The Economic Impact of the “New IP” and the Internet of Things: A US and Global Forecast 2015 to 2025

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The “New IP,” The Internet of Things and “Tech Innovators”
The “New IP” and Tech Evolution

• We are beginning a new phase of technology development that differs from earlier phases

• Phase 1: 1975-1995: Mainframe computing to personal computing and the rise of the commercial Internet

• Phase 2: 1995-2015: The Internet’s ascendancy, client/server computing, IP networks

• Phase 3: 2015 onwards: The “New IP,” cloud computing/compute infrastructure reorganization, Big Data, Intelligent Mobile devices, the Internet of Things, Bit Chaining and Social Media strain existing infrastructure and change business models
What is the “New IP”?

• The “New IP”* is a state-of-the-art, virtualized IP network. For service providers, networks built on The New IP technology save money on capex (capital expenditure) and opex (operational expenditure). The Old IP (Old Internet Protocol) represents utilitarian pipes that are not virtualized and don’t reduce capex and opex.

• Here, we extend this terminology to new large and smaller enterprises, particularly to “tech innovators” that employ many “New IP” features in their networks and are also concerned with reducing capex and opex.

# The “New IP” vs the Old IP

<table>
<thead>
<tr>
<th>The Old IP</th>
<th>The New IP</th>
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<tbody>
<tr>
<td>Designed to scale clients (devices/nodes)</td>
<td>Capable of scaling clients and resources on-demand (cloud-like)</td>
</tr>
<tr>
<td>Rigid topology and architecture</td>
<td>Fluid in topology and architecture</td>
</tr>
<tr>
<td>Hardware-centric</td>
<td>Software-centric</td>
</tr>
<tr>
<td>IT-centric</td>
<td>User-centric</td>
</tr>
<tr>
<td>Integrated control and data planes</td>
<td>Disaggregated control and data planes</td>
</tr>
<tr>
<td>Decentralized intelligence and management</td>
<td>Centralized intelligence and management</td>
</tr>
<tr>
<td>Proprietary but standards-driven innovation</td>
<td>Open platform and open-sourced innovation</td>
</tr>
<tr>
<td>Time-bound provisioning and change management</td>
<td>On-demand provisioning and programmability</td>
</tr>
<tr>
<td>Key success metric: performance (speeds and feeds)</td>
<td>Key success metric: agility (usability)</td>
</tr>
<tr>
<td>Killer apps: data networking communications (email), ecommerce, voice/video/data integration (VoIP, unified comms)</td>
<td>Killer apps: Cloud everything, mobile data centers, big data analytics, virtualization everywhere</td>
</tr>
<tr>
<td>Management considers your network as an essential budget line item</td>
<td>Management considers your network to be a strategic asset that serves both the bottom and the top line by saving/making money</td>
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</table>

How “Tech Innovator” Firms use the “New IP”

• To create new services/businesses almost “on the fly”
• Some industries will benefit from moves to a “programmable world”
  • Tesla is already managing cars using “fly-by-wire” technology
  • Automakers will shift to this model and treat cars as “systems of programmable devices” connected to the Internet
  • “Fly-by-wire” will characterize many industries, changing retailing, service sectors and aerospace, as well as health care and pharmaceutical research
• These industries will shift investment from traditional infrastructure to “New IP” infrastructure
• This will change productivity, investment and jobs in many industries.
Internet of Things and the “New IP”

• The IoT “connects devices such as every day consumer objects and industrial equipment onto the network, enabling information gathering and management of these devices via software in order to increase efficiency, enable new services, or achieve other health, safety, or environmental benefits.” *

• Very much like IoT is Industry 4.0** or the 4th Industrial Revolution coupled with the introduction of cyber-physical systems.“ It is focused on smart products, procedures and processes (smart production). A key element ... is the smart factory” where “there is direct communication between man, machine and resources.” With “interfaces to smart mobility, smart logistics and smart grids the smart factory is an important element of future smart infrastructures.”


**Industry 4.0 includes Big Data, cloud computing, cyber-physical systems, RFID chips, Internet of things and services, machine-to-machine communication and Smart X (i.e. intelligent features in many things). Stefan Heng and others, Deutsche Bank Research, “Industry 4.0. Upgrading of Germany’s industrial capabilities on the horizon,” April 23, 2014, pp.2, 4. https://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD00000000000333571/Industry+4.0:+Upgrading+of+Germany%E2%80%99s+industrial+capabilities+on+the+horizon.PDF
What the Internet of Things Changes: Integrated Systems and “Block Chaining”

- Information technology connects “production, marketing and logistics and thereby captures all resources, production facilities and ware-housing systems.”* This means changes occur in:
  - Business models
  - Work organization
  - Downstream services

- Block Chaining * -- a long ledger of transactions shared by participants of a network that provides “for contract-based device interactions and to achieve consensus based device coordination across a global network of devices” -- offers a way to use the Internet of Things for secure financial transactions and to create verifiable records of services and products for genomic information that will be used for disease treatment.

- By “integrating cyber-physical systems into production and logistics” and through a “rigorous end-to-end implementation of the internet of things and services in industrial processes” as well as services
  - “Business processes can be structured more dynamically”
  - “Seamless data collection enables the rapid use of production-relevant data for near-term decision-making regardless of the location”
  - “Individual customer-specific criteria concerning design, configuration, ordering, planning, production and operation as well as enabling modifications to be made at short notice” including one-offs in autos and furniture.


Entrepreneurship and the “New IP”

• The “New IP” provides a number of opportunities for entrepreneurship:
  • The “rapid use of production-relevant data for near-term decision-making regardless of the location”* opens opportunities for start-ups to exploit reduced market lead times.
  • If “individual production lines organize themselves independently according to demand” startups can gain advantages by being able to respond rapidly to shifts in demand.
  • Startups can begin with even smaller production runs and be successful if “Individual customer-specific criteria concerning design, configuration, ordering, planning, production and operation as well as enabling modifications to be made at short notice”* including one-offs in autos and furniture.

* Heng and others, p. 7.
Trends Indicate a Decline of New Firm Creation and in Business Dynamism over 3 Decades

Explore How Much Networking to Obtain Knowledge Promotes Cross-Innovation in Startups

47 cases are studied here to examine if “successful cross-innovation depends ultimately on a re-networking or connection respectively of existing elements of and actors in the innovation system.” Thomas Lammer-Gamp, “Creative Industries Policy recommendations - promotion of cross-innovation from creative industries,” Berlin, Institut fur Innovation und Technik, March 15, 2014, pp. 11 and 13.
Research Agenda

Productivity, Investment, Growth, Employment Impacts and type of Jobs Created
The “New IP,” The Internet of Things and US Productivity, Investment and Growth

• “Tech innovators” emerge in industries such as finance, pharmaceuticals, retailing, media and aerospace. Firms in other sectors such as autos and telecoms make changes to try to become “innovators”

• Detailed interviews with informed executives in “tech innovators” can help forecast:
  • Likely productivity and investment impacts of the “New IP” as well as the Internet of Things in individual firms from 2015 to 2025.

• Estimates of productivity and investment changes at the firm level can be linked to the timing of adoption of the “New IP” as well as the Internet of Things in each industry

• We can then forecast GDP impacts at different times because we know how rapidly productivity and investment changes are likely to happen in these industries

• We can modify baseline forecasts in US Input/Output models to estimate productivity and investment changes in the US economy from 2015 to 2025 that are linked to the growth of the “New IP” as well as the Internet of Things.
The “New IP,” the Internet of Things and Global Productivity, Investment and Growth

• Using the US as a guide, interview non-US firms in “tech innovator” industries to see if their adoption of “New IP” as well as the Internet of Things differs from the pace expected in the US and if investment and productivity changes are similar.

• Detailed interviews with informed executives in European and Asian “tech innovators” can help forecast:
  • The likely productivity and investment impacts of the “New IP” and the Internet of Things in firms in industries in these economies

• Estimates of productivity and investment changes can be linked to the pace of adoption of the “New IP” as well as the Internet of Things in each European and Asian industry

• We can forecast GDP impacts for Europe and Asia based on knowing the productivity and investment changes in these industries

• We can modify baseline forecasts in European and Asian Input/Output models to quantify how productivity and investment changes could occur across these economies from 2015 to 2025 that are linked to the growth of the “New IP” as well as the Internet of Things
Evaluating the Economic Impact of the Internet of Things

- The Internet of Things is causing major changes at the enterprise level. In-depth interviews with firms can reveal:
  - The speed with which firms are investing in the Internet of Things and Linking it to broad changes in interconnected production and services creation.
  - The amount invested over time at an industry level
  - The expected gains in productivity over time from moving to IoT
  - The new business models likely to be used for IoT
  - The more flexible jobs that will be created for IoT and the jobs that will very likely be lost over the next decade.
  - The use of new techniques such as “block chaining” and how it will affect verticals such as finance and health care.
  - What economic impacts will there be in new value chains that are created to support IoT?; previous value chains may also be dismantled.

- We will make these results a subcategory in the economic analysis of the “New IP” that we conduct with the sector-based models described above. This will help to determine how much the Internet of Things is likely to impact expected growth for the US and other economies. Our model will develop an approach that permits us to assess the pace of change over time for specific industries and economies.

- We will assess how the Internet of Things is related to labor force changes by modifying occupation by industry forecasts for the US, the UK, Finland, and other economies. We expect this will illuminate IoT driven employment adjustments over time and illustrate how they differ from changes related to the “New IP.”
The “New IP,” the Internet of Things and US Employment

• Moving to a “everything-as-a-service” mode shifts jobs to support the “New IP” and Internet of Things environment

• Detailed interviews with executives at “tech innovators” can help to define what jobs will be lost and which ones will expand.

• The interviews will also clarify what type of skills firms will need for the future for the “New IP” as well as the Internet of Things. Using this information, we will prepare an adjustment to the baseline forecast of needs by industry over the 2012-2022 period. A related question we will pose is whether intelligent software will “simplify” more complex tasks and create the potential for new, mid-level jobs.

• These estimates can be compiled by industry and linked to the pace of adoption of the “New IP’ environment from 2012-2022

• The estimates of occupational changes for specific “tech innovator” industries can be incorporated into the current Labor Department estimate of occupational changes for 2012-2022

• The result will be a forecast of job gains and losses for many US industries during 2012 to 2022. This will be done by adjusting the baseline Labor Dept. forecast. We will also be able to quantify employment changes in supplier industries.

• Factor analysis will help us define “key drivers” behind these changes, such as how closely the changes are linked to levels of “New IP” investment or to the Internet of Things and to new business model development.
The “New IP,” the Internet of Things and Global Employment

- Knowing the pattern for the US, interviews with Asian and European firms will indicate what job changes are likely to occur as “tech innovator” firms adopt the “New IP” and Internet of Things and the pace of adoption during 2012-2022.

- We can examine the changes forecast for US jobs and compare them with the occupations and the magnitude of changes expected in Asia and Europe.

- We can use existing occupational forecasts for Asia and Europe and adjust them in the same way that we plan to adjust the forecast for occupational changes in the US. In case a country or region does not have a forecast available, we will adjust the US forecast to reflect the different industrial mix in Asia and/or Europe to do this analysis. We expect that there will be European forecasts that we can use.

- The forecast will quantify job gains and losses by major industries for the “New IP” as well as for the Internet of Things. It will also quantify how supplier industries will be impacted by changes in each of these areas.
Measuring how the “New IP” and Internet of Things Changes Employment

- The Department of Labor’s Bureau of Labor Statistics forecasts the growth of US occupations for 10-year periods. The current forecast for Software Developers by industry for 2012 to 2022 is shown at the right. An informed approximation of the impact of the “New IP” and Internet of Things is added for 2022.

- We plan to interview industry strategists and senior executives to ascertain how they believe the “New IP” and Internet of Things could change occupational growth and the distribution of occupations by industry.

- We will use this information to create a separate forecast for a selected group of occupations that are closely linked to the “New IP” and IoT-related changes at an industry level. We will analyze how these changes differ from the baseline Labor Department 2012-2022 forecast.

- One effect we will search for is whether there will be a “simplification” of “complex tasks” as a result of the adoption of the “New IP” and IoT. This would be part of the “deepening” process that happens when there are vast turnovers in existing patterns of industrial organization and behavior.

- One likely example, as noted before, is the auto industry. It could change from a producer of “drivable” cars to a provider of “systems of programmable devices,” including sensor networks and platforms for software-based controls. This could create more networking-oriented jobs.

- The overall goal is to describe how taking technological changes into account more explicitly could improve forecasts of occupational shifts. We will explore what patterns of change are most likely under several different scenarios, such as a “limited shift” to the “New IP” and IoT a “moderate shift” to the “New IP” and IoT and a “rapid shift” to the “New IP” and IoT.

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<tbody>
<tr>
<td>Professional Scientific</td>
<td>41.8</td>
<td>48</td>
<td>41</td>
</tr>
<tr>
<td>Information (Publishing)</td>
<td>15</td>
<td>14.4</td>
<td>18</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>8.8</td>
<td>6.1</td>
<td>14</td>
</tr>
<tr>
<td>Insurance carriers</td>
<td>5.4</td>
<td>5.2</td>
<td>7.0</td>
</tr>
<tr>
<td>Data processing</td>
<td>4.7</td>
<td>4.6</td>
<td>8.0</td>
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Software Developers, 2012 to 2022
Measuring how the “New IP” and the Internet of Things impacts an Industry

• To build up a picture of industry-level change from the baseline pattern of growth, experts within specific firms will help us estimate the productivity and investment impacts of the “New IP” and Internet of Things in their firms.

• We will aggregate and adjust these estimates to quantify the key impacts by industry.

• The chart on the right shows a methodology that was used to estimate the impact of grid computing adoption in the financial services industry. Separate estimates were developed for the adoption/penetration of cluster grids and enterprise grids.

• Creating adoption curves for an industry help us estimate how rapidly productivity and investment impacts will occur in a specific sector such as financial services.


Illustrating how the “New IP” and the Internet of Things Might Promote Economic Dynamism

• Use in-depth interviews to evaluate suppliers to large firms that are able to leverage the “New IP” and Internet of Things to provide marketing and other inputs that smaller firms might not have provided earlier. One example of this is Hubspot.

• Create an index to identify what “tech innovator” industries are turning to new, dynamic firms. Evaluate the key success factors used by these new firms. Relate these success factors to the firms and industries that they supply.

• Answer questions such as “does the “New IP” and Internet of Things provide a possible vehicle to reverse the current downward trends in new business formation and dynamism?”
Final Results

• How much is the “New IP” and Internet of Things likely to affect US, Asian and European economic growth?

• What sectors are likely to become the first “motors” for growth? How do they differ by economic area, i.e., which markets grow the fastest in each part of the world?

• How will the “New IP” and Internet of Things change productivity in each economic area?

• How will the “New IP” and Internet of Things change employment in each economic area?

• How likely is it that intelligent software, an element of the “New IP” and Internet of Things will “simplify” complex tasks and open the way for workers with middle level skills to run complex networks, large data centers, and other, more technical tasks?

• The study provides a detailed analysis of global adoption of the “New IP” and Internet of Things at a firm and industry level.

• It also indicates the key factors that are responsible for differences in adoption in different parts of the world.

• The analysis will indicate whether new patterns of cross-innovation might provide a path to reinvigorate business dynamism in the US and overseas.
Affiliated Experts and Groups

- Clyde V. Prestowitz, President, Economic Strategy Institute
- Vint Cerf, Chief Internet Evangelist at Google and Advisor, Innovation for Jobs (iiij.org)
- David Nordfors, CEO, Innovation for Jobs (iiij.org)
- Roger J. Moncarz, Branch Chief in the Occupational Outlook Studies Branch, Bureau of Labor Statistics

Organizations considering links with the project:

- Brocade – Christine Heckart, SVP Ecosystems & Chief Marketing Officer
- Cisco – Monique Morrow, CTO-Evangelist New Frontiers Development and Engineering, and Aron Dutta, Financial Services
- Intel – Sandra Rivera, Network Platforms Group
- IBM – Mac Devine, CTO and Director of Cloudfirst Innovation
- VMware – David Tennenhouse, Chief Research Officer
- Barclays – Michael Harte, Chief Operations & Technology Officer
- Swisscom – Penny Schiffer, Senior Strategy Manager
- Juniper Networks – Jennifer Lin, Product Manager Senior Director
- Alcatel-Lucent – Gabrielle Gauthney, Executive VP, Global Government & Public Affairs, Guy Shemesh, Sr. Director, Cloud Solutions
- Unify – Joe Ziskin, Senior Vice President
- Virtual Clarity – Joe Peskin and Rens Troost.
- Lopez Research – Maribel Lopez
- Battery Ventures – Adrian Cockcroft
- Pfizer – Nelson Tai