest road and weather conditions.
- **Connected healthcare and patient monitoring**—Examples include smart pills that patients can ingest to help doctors diagnose and treat diseases.
- **Sensors**—Extremely small sensors can be placed on plants and animals, and then connected to the Internet, revolutionizing food production.
- **“Internet Routing in Space”**—A program from Cisco designed to launch the Internet into space.
- **Connected education**—Better use of technologies will help scale teachers, faculty, and educational content, increasing new ways of learning and giving students the flexibility to learn at their own pace, anywhere, anytime, using any device.

Currently, IoE comprises a loose collection of disparate, purpose-built networks that, interestingly enough, mirror the early days of the Internet when multiprotocol networks were eventually connected via IP.

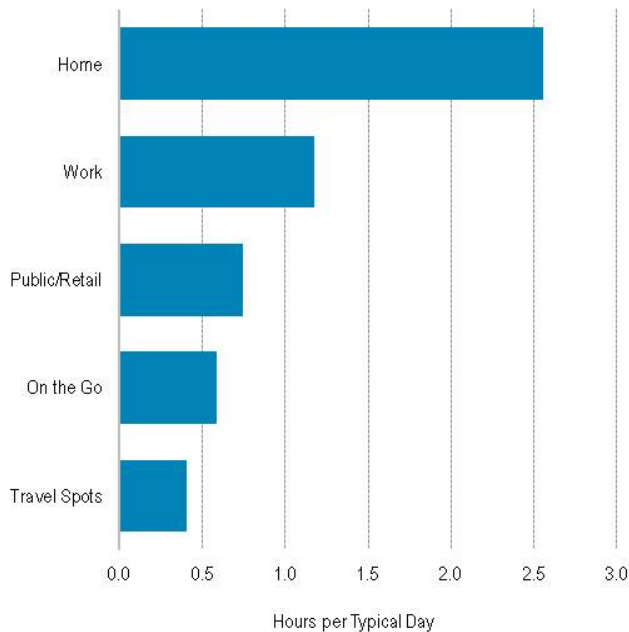
### Implications of IoE

- IoE will create a need for open standards, particularly for “plug and play”; today’s standards are mostly proprietary.
- IoE will turn information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries.
- IoE will generate and drive huge volumes of data onto networks.

## 9. The New Mobile

The first trend—A World Gone Mobile—identified *how* the world has gone mobile, and the important role mobility will play in shaping the future of the Internet and the Internet economy. However, Cisco IBSG found that the way people think about “mobile” has changed. Today, mobile is increasingly less about on-the-go walking or driving, and more about the convenience of a “nomadic” lifestyle—moving, sitting/stopping, and connecting, and then moving on again. Research by Cisco IBSG found that consumers spend 2.5 hours per day using their mobile devices in their homes, compared with just 0.5 hours engaged in real mobile, on-the-go activities (see Figure 3).<sup>24</sup>

Figure 3. Average Daily Mobile Usage in the United States per Location.



Source: “What Do Consumers Want from Wi-Fi?: Insights from Cisco IBSG Consumer Research,” Cisco IBSG, May 2012

Four key technological and social forces are converging, giving rise to the “new mobile”:

1. **Applications**—Apps are becoming richer, more data-intensive, and less “mobile” in nature.
2. **Devices**—Mobile devices are becoming the preferred personal connectivity device.
3. **Rise of Wi-Fi**—The ability to get low-cost wireless speed and connectivity to fuel new bandwidth-hungry devices and applications is increasing.
4. **Nomadic use**—Data consumption happens on mobile devices and on networks, but not necessarily while “on the go.”

### Implications of the New Mobile

- Mobile devices will need to support a huge amount of data and bandwidth in the home.
- Privacy and security will be essential requirements for meeting customer expectations.
- Technical and business integration will become the standard across multiple types of access networks.

## 10. Converged Networks: A New Platform Architecture

Networks of all types and at all levels (public, private, local, and so on) are converging to create a new platform. Key components of this new architecture include:

- **Access**—The access layer will continue to be a “HetNet” (heterogeneous network) of macrocellular, Wi-Fi, small-cell, and fixed access. These technologies will logically converge to provide users with seamless Internet access.
- **Core**—The core layer is moving to converged all-IP networks, where a packet is a packet whether it has originated on a mobile network or on a fixed broadband network.
- **Content delivery**—Given the huge amounts of data—especially entertainment content—that people are and will be consuming, it will become increasingly important to locate the right content as close to the consumer as possible to ensure an excellent customer experience and improve network operations and economics. Because of this, SPs are embedding content delivery networks (CDNs) into their networks, as well as working to create a common federated approach to form a global distribution network.
- **Network data centers**—As mentioned earlier in this paper, cloud is driving the convergence of the network with the data center. Data center traffic is already in the zettabyte era, and by 2015, 34 percent of that traffic will be cloud-based.<sup>25</sup> This means that the success of the cloud service will be intimately linked to the availability and operations of the network.

### Implications of Converged Networks

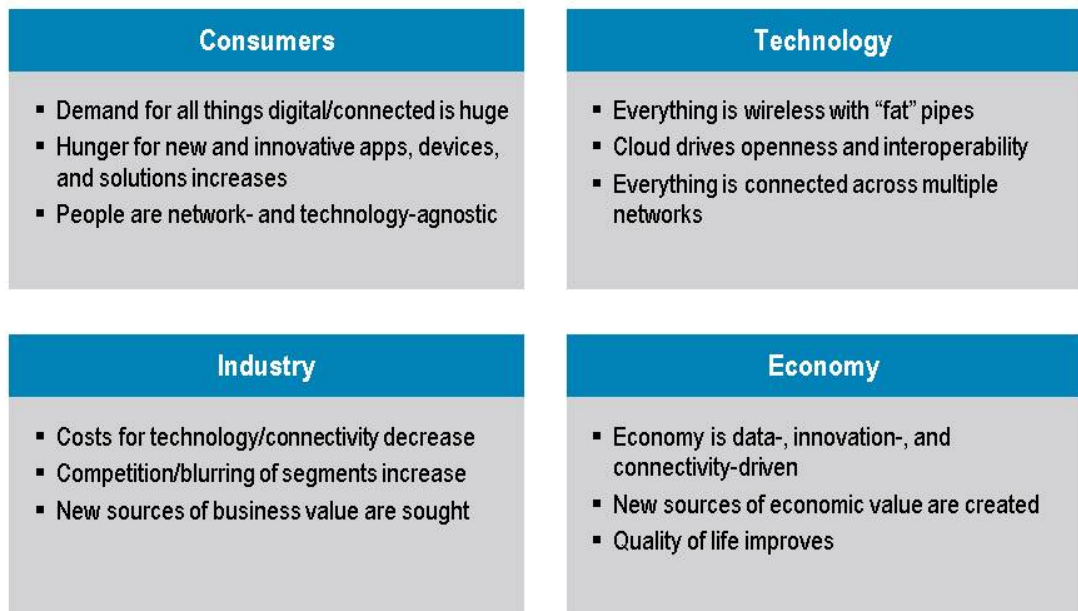
- Network operators will need to manage, operate, and integrate multiple networks—all based on IP.
- The Internet will no longer be just about networks—it will extend to things, intelligence, computing, and data centers.

## The New Digital Explosion

Cisco IBSG has developed a plausible scenario for how these 10 disruptive technology trends might come together to shape the future of the Internet. We call this the “New Digital Explosion.” Why “new”? Changes in devices, networks, applications, delivery models, user behaviors, and mobility will create a step change in demand for and reliance on the Internet.

The New Digital Explosion is not just about technology; it covers all aspects of consumers, the ICT industry, and global/national economies. Consumer demand for value-added technology that is “invisibly” powered by the Internet will rise greatly. Future technology will be all about mobility, cloud, and everything connected through fast and pervasive networks. The ICT industry will face a number of new challenges and opportunities (see Internet Business Paradox section on page 13). The new “Internet economy,” or “knowledge economy,” will not only create a remarkable amount of good; it will also raise a number of social and political challenges (these are discussed on pages 14 and 15).

Figure 4. The New Digital Explosion.

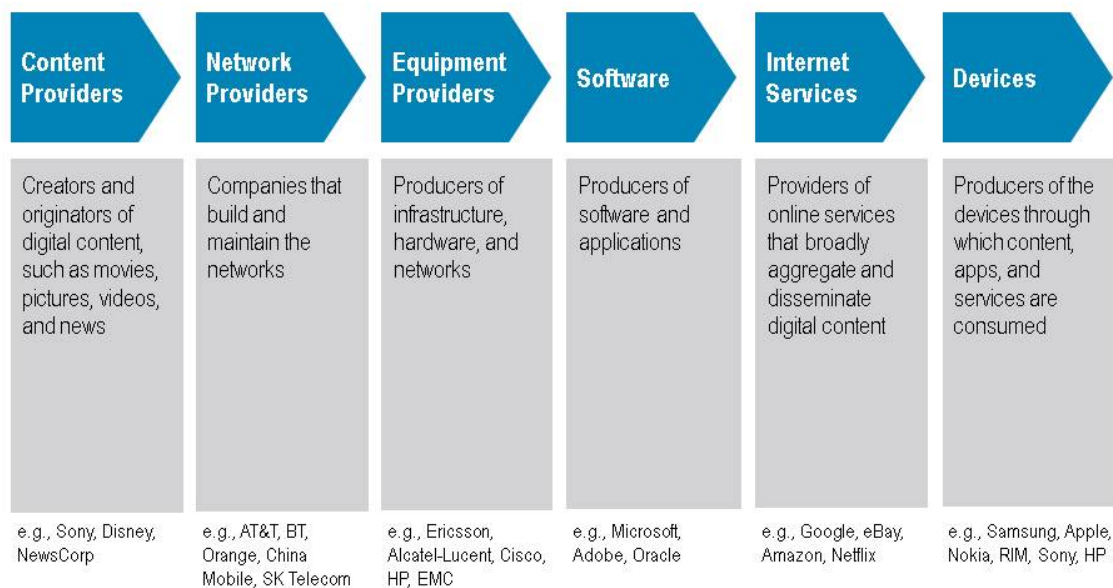


Source: Cisco IBSG, 2013

## The Internet Business Paradox

The New Digital Explosion presents a number of challenges to each segment of the ICT industry value chain. Cisco IBSG describes the key segments in Figure 5.

Figure 5. Segments of the ICT Value Chain.



Source: Cisco IBSG, 2013

One thing is certain: the New Digital Explosion will change the ICT industry. The industry is facing what Cisco IBSG calls the “Internet business paradox.” Despite current demand—and explosive projected demand—most players across the ICT value chain will (if they already have not) be challenged with *converting* this demand into money. A number of key factors are conspiring, increasing this challenge:

- Technology price compression and obsolescence are decreasing margins and product lifecycles.
- Aggressive competition is decreasing margins and making product differentiation harder.
- The rights of content owners are often neglected, making it difficult for them to extract the true value from their content.
- Consumers increasingly expect much of the technology they use and content they consume to be free (such as music and Wi-Fi), thereby greatly reducing the number of monetization opportunities.
- The fickle, fashion-conscious nature of technology consumers means that they are always shifting to the next “big thing.”

Following are major challenges that each key segment of the ICT industry value chain will face in the New Digital Explosion:

### Content Providers

- **Alternative business models**— finding new ways to monetize content
- **New distribution models**—developing new channels to distribute content
- **Multi-rights ownership**—enabling consumers to acquire content for legal use on multiple devices

## Network Providers

- **Revenues / costs**—understanding how to balance costs and revenues from the growth in OTT traffic
- **HetNet integration**—incorporating multiple technologies into the network architecture
- **OTT collaboration**—seeking new “win-win” partnership opportunities

## Equipment Providers

- **Cost leadership**—driving down costs to provide competitive prices
- **Innovation**—investing in R&D to create market-leading products
- **Product leadership**—embracing open standards to drive new-market adoption

## Software Providers

- **Innovation**—creating new, market-leading applications
- **Cloud integration**—using cloud delivery models
- **Mobile enablement**—ensuring that all applications are mobile-friendly

## Internet Services

- **Business models**—seeking new ways to make money
- **Cloud**—finding ways to benefit from the cloud for enabling innovation, improving customer experience, and reducing costs
- **Value chain**—collaborating with other segments across the value chain

## Devices

- **Innovation**—generating a compelling portfolio of market-leading devices
- **Beyond handsets**—moving beyond people-centric devices to the IoE world of machines and sensors
- **Connected home**—developing a portfolio of consumer devices that integrates with your devices and those of your competitors
- **Cloud extension**—closely integrating devices and the user experience with the cloud

## Creating the Right Policy and Regulatory Environment

Many countries have established policy/regulatory frameworks and environments that have helped foster the growth of technology infrastructure and the Internet economy. However, the next generation of the Internet will be about “moving up the stack, beyond infrastructure.” Successful policymakers and regulators must create the right environment to encourage innovative applications, new business models, and entirely new services, addressing six major areas when it comes to the future Internet:

1. **Competition**—Encourage competition within and outside the country to speed up advances in technology. Take Japan for instance: the country’s protectionist nature is a major reason for its slide in dominance and for the rise of South Korea’s global success.<sup>26</sup>

2. **Innovation**—Innovation will be essential to business and national success. Encourage innovation through education, financial incentives, and a supportive political environment.
3. **Standards**—Promote open and global standards. South Korea, for example, has become a technology juggernaut by embracing Android and Code Division Multiple Access (CDMA) technologies. By contrast, the Japanese electronics industry lost its preeminent position by adopting unique, domestic standards.
4. **Consumer protection**—Big Data and cloud will increase the importance of customer data and privacy. Governments must work within national and international legal structures to ensure consumer trust.
5. **Openness**—Net neutrality, international cooperation, and non-protectionist industrial policies will become critical in encouraging competition and opening up global markets for technology leaders.
6. **Economic models**—Develop, operate, and enforce frameworks that enable balanced investments in content or infrastructure, with revenues derived from other services such as peer-to-peer pricing. Make arrangements with network operators/OTT providers to balance network costs and OTT revenues.

## Toward the Next Generation of the Internet

The 10 technology trends discussed in this paper will significantly alter the next generation of the Internet. Characterized as the New Digital Explosion, the future Internet will be considerably faster, smarter, more connected and pervasive, and more mobile. This new world will ignite life- and society-changing applications and services that may be unimaginable today. In the not-so-distant future, our children will be viewed as the “Internet dinosaurs.”

On the one hand, these changes will disrupt the ICT industry: There will be greater competition, redefined value chains and business models, and new strategies, undoubtedly causing many players to exit the industry. On the other hand, the next generation of the Internet will spawn new entrants and innovative start-ups. Governments will have an important role to play in creating an environment that *encourages* business and technology innovation, investment, and competition. Such an environment will help create a New Digital Explosion filled with boundless benefits.

While the Internet has fundamentally changed society, the next generation of the Internet will revolutionize the way that we work, live, play, and learn.

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