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Wireless: Direct Contributor, Catalyst for New Markets

Economic Impact of Wireless in NYS

June, 2014

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NYS Wireless Association

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SUMMARY

The Scope of Wireless' Impact

The impact of wireless technology on the current economy is immense—it is literally immeasurable. Its direct impact—jobs at wireless carriers, supplier firms, and equipment and software manufacturers plus tax revenue at all levels of government—is certainly large. Accurate accounting of these direct impacts is challenging enough.

Yet these impacts are trivial when compared to what the existence of wireless technology makes possible in other sectors of the economy. The self-driving car; remote security technology; the fabulous proliferation of apps that provides services, both great and small, that we never imagined; the emerging "Internet of things"—all are made possible by wireless. Every day we hear of new wireless-enabled products and services or enhancements of established products and services that are made possible by wireless technology.

Even more difficult to measure is the contribution of wireless to quality of life. Mobile calls to 911 have saved countless lives. Agricultural markets in emerging economies have become more efficient and dramatically more equitable, boosting incomes to the poorest of the poor. Wireless redeems time that would have otherwise been wasted by a delayed flight or a wrong address; plans can be changed on the spur of the moment, enriching our leisure time; new social connections can be explored in real time. The list is endless—and efforts to convert these contributions, both large and small, will inevitably fall short.

Counting the Countable

This report counts the tangible impacts and summarizes studies that have made an effort to measure and forecast wireless' catalytic effects.

Direct Impacts

Wireless is as old as radio-- Guglielmo Marconi developed the "wireless telegraph" in 1896. Changes in wireless technology have spurred an explosion in the application of wireless, however.

- **In New York alone, there were about 21 million wireless subscribers in 2012, nearly 4 times the 5.4 million in 2000.**
- **Total employment for the wireless sector in NYS is estimated at about 60,000, with a combined payroll of $5.1 billion.** This includes direct employment combined with spillover employment, including firms building out the wireless infrastructure and providing supporting services to carriers.
- Public and private sector investment in the wireless industry has been substantial in New York State, especially public sector investment focused on public safety communication. **Public investment since 2008 including state and federal funding totals at least $520 million, while annual private investment from cell tower leasing and wireless carriers likely exceeds $1.6 billion.**
- **The wireless industry is responsible for nearly $2.4 billion in taxes to New York State and local governments.** The wireless industry is subject to several different forms of taxation in NYS including state and local sales tax paid on services, state and local sales tax paid by direct and spillover employees, income taxes paid by direct and spillover employees, property taxes paid by firms, and the wireless sector's share of the excise tax, among others.

Future Shock

The pace of data demand growth is accelerating.

- **Smart devices use 29 times as much data as non-smart devices, and 77% of new devices nationwide were smart in 2013.** As smart devices take over more of the market, total consumption of data will continue to skyrocket.
- **By 2018, Cisco forecasts that global data demand will be 10 times 2013 levels.** The growth in the number of devices, continuing shift to "smart" devices, explosive growth of "machine to machine" connections, the growth of video, and the regular emergence of new applications are responsible.

Information Age Economics (IAE) explores the implications of a technology whose impact is justly compared to the internal combustion engine, electrification, the railroads or the personal computer.

Precise estimates may be beyond the reach of science, but it is indisputable that wireless has had and will continue to have a transformative impact on the economy. IAE speculates that the GDP impact will be $1.2 trillion by 2017 and be associated with 1.2 million jobs.

Acknowledgements

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Staff Team

Mike Silva played a very important role in the modeling of the wireless industry's impacts.

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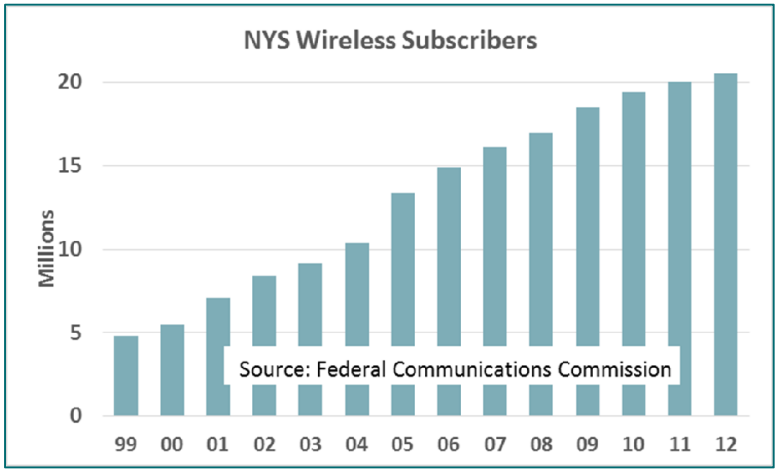
Overview of the Wireless Industry in NYS

Wireless Connections Soar

Mobile communication is hardly new. Marconi's wireless telegraph was created in 1896. The two-way radio became common in the early 20th century, but use was limited to military and commercial application, such as radio transmissions by ships or between police cars. Early mobile systems in the 1950s resembled a sort of broadcast system, eventually becoming automated in the 1960s. True mobile telephony in the United States got its start in the early 1980s when bulky "car phones" became affordable.[1] Digital rather than analog transmissions marked the second generation of mobile phones in the 1990s, followed by the 3G era in the 2000s which ushered in smaller phones with greater data capacities and higher speeds. This brings us to the fourth generation of mobile communications, with an increasing demand for mobile and data capable devices.

Use of wireless services has grown exponentially over the past two decades, as consumers rely more and more on not just voice devices, but increasingly on data capable devices. CTIA-The Wireless Association, the leading trade association in the wireless carrier industry, estimates that at the end of 2012 there were 326 million subscriber connections in the United States, nearly thirty times the number of connections that existed ten years prior,[2] and more than one connection for each of the 309 million residents of the United States. At the end of 2012, the Federal Communications Commission (FCC) estimated that there were over three hundred million mobile telephone subscribers, of which about twenty-one million resided in New York State.



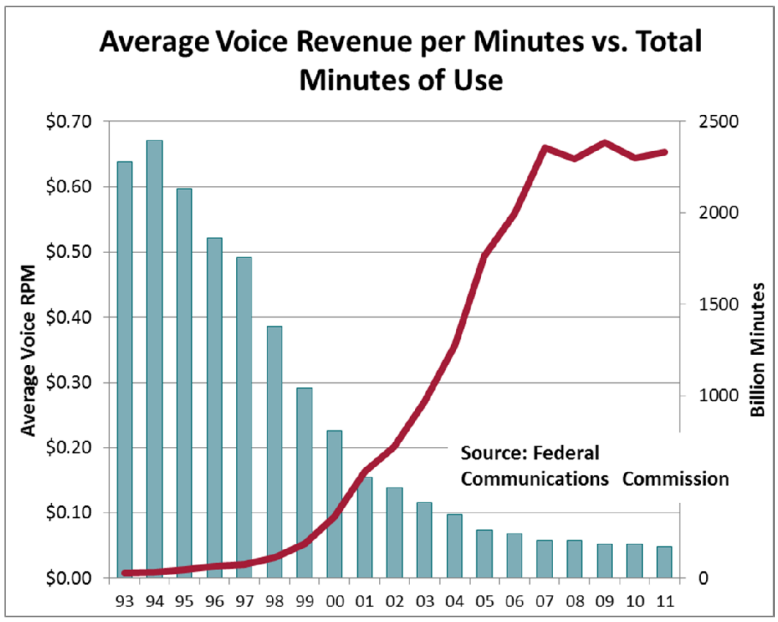
[1] "A Brief History of Mobile Communications," Richard Frenkiel, www.winlab.rutgers.edu

[2] The CTIA Wireless Survey data is obtained from wireless carriers that report their information to the CTIA. There is some estimation because carriers who have fewer than 500,000 subscribers are not required to report their subscribership. The CTIA estimates a remainder of approximately 7 million subscribers.

While the U.S. leads some countries, the International Telecommunications Union (ITU) reports that mobile subscriptions per capita in the United States are far below many nations. In 2003 when only 31% of U.S. households had high-speed internet access, about 50% of all South Korean and Canadian households had high-speed access.[3] South Korea has the fastest average connection speed in the world at 12Mbps.[4]

Not only has the number of connections grown dramatically, data volumes also continue to grow as data capable handsets and devices become increasingly more popular. Average voice minutes per subscriber per month peaked in 2007. Declines are attributed to wireless devices penetrating nearly the entire population, encompassing less active users, e.g. the elderly and the very young. Moreover, younger users are gravitating toward a heavier reliance on text and multimedia messages.

Although average voice minutes per user has dropped along with average call length, the volume of data and number of text and multimedia messages have grown. Average text messages per user per month peaked in the beginning of 2011 at about 600. Average multimedia messages per user per month have been fluctuating between 10 and 20 messages since 2009, peaking in the second half of 2010. Total text messaging volumes reached 1,170 billion messages for the six month period from July through December 2011; multimedia message (MMS) volumes reached a high of 32.1 billion messages from May through June 2010, and have maintained levels above 24 billion messages per six month period.[5]



As capacity has expanded and technology has reduced costs, prices have fallen dramatically, as is reflected in revenue per user, per voice minute or per text message. While the CTIA estimates that the yearly service revenues for 2012 reached a high of $185 million, average revenue per minute including data revenues was below $0.08, and average voice revenue per minute fell below $0.05.

[3] Pewinternet.org, "Adoption of Broadband to the Home," 2003
[4] http://news.bbc.co.uk/2/hi/programmes/click_online/9093991.stm
[5] FCC 16th Annual Wireless Competition Report with data from the CTIA

Wireless Industry: Current Trends

Many changes have occurred in the wireless industry over the past decade.[6] CTIA provides a timeline that helps outline some of the major changes in the wireless industry. In 2002 camera phones were first released in the U.S. markets, beginning the expansion of the definition of a "cell phone." Arguably, BlackBerry can take credit for introducing data to the wireless marketplace. In 2003 they launched a phone that was a voice and texting device, but could also send and receive email and browse the internet.[7] While very simple compared to current smartphones, this BlackBerry smartphone paved the way for a world dominated by smart devices.

In 2007 the first iPhones were launched, which began the wave of demand for handsets and data capable devices. In 2008 applications, or "apps," were introduced for the iPhone at the same time as the first Google Android phone hit the market, becoming a rival operating system to the iPhone. A year later, numerous companies presented their own app stores to compete with Apple, including BlackBerry, Nokia, and Windows. The first 4G handset was unveiled in 2010 and the FCC launched its National Broadband Plan with goals to map and expand the use of spectrum for wireless broadband. This was followed by the National Wireless Innovation and Infrastructure Initiative to expand access to wireless for households in the United States.[8]

From these initiatives and developments we can see obvious changes in the demand for not just phones and wireless access, but also data handsets and devices and smartphones. In the U.S., the number of wireless laptops, aircards, and modems has surpassed 20 million, more than double the amount in 2009. The number of smartphones skyrocketed to over 111 million and data capable handsets and devices reached almost 300 million in 2011.[9] As the quality of service has improved and the cost has fallen, an increasing number of households have chosen to substitute wireless for wireline telephone service. As the graphic on the next page illustrates, the National Health Interview Survey found that 38% of adults lived in households that relied exclusively on wireless telephony. At the other end of the scale, however, just over 2% of households have no telephone service at all.[10]

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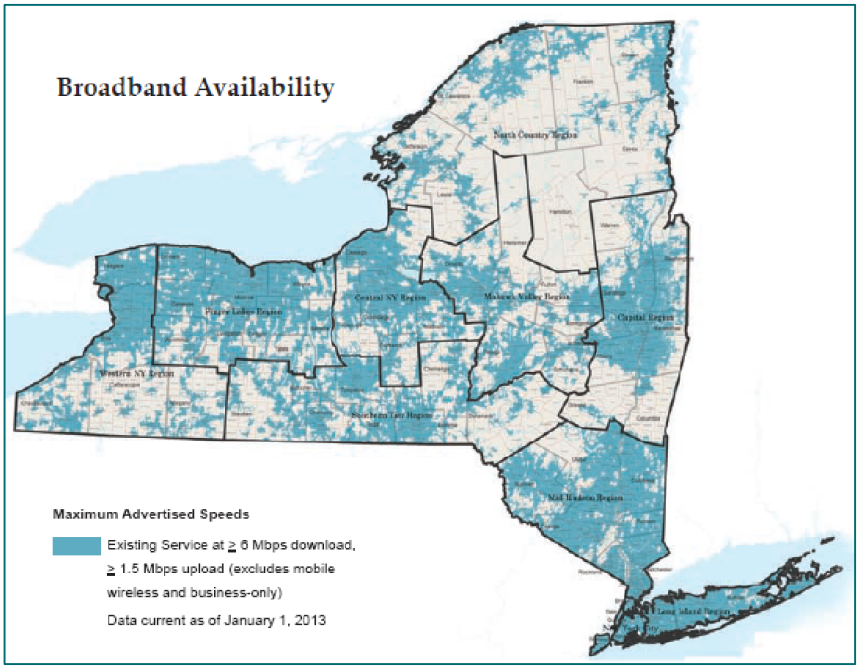
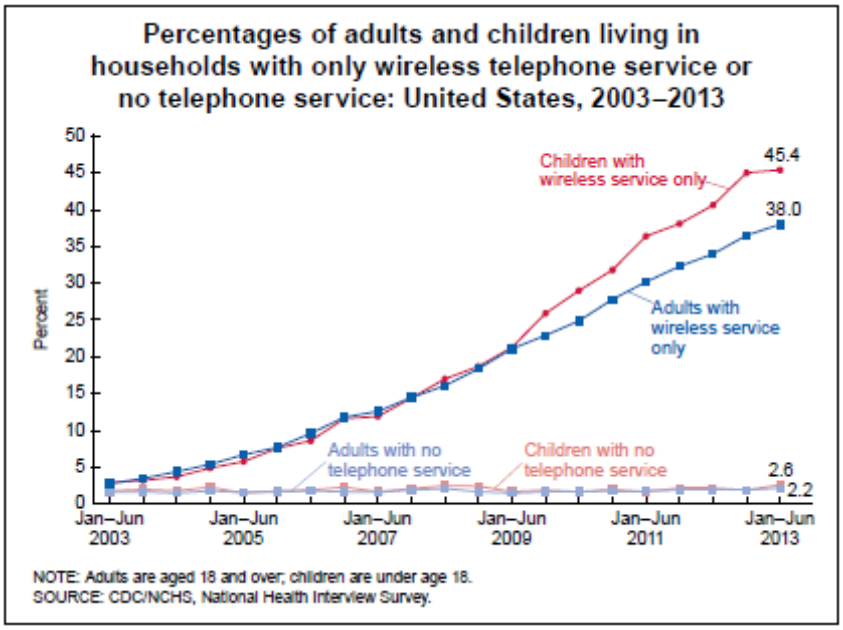
[6] CTIA Wireless History Timeline at www.ctia.org
[7] BlackBerry, http://www.bbscnw.com/a-short-history-of-the-blackberry.php
[8] CTIA Timeline
[9] FCC
[10] Centers for Disease Control, http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201312.pdf

Access to Wireless Service

Despite the number of wireless connections exceeding 320 million, not every household has access to wireless services and coverage.





The New York State Broadband Mapping initiative shows numerous areas without broadband coverage of any kind, which is correlated with a lack of any wireless service, although some will have access to voice only cellphone without data capacity. These areas without coverage are primarily in Northern New York in the Adirondacks, but there are also census blocks elsewhere in the state without coverage. According to this source, about 5% of households statewide lack access to broadband service. Unsurprisingly, the least well served areas are in the Adirondacks and the Catskills.[11]

Once a convenience, the range of services provided over wireless technology has shifted the conversation over access. Increasingly, broadband has become a needed utility for business, an essential amenity for travelers, and a critical complement to public safety services.

[11] New York State Broadband Annual Report 2013, http://nysbroadband.ny.gov/assets/documents/Annual_Report_7.12.13_WEB.pdf

Contribution of Wireless Industry to NYS Economy

That the wireless industry is significant to the health and growth of the New York State economy is self-evident. Measuring the "economic impact" of a single sector of the economy on the remaining sectors of the economy is challenging, however, particularly when the industry arguably touches all sectors in some way. The goal of an economic impact study is to assess how the overall economy would be different were the sector absent. In this case, that pure question is more difficult to answer as this sector has created entirely new product and service categories and has revolutionized old ones.

Economic impact can be measured in many ways.

- The wireless industry has a **direct impact** on the economy through its own spending on labor, materials, equipment and contracted services.
- There are additional "direct effects" of **associated product and service sales**, e.g. accessories and the large reseller market.
- The wireless industry facilitates the growth of **supplier firms** with which it contracts for service. The cellular tower and backhaul companies are obvious beneficiaries of these carrier contracts. Public investment in wireless infrastructure also contributes to the economy.
- Income earned directly in the wireless sector and associated firms supports a range of additional business firms, particularly **retail and service establishments**.
- **Taxation of the industry**—from taxes on the service itself to assessments on the earnings of businesses—is relatively heavy, at least when compared to other sectors of the economy. Indirect taxation, i.e. sales tax on employee purchases and personal income tax, is also significant.
- More difficult to measure, access to **wireless can improve productivity**. We measured the potential value of wireless access for commuters.
- Finally, the wireless industry, as a consumer product, **increases the well-being of consumers** through direct consumption of wireless services. We assess the "consumer surplus" generated by the industry.

Market Size

Direct spending in the wireless industry on infrastructure, cellular sites, and wireless upgrades is a major contributor to investment both within New York State and in the nation as a whole. In 2012, there were about 301,779 cell sites nationwide. In 2012 the total annual incremental capital

investment was $12.2 trillion (2012 dollars), totaling about $78 per customer.[12]

Total revenue in the wireless marketplace in NYS was about $12.5 billion in 2012, earned from 21 million subscriber accounts. In-state retail sales of wireless accessories likely totals another $440 million.

Employment & Payroll

Direct Jobs

The federal Bureau of Labor Statistics (BLS) has not reported wireless communications employment for New York State since 2010, a casualty of rules barring disclosure when the industry category contains few firms. Moreover, the figures reported by the BLS in 2010, when disclosure was allowed, indicated about 2,800 workers statewide, a figure that we know to be incomplete. The difficulty with the BLS figure lies in the means by which the North American Industry Classification System (NAICS) assigns employment to specific industries. Firms with separate buildings dedicated to specific functions are encouraged to assign NAICS codes accordingly.

Consider wireline common carriers as an example. They are encouraged by BLS to assign employment at headquarters to the "Management of Companies" code instead of "Telecommunications." Similarly, call centers are likely assigned to "Telephone Call Centers" which is part of "Business Support Services." Thus total employment for "wireless communications services" is missing significant employment figures for in-state wireless carriers.

By reference to other sources of information (including published and unpublished data and inference from the number of company-owned retail locations, etc), CGR estimates that direct wireless communications carrier employment in New York State was about 14,000 in 2012, with workers earning an estimated $1.6 billion annually.

The wireless carriers may be the core of the industry, but the retail market is quite large. Looking only at the dedicated telecommunications retailers (assumed in this report to be exclusively focused on the wireless sector) identifies another 4,800. Note that additional employment is embedded in broad market retailers such as Best Buy, Radio Shack and Walmart. We estimate that NYS firms classified as "other telecommunications" and operating in the wireless space employed another 400 workers.

[12] CTIA and FCC, inflation adjusted using GDP deflator

The wireless accessory market likely adds an additional 1,400 for **total direct employment of nearly 21,000. Direct payroll across all employment components sums to $2.0 billion annually.**

Spillover Jobs

Estimating the spillover employment of this relatively still-young industry is made even more challenging as the national input-output tables for the U.S. economy have yet to catch up. Our best assessment places employment of firms supplying the providers (e.g. firms building out the wireless infrastructure, and providing other supporting services to the carriers and other wireless companies) and of firms serving the consumer demands of wireless sector employees at about 36,000, nearly three times the direct employment. Additional earnings for these firms totals about $3.1 billion for a total payroll impact of $5.1 billion annually.

Included in the "indirect" portion of this data is capital investment by the carriers, principally in cellular tower development. By allocating national data compiled and reported by CTIA-The Wireless Association, CGR estimates that capital investment in wireless infrastructure in NYS in 2012 was $1.6 billion.

Combined direct and spillover employment for the sector in New York State is estimated to be about 60,000 earning $5.1 billion in payroll.

Employment impacts (thousand)	Direct	Indirect (supplier firms)	Induced (from employee spending)	**TOTAL**
Wireless service providers	14.0	19.2	17.1	**50.3**
Other telco	0.4	0.5	0.4	**1.3**
Telco resellers	4.8	0.2	1.4	**6.3**
Accessory market	1.4	0.2	0.4	**2.0**
TOTAL EMPLOYMENT	**20.6**	**20.1**	**19.3**	**59.9**
Payroll impacts (million)				
Wireless service providers	$ 1,583.8	$ 1,845.6	$ 1,050.1	**$ 4,479.5**
Other telco	$ 41.0	$ 47.8	$ 27.2	**$ 116.0**
Telco resellers	$ 272.3	$ 13.0	$ 87.2	**$ 372.4**
Accessory market	$ 61.3	$ 14.0	$ 23.0	**$ 98.2**
TOTAL PAYROLL	**$ 1,958.3**	**$ 1,920.3**	**$ 1,187.5**	**$ 5,066.1**

Capital Investment

Public Investment

In New York State, public investment in the wireless industry has been substantial, particularly focused on improving access to broadband (some portion of which is wireline). There has been extensive effort by New York State through the Connect NY Broadband Grant Program to improve access to wireless broadband for people across the state, particularly for those living in underserved areas.

Public safety infrastructure is also deeply reliant on wireless technology. Advances in public safety communication and the need for coordinated communication across various public safety agencies has spurred new investment in these systems, which supports additional employment in the state. The recent focus of the Department of Homeland Security has been on improving interoperability and replacing older radio systems with technology operating at 800 mhz. Going back to 2008 (and surely missing some programs), the total combined federal and state funds devoted to improving public safety communication has been more than $450 million. As additional costs are incurred at the local level, total spending on public safety communication has been at least one half of a billion from 2008 to 2012.

FirstNet

The First Responder Network Authority (FirstNet) is a nationwide initiative aimed at creating a wireless broadband network for public safety purposes. Established by the 2012 Middle Class Tax Relief and Job Creation Act, FirstNet is intended to provide "a single interoperable platform for emergency and daily public safety communications."

The law allocates 34 MHz in the 700 MHz band and up to $7 billion in funding for network construction. FirstNet is an independent authority within the U.S. Department of Commerce's National Telecommunications and Information Administration.[13]

New York State was allocated $4.9 million (with a match of an additional $1.2 million) through the federal State and Local Implementation Grant Program to finance the state's participation in FirstNet.[14]

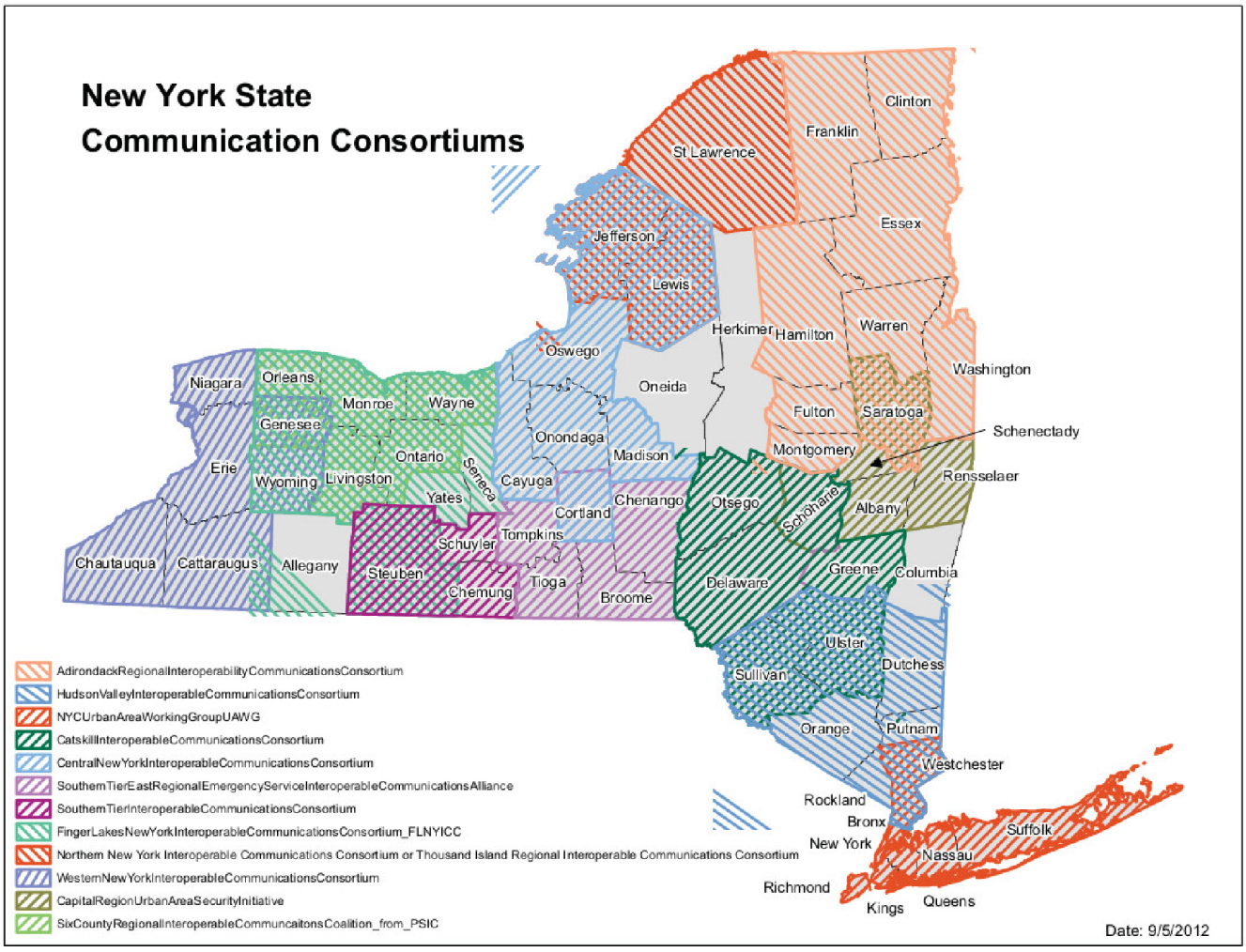
[13] http://www.firstnet.gov/about
Congressional Research Service, *The First Responder Network (FirstNet) and Next-Generation Communications for Public Safety: Issues for Congress*, Linda K. Moore, March 12, 2014 http://www.fas.org/sgp/crs/homesec/R42543.pdf.
[14] http://www.ntia.doc.gov/category/state-and-local-implementation-grant-program

Interoperable Communication Consortia

Most of New York's counties have joined one of the communication consortia. Michael Allen, 911 Coordinator for Oswego County, has compiled spending data for these various initiatives and has documented planned spending of about $64.5 million among three of the state networks[15]. Note that not all of these investments are in wireless communication.

- Central New York Interoperable Communications Consortium
  - $40.1 million annual operational expenses
  - $6.1 million annual operational revenue
  - $114.7 million in local investment
  - $49.7 million in Grants, State/Federal
- Adirondack Consortium
  - $10.9 million annual operational expenses
  - $2.7 million annual operational revenue
  - $10 million in local investment
  - $24.1 million in Grants, State/Federal
- Southern Tier Consortium
  - $14.6 million annual operational expenses
  - $2.1 million annual operational revenue
  - $37.2 million in Grants, State/Federal

[15] See http://nysac.org/Conferences/documents/Financing9_1_1.pdf



NYS Local Government

Public investment accomplished and planned by New York City and NYS counties has been considerable. CGR contacted New York's largest counties to document expenditure.

New York City: Following the events of 9/11, New York City acknowledged that its public safety communication system had been wholly inadequate to the crisis. The city has responded by developing a government-dedicated broadband wireless infrastructure supporting public safety called the New York City Wireless Network (NYCWiN). The network provides agencies real-time access to high-speed voice, video and data communications throughout the five boroughs.

NYCWiN operates two fully redundant 24-hour network operation centers and 377 transmitters providing blanket coverage over 300 square miles across five boroughs. The system provides over 830,000 NYCWiN points

of presence powering more than 300 applications across 30 City agencies.[16]

Developed by Northrup Grumman under a $500 million contract with NYC, the system went live in 2009.[17] The system is reported to cost $40 million annually to operate.

New York City is also expanding Wi-Fi access by issuing a franchise to employ the city's 7,300 remaining phone booths for the purpose. With proposals due at the end of June, 2014, the franchise is expected to earn as much as $20 million for the city.[18]

Suffolk County: In April of 2014, the Suffolk County Executive announced a major investment in wireless communications. The public safety radio system will be upgraded to P25, a suite of standards for digital radio communications for use by federal, state/province and local public safety agencies. Moving to this standard countywide will facilitate communications across public safety agencies and mutual aid response teams in emergencies. The project will be implemented in phases, first replacing the aging infrastructure at several communications sites, and next replacing and or upgrading existing radios to new digital technology.

The Suffolk County announcement indicates that "The state-of-the-art system includes features such as portable GPS functionality, digital encryption capabilities for secure communications, added capacity which will allow fire departments the ability to utilize the system for large scale events, such as brush fires and text messaging capabilities." The total project will cost about $23 million—$11.9 million in the first phase for major equipment purchases and hardware upgrades and an additional $10 million in the second phase for new radios and related equipment[19].

Erie County: The Erie County Public Safety Communications Committee has been working to create a UHF (400 MHz.) solution for Erie County

The first stage of the system will be to upgrade the Erie County Sheriff's infrastructure to a digital simulcast system. The next stage will bring all fire agencies currently operating on low band up to a mixed mode analog/digital simulcast system.

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[16] http://www.nyc.gov/html/doitt/html/citywide/nycwin.shtml.
[17] http://www.digitalcommunities.com/articles/New-York-City-Wireless-Network-Goes.html
[18] http://www.muniwireless.com/2014/05/02/nyc-rfp-free-citywide-wifi/
[19] http://goo.gl/6oUcf4.

The intention is to create a countywide mutual aid police frequency, a countywide mutual aid fire frequency, a countywide local government frequency and to upgrade the MERS Radio System countywide.

Monroe County: Monroe County is moving forward on four public safety communications projects.

900 MHz Digital Paging System: The 900 MHz digital paging system will replace the now-obsolete 450 MHz digital paging system. Equipment for the system is no longer available and maintenance is very costly. The system is a communications necessity for public safety officials and other municipal officials. The new two-way is being tested. The user device, 1501 Responder pager, is available and can be ordered by contacting Radio Center at 428-5146. The current and latest version of the Firmware is Version 1.20 Build 18.

Law Enforcement Voice System: The UHF law enforcement voice communications system was replaced on January 10, 2010 with a digital, FCC compliant, "narrow band" system to create additional frequencies for public safety agencies.

Public Safety Data System (MDT): MACRO completed a second study of the public safety data system and recommended a replacement. This system has reached its life cycle and is part of the Public Safety Integrated Management System replacement. This system supports MDT's and laptop computers in the cars as well as station house MDT units.

Fire/EMS Narrow-Band Project: The current radio system used by the fire and emergency medical services uses radio frequencies in the VHF band (138-174 MHz. Most frequencies used in Monroe County are in the 153-155 MHz range. Like the UHF frequencies, FCC is requiring them to be "narrow-banded". This change means moving to a 12.5 MHz split between the next closest frequency. Many current radios used by the services (both mobile and portable) are not manufactured to the new 12.5 "narrow-band" standard and therefore will not accept the new frequencies.

Onondaga County: Onondaga County established the Onondaga County Interoperable Communications System (OCICS), a UHF digital simulcast trunked land mobile radio system that provides approximately 99% portable radio coverage throughout the county and serves approximately 133 public safety and public service agencies and 6,500 subscriber radios; The county has also been a leader in the Central New York Interoperable Communications Consortium.

During 2012, the county implemented a NYS DHSES OIEC Statewide Interoperable Communications Grant (SIECG) in the amount of $331,446

to fund the narrowbanding of the legacy UHF MED (ambulance to hospital) radio system.

Private Investment

CTIA The Wireless Association estimates national capital investment in wireless infrastructure at $24 billion in 2012. Recon Analytics estimates that wireless carriers in the United States spent $34.4 billion in 2013. This investment in network improvement, about $110 per capita, is twice what was spent in Europe[20]. **If these estimated capex expenditures are proportional to population, it would mean capital spending of $1.6 billion in 2012 and nearly $2.2 billion in 2013 in New York alone.**

The level of capital investment by commercial mobile carriers, both nationally and in NYS, is likely to continue to rise due to cell site densification and deployment of heterogeneous network technologies such as in-building distributed antenna systems, small cells, and stadium networks.

Specific news reports about private investment in New York's wireless infrastructure support these figures. Companies view investing in wireless broadband upgrades as both profitable and a long-term benefit for the companies and the consumers. Several of the publicly-reported major private investments in New York State include the following:

- Verizon Wireless (now simply Verizon) invested $125 million in Upstate New York in 2010[21];
- Kohlberg Kravis Roberts announced in October 2013 that it would invest $100 million in wireless telecommunications infrastructure[22];
- Time Warner Cable and Cablevision signed a 10-year franchise renewal deal in 2011 and agreed to invest $10 million in communications upgrades, expanding wireless access in city parks and within the five boroughs, focusing on Brooklyn, Queens, and the Bronx[23];
- AT&T is reported to have spent $1.4 billion on wireless and wireline networks from 2010 to 2013.[24]

This list is certainly incomplete. Moreover, the specific timing of the investments make it difficult to estimate annual capital expenditures, other than to observe that the total is quite substantial.

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[20] http://www.wirelessweek.com/news/2014/06/report-us-carriers-spent-109-citizen-capex-2013
[21] Verizonwireless.com
[22] Bizjournals.com
[23] Crainsnewyork.com
[24] http://nyswa.org/att-details-upgrades-investments/

Cellular Towers & Macro Cell Sites

As previously noted, there were over 300,000 cellular antenna sites in the nation as of 2012. Every "cell site" in the country is an investment, including spending on equipment, set up, and maintenance. A cell site is not necessarily the same as a cell tower, as a cell site can include antennas on top of a building, for example. A cell tower costs on average $250,000 to $300,000 to construct. The cost of collocation, when a wireless carrier installs its equipment on the tower of another carrier or on an existing building, is about one-tenth as much.[25] Costs can be considerably higher in parts of New York based on variables including local regulatory environments.

With two to three "tenants" per tower, each tower can generate from $50,000 to $90,000 in annual leasing revenue. Due to zoning laws and restrictions, collocation is often encouraged as opposed to constructing new cell towers. It is uncertain how many cell sites versus cell towers specifically there are in the United States.

Additionally, the cost of collocation depends of the price of leasing that "space" as is charged by each individual cell tower company or carrier. In many states, due to limited space, leasing cell towers to "tenants" has become very lucrative—as mentioned above the average revenues can total nearly $100,000 per tower per year. Some estimate that New York State may have some of the most expensive cell tower rental costs in the country, exceeding the $25-30,000 average yearly cost per tenant. This indicates that businesses see the wireless industry in New York State as a worthwhile business investment.

According to the FCC's registry of antenna structures, there are about 3,000 antenna structures that are either formally registered or pending registration in New York State. These structures include cell towers, but also extend to any structure that supports an antenna and is at least 200 feet tall or are tall enough to potentially interfere with flight and air patterns.[26]

If the average lease rate for mobile antenna structures is $30,000 and New York State contains 3,000 antenna sites, annual revenue is $90 million.

[25] PCIA, www.thedasforum.org
[26] See the fcc.gov website and ASR system

Investment & Rents

Cell tower leasing	*Cost of cell tower annual lease*	$ 30,000
	Number of towers in NYS	3,000
	TOTAL LEASE REVENUE (million)	**$ 90.0**
Private infrastructure investment—some combined wireless & wireline		**Spending (million)**
	AT&T: 2010-2013	$ 1,400.0
	Kohlberg Kravis Roberts & Co. with Associated Partners L.P.--announced 2013	$ 100.0
	Verizon 2010	$ 125.0
	Time Warner & Cablevision	$ 10.0
Total private (published)		**$ 1,635.0**
Public investment in wireless and broadband		
	Public Safety Answering Points (PSAP) Grant, supported by the Statewide Public Safety Communications Account: 2012	**$ 9.0**
	PSAP 2013	**$ 9.0**
	Public Safety Interoperable Communications (PSIC)--2008 award within NYC Urban Area Security Initiative (UASI)	**$ 34.8**
	PSIC--awards 2008 (through 2012) outside NYC UASI	**$ 25.9**
	American Recovery and Reinvestment Act (ARRA) Broadband 2009	**$ 160.0**
	NYS Division of Homeland Security and Emergency Services (NYS DHSES), Office of Interoperable and Emergency Communications (IECGP): 2008-2010	**$ 21.1**
	NYS DHSES IECGP 2011	**$ 20.0**
	NYS DHSES IECGP 2012	**$ 102.0**
	NYS DHSES IECGP 2013	**$ 75.0**
	Connect NY Broadband 2013	**$ 25.0**
	Connect NY Broadband 2013 Private Sector Match	**$ 32.0**
	Regional Economic Development Council 2011 & 2012	**$ 5.8**
Total public		**$ 519.6**

Fiscal Impact on State and Local Government

Subject to several different forms of taxation, **the wireless industry contributes a remarkable $2.4 billion to New York State and NYS local government**. This total includes estimates of the

- State and local sales tax paid on telecommunications services,
- State and local sales tax paid by direct and spillover employees,
- MTA sales tax surcharge in the downstate region,
- Wireless sector's share of the excise tax on telecommunication services (Section 186e of the NYS Tax Law),
- Public safety communications surcharge (Section 186f of the NYS Tax Law),
- Property taxes paid by the firms, and
- Income taxes paid by the workers, both direct and spillover.

Fiscal Impact: State & local tax revenue ($million)

	Total revenue from 186e tax on telco services	***$ 459.2***
	Implied total telco revenue	*$ 18,369.1*
Wireless Services: Business taxes	Wireless share of 186e tax	$ 313.5
	Additional MTA Tax (17% surcharge on 186e tax)	$ 35.9
	Revenue from 186f tax per wireless device	$ 187.6
Business Property Tax	Property Tax paid by business	$ 305.0
Wireless Services: Sales tax	State Sales Tax (4%)	$ 501.6
	Local Sales Tax (variable)	$ 529.1
	MTA Sales Tax (.375% for specific counties)	$ 31.7
Payroll: Sales tax on 30% sales taxable share of PI	State Sales Tax (4%)	$ 61.6
	Local Sales Tax (variable)	$ 65.0
	MTA Sales Tax (.375% for specific counties)	$ 3.9
Accessories: Half sales taxable	State Sales Tax (4%)	$ 8.9
	Local Sales Tax (variable)	$ 9.4
	MTA Sales Tax (.375% for specific counties)	$ 0.6
Personal Income Tax	NYS Personal Income Tax	$ 303.8
TOTAL TAX		**$ 2,357.5**

Consumer Surplus

"Consumer surplus" is a concept used by economists to assign a value to the differential between what consumers *actually* pay now and what they would be *willing* to pay, if the good or service were in short supply. The textbook example is water—available to most households at a price approaching zero, its abundance masks the fact that human beings would pay any price at all if water were scarce.

Only a theoretical concept for many goods and services, the fabulous reduction in the cost of wireless telephony over a short period of time permits economists to estimate the consumer surplus of wireless voice services. In the early 1990s, 20 million subscribers purchased 30 billion minutes at a price of about 65¢ per minute (in 2012 dollars). By 2011, the cost per minute had fallen to less than a tenth of that price and 316 million subscribers were buying 2.3 trillion minutes.

Thus while consumers have shown that they are willing to pay 65¢ for each of the first 30 billion minutes purchased, they actually spent less than 5¢. The added "value" to the consumer for these 30 billion minutes is about 60¢ per minute. **The total consumer surplus of wireless telephony for NYS consumers is estimated at about $46 billion.**

Productivity Impacts

The wireless industry has transformed the ability of workers to take advantage of unproductive time. Consider the mom who can use a wireless connection to complete a legal brief or report while waiting for her son to compete in a (seemingly interminable) karate or gymnastics tournament. The demands of the workplace may otherwise have forced her to miss the tournament altogether without wireless technology. Before mobile telephony, a physician on call couldn't stray from proximity to a landline—his daughter's soccer pitch would have been out of bounds.

For illustrative purposes we estimate the value of time that might "redeemed" for NYS commuters through wireless technology.

Of NYS commuters who travel at least 30 minutes each way on their daily commute, those who drive alone or walk spend two-thirds of a billion hours a year commuting. **If talking on the phone during the commute were worth the minimum wage to commuters walking or driving alone, the annual value would be $4.8 billion.**

Those who carpool, take the train or the bus spend about 435 million hours commuting. As these commuters could use data as well as voice, the time

redeemed could be even more valuable. Again, **valued only at the minimum wage the value of time redeemed when commuting in carpools, by the train or the bus would be $3.2 billion.**

Economists could use "contingent valuation" methods to better estimate the value of these productivity-enhancing technologies to individual commuters. Some commuters value time away from electronic communication and would assign a very low value to wireless access. Others would be willing to pay a substantial sum. Analysis of relatively new in-flight Wi-Fi by airlines may help refine these estimates.

Productivity impacts: All NYS commuters traveling at least 30 minutes each way (millions)

Car alone or walking: Hours commuting	661.4
Car alone or walking: Value of time at minimum wage	$ 4,795
Commuter rail or carpool: Hours commuting	435.8
Commuter rail or carpool: Value of time at minimum wage	$ 3,160
Total value of time at minimum wage	**$ 7,955**

Mobile Data Expands Established Markets, Creates New Ones

Mobile data, made possible by wireless technology, is revolutionizing established markets. As an example, SMS (conventional text messaging) and MMS (multimedia messaging) have been displacing mobile voice telephony, particularly with younger consumers.

Mobile data is also creating entirely new markets for products and services that were either prohibitively expensive or technically unachievable without wireless. Google's driverless car has captured the imagination: Urbanists dream of city centers without vast parking structures; transportation planners dream of an end to drunken driving and highways that can move at capacity at full speed. Dubbed the "Internet of things," wireless enables ubiquitous connections among devices, controlled by user-friendly apps. The number of "machine to machine" connections is expected to reach two billion by 2018.

Speed also increases demand for data. MMS expands with better connections. Fourth generation connections (4G) accounted for 3% of devices in 2013, but 30% of data throughput.

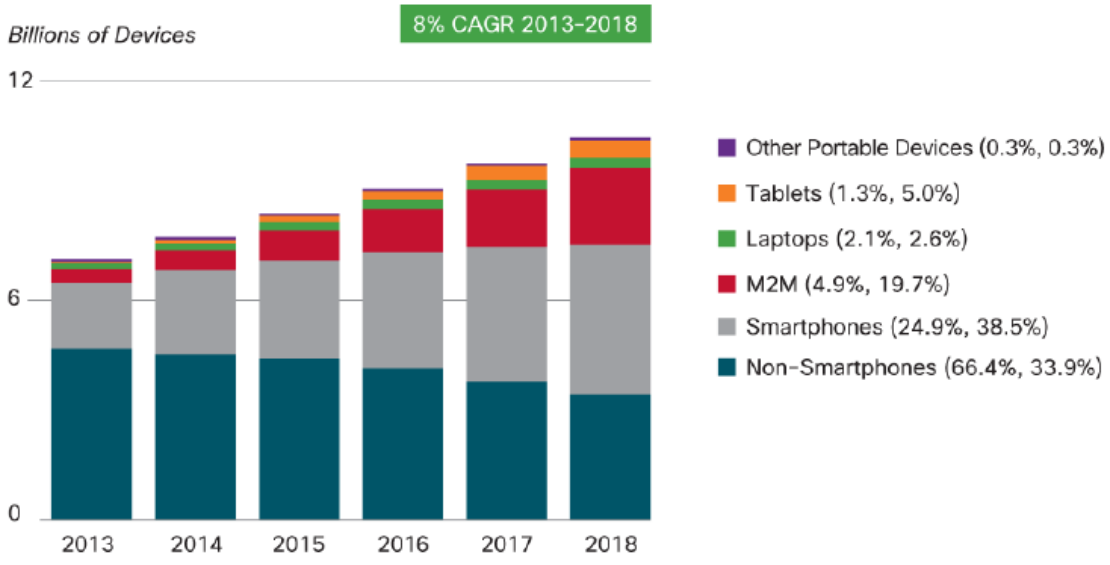
Cisco Global Mobile Data Traffic Forecast Update, 2013–2018

Cisco has developed forecasts of growth in devices and data demand that, if anything, appear conservative[27]. Key data points:

- Global mobile traffic grew 81% in 2013, reaching an aggregate level of demand that is 18 times of the entire global Internet in 2000. Cisco's forecast through 2018 assumes a compound annual growth rate (CAGR) of 61%.
- As smartphones displace traditional handsets and other devices, data use will continue to increase.
  - In 2013, 77% of new devices were "smart;" the net increase in new smartphones was about 400 million.
  - Smart devices use 29 times as much data as non-smart devices, yet represent only 21% of installed devices.
  - Data use by smartphone owners grew 50% in 2013 from 353 MB per month to 529 MB per month.

Number of Devices to Equal World Pop in 2014

Cisco projects that the total number of devices will grow at a compound annual growth rate of 8%. Yet as the share of smart devices rises from about one third in 2013 to two thirds by 2018 and 4G connections become more common, the total demand for data will soar.



Figures in parentheses refer to device or connections share in 2013, 2018.
Source: Cisco VNI Mobile, 2014

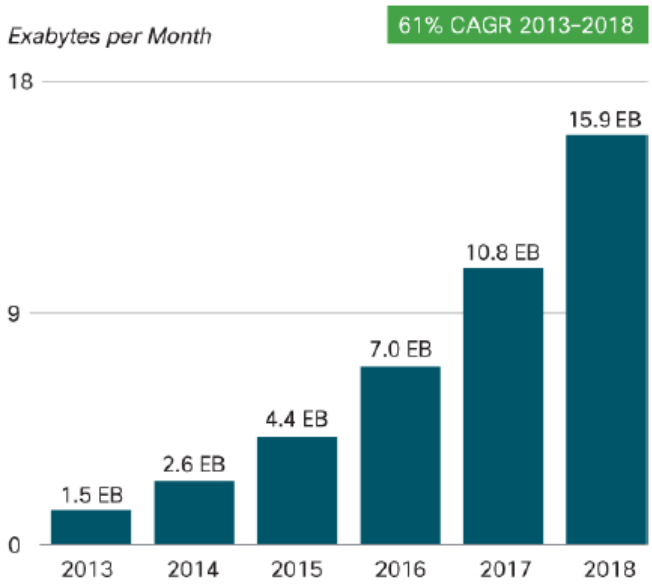
[27] Cisco Systems, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013–2018, February 2014. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.pdf

Mobile Video Growing Rapidly

Faster connections have enabled an explosion of demand for video over mobile devices. The Wall Street Journal reports that Netflix accounted for a third of total Internet traffic during recent busy periods[28]. A growing share of this flows to tablet computers.

Cisco forecasts 61% CAGR for mobile video through 2018, reaching 69% of total mobile data.

Total Data Demand: Nearly 16 Exabytes per Month by 2018



Source: Cisco VNI Mobile, 2014

Combined, the growth in the number of devices, the continuing shift to "smart" devices, the explosive growth of "machine to machine" connections in the emerging "Internet of things," the explosion of video and the regular emergence of new applications for mobile data caused Cisco to forecast that global data demand will hit 15.9 exabytes per month by 2018, ten times the volume recorded just last year.

[28] "Netflix's Share of Internet Traffic Grows," *Wall Street Journal*, May 14, 2014. http://online.wsj.com/news/articles/SB10001424052702304908304579561802483718502

Impact of Wireless Capital Investment on GDP

In a report issued by the PCIA - The Wireless Infrastructure Association in 2013, Information Age Economics (IAE) attempts to measure the connection between wireless infrastructure investment and gross domestic product. IAE observes that the economic impact of wireless must account for both the direct impacts and "catalytic" impacts upon other products and services:

> *[W]ireless broadband is such an important enabling technology that it is likely to unleash positive productivity shocks from derivative innovations and is therefore akin to other disruptive enabling technologies, such as the deployment of the electric infrastructure, the national railroad and interstate highway systems, the invention of the combustion engine, the global impact of the personal computer, as well as the Internet and the World Wide Web, in its outsized contributions to economic growth and employment.* [29]

The IAE report begins by totaling the "direct" impacts on GDP and employment, including the development of new infrastructure supporting a move to near-universal and ubiquitous wireless. Much of the impact of wireless, however, is in its impact as an "enabling" technology. New technologies mentioned by IAE include:

- Machine-to-machine (M2M) applications,
- Mobile payment systems and marketplaces,
- "Smart" devices that spur new industries, and
- An array of innovative applications that have yet to be conceived.

IAE's model relies on research conducted on prior "disruptive" technology and specific analyses of what is already anticipated. The study forecasts an impact on GDP of $1.2 trillion, with an employment impact of 1.2 million jobs by 2017.

IAE envisions a positive "productivity shock" that will be unleashed by ubiquitous wireless broadband.

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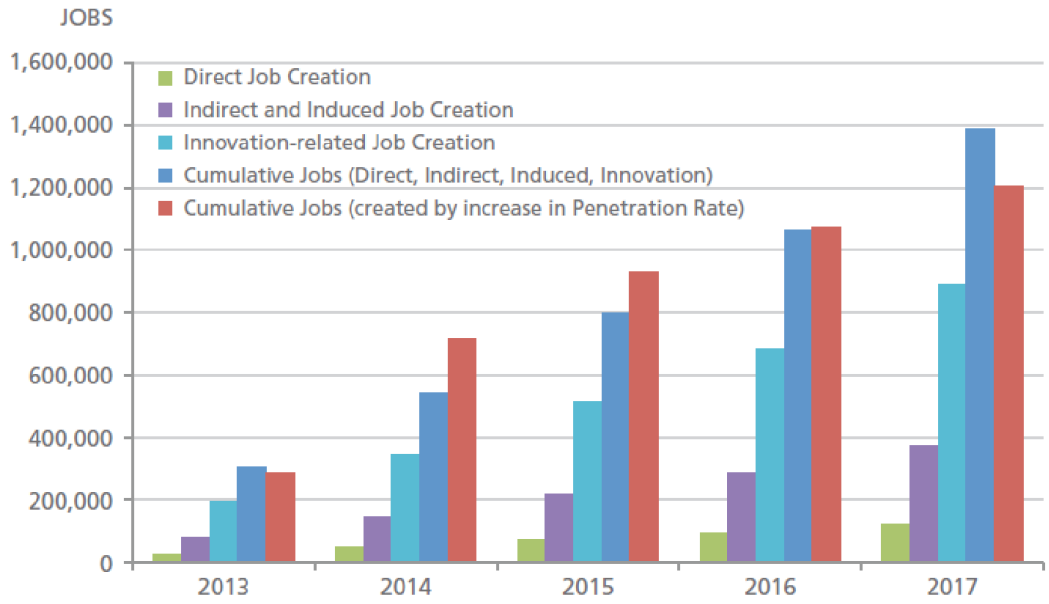
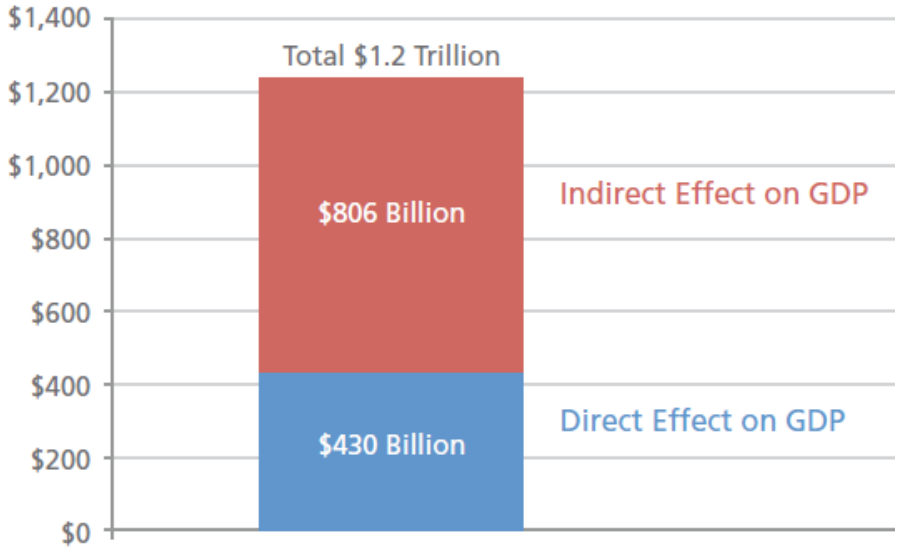
[29] Information Age Economics, *Wireless Broadband Infrastructure: A Catalyst for GDP and Job Growth 2013-2017*, Alan Pearce, Ph.D., J. Richard Carlson, MBA, Michael Pagano, Ph.D.. PCIA, September 2013. http://www.pcia.com/images/IAE_Infrastructure_and_Economy2.PDF

IMPACT OF WIRELESS CAPEX ON JOB CREATION



TOTAL EFFECT ON GDP (IN BILLIONS)



CONCLUSION

A comprehensive compilation of all of the ways wireless has affected the economy and society may be impossible, but that the impact has been and will continue to be extraordinary. Moreover, the breadth and depth of wireless' impact will surely expand over time as entrepreneurs build new products and services on the near-miraculous capabilities offered by this technology.