

Networking Trends



Raj Jain

Washington University in Saint Louis

Saint Louis, MO 63130

Jain@cse.wustl.edu

Audio/Video recordings of this class lecture are available at:

<http://www.cse.wustl.edu/~jain/cse570-15/>



- ❑ Sources of Trends
- ❑ Processor, Storage, Clouds and Mobile Apps
- ❑ Cisco Visual Networking Index
- ❑ Gartner Hype Cycle 2014
- ❑ Google Trends

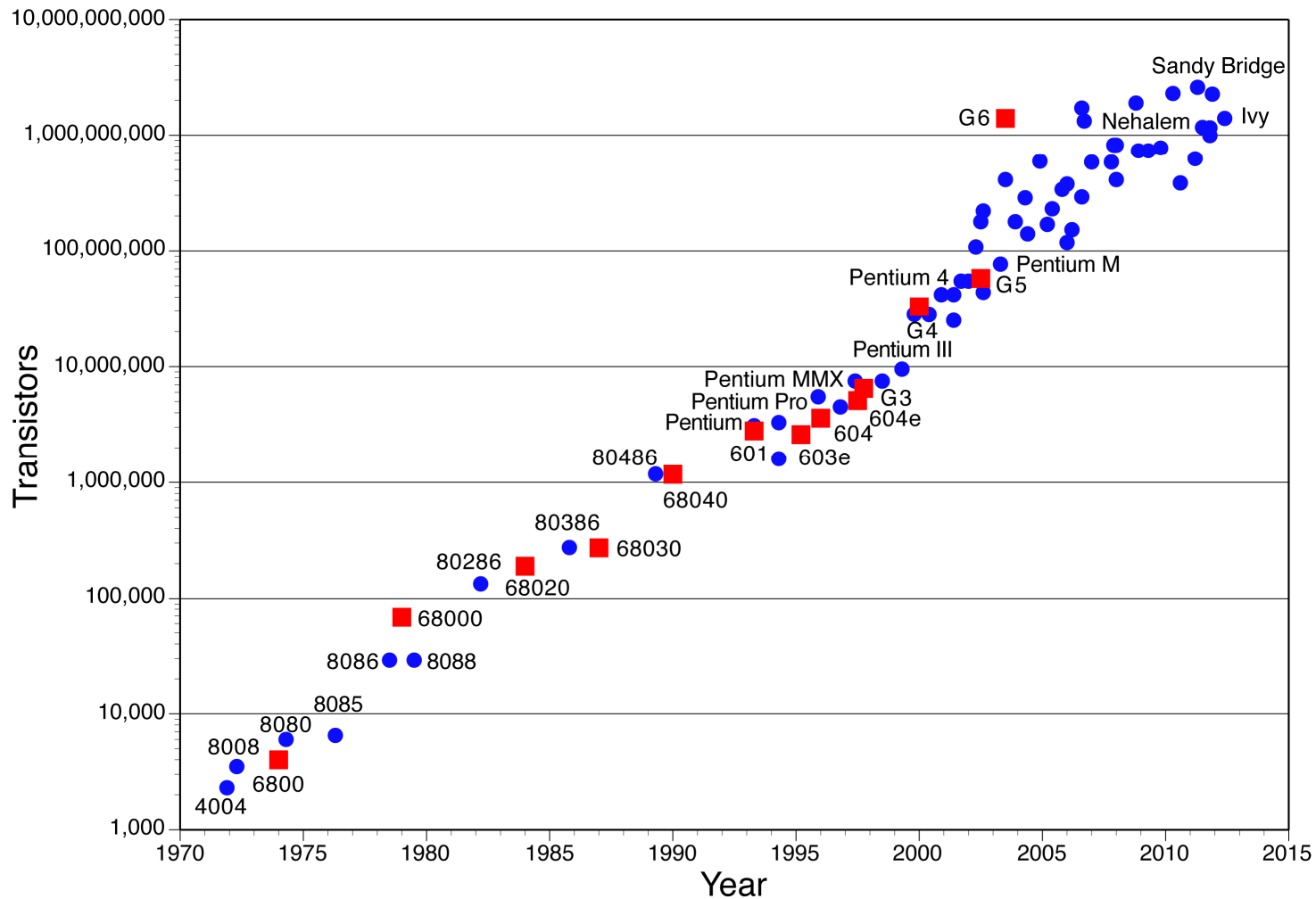
Sources of Trends

- ❑ Activities in technical industry organizations: IEEE, IETF, ITU
- ❑ NSF funding areas
- ❑ Venture capital investments
- ❑ Industry analytics companies like Gartner
- ❑ Google searches by people all over the world



“VCs have a herd mentality.”

Processor Growth: Moore's Law



Ref: https://www.reddit.com/r/askscience/comments/32f8us/did_moores_law_calculate_correctly/

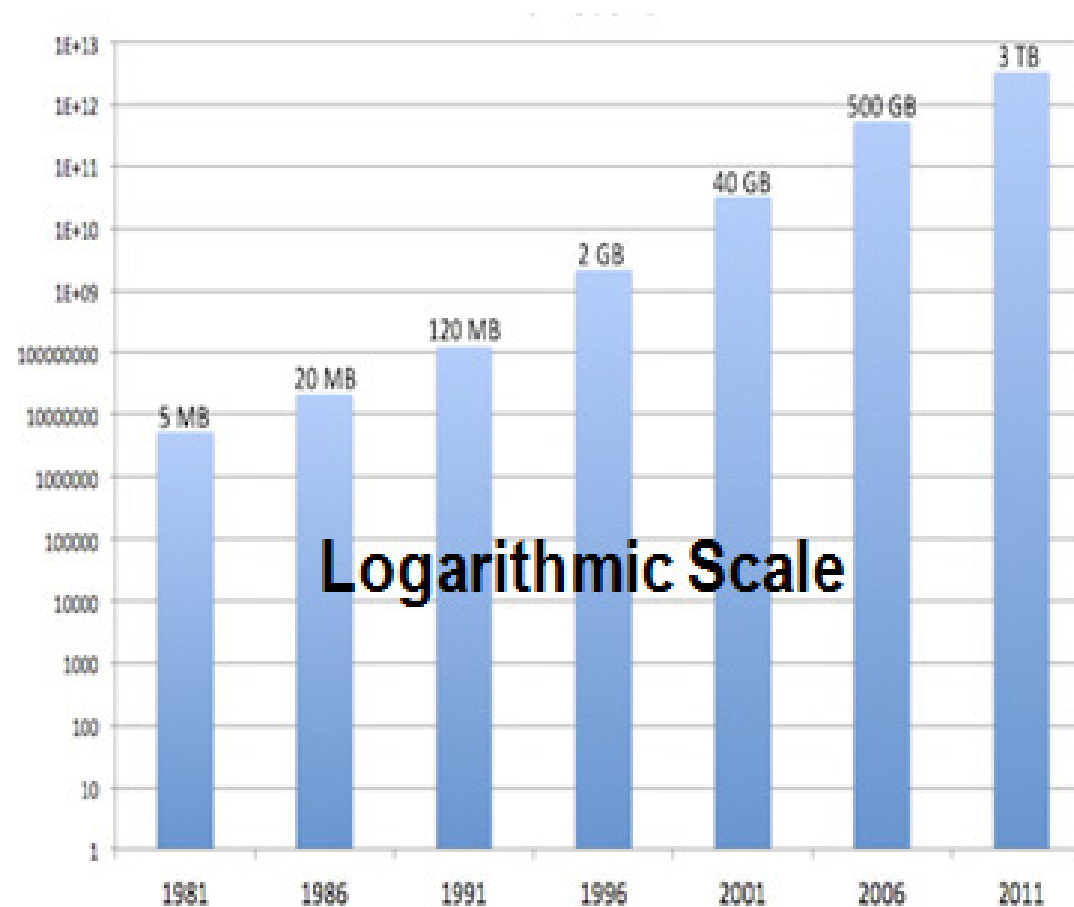
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Storage Capacity

□ PC hard drive size



Ref: <http://www.mhealthtalk.com/wp-content/uploads/2012/04/Storage-Capacity.jpg>

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Clouds and Mobile Apps

- ❑ August 25, 2006: Amazon announced EC2
⇒ Birth of Cloud Computing in reality
(Prior theoretical concepts of computing as a utility)
- ❑ *Web Services To Drive Future Growth For Amazon* (\$2B in 2012, \$7B in 2019)
- Forbes, Aug 12, 2012
- ❑ June 29, 2007: Apple announced iPhone
⇒ Birth of Mobile Internet, Mobile Apps
 - Almost all services are now mobile apps: Google, Facebook, Bank of America, ...
 - Almost all services need to be global (World is flat)
 - Almost all services use cloud computing



Networks need to support efficient service setup and delivery

Cisco Visual Networking Index

1. 2014 **mobile** data traffic was 2.5×10^{18} B/month.
30× the size of the entire global Internet in 2000 (75 PB/mth).
2. Mobile **video** traffic was more than 55% of the mobile traffic in 2014.
3. 7.4 B mobile devices and connections in 2014
26% of these devices and connections were “Smart Phones”
4. A **smart phone** generates 22× traffic of a non-smart phone.
5. **4G** connections generate 10× the traffic of a non-4G
6. 109 Million **wearable devices** in 2014 generating 15 PB/month
7. 46% of mobile traffic was **offloaded** through WiFi or femtocell
8. 27% mobile devices were potentially **IPv6** capable

Ref: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019, Feb 3, 2015,

http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.pdf

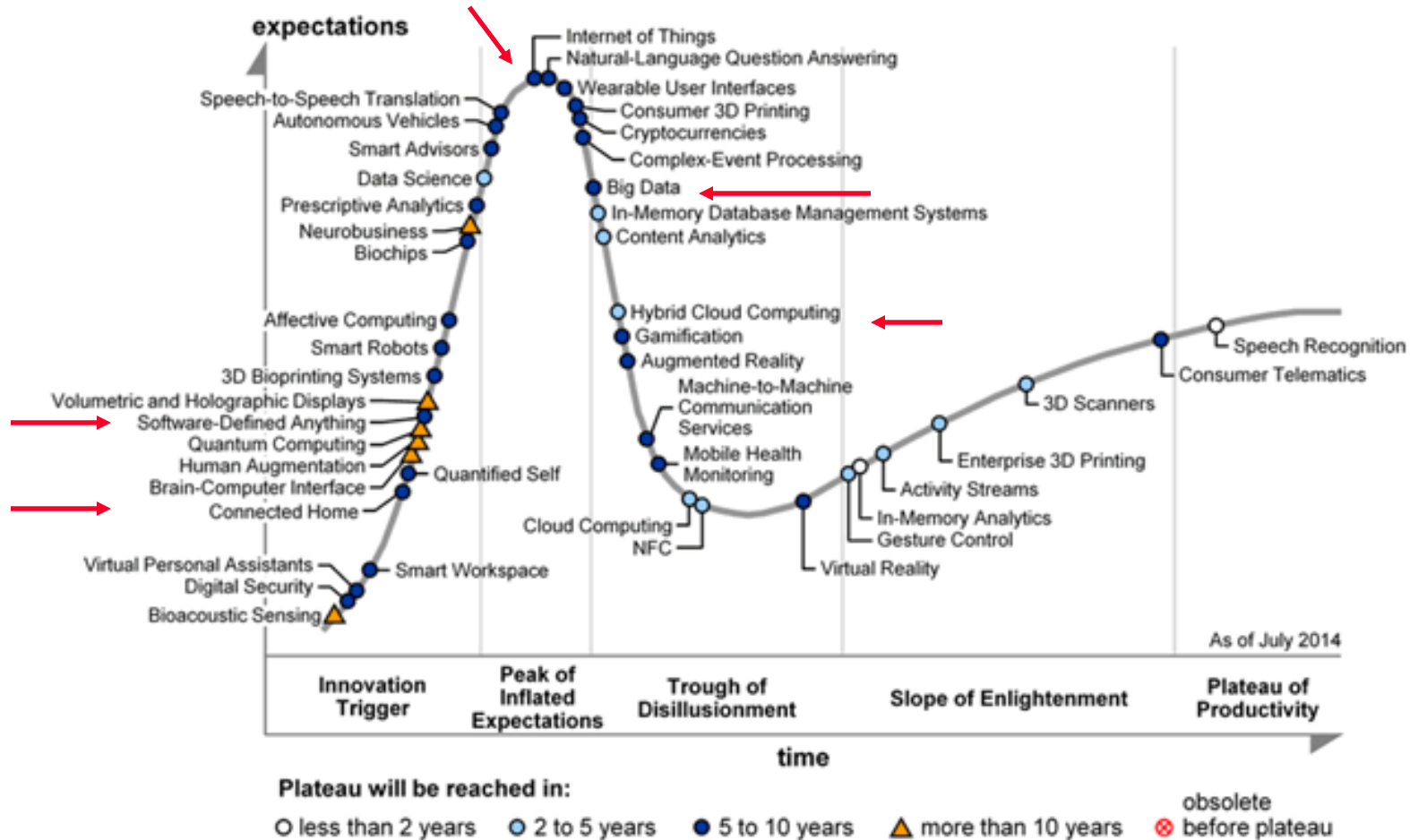
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Gartner Hype Cycle 2014

Gartner Hype Cycle for Emerging Technologies, 2014



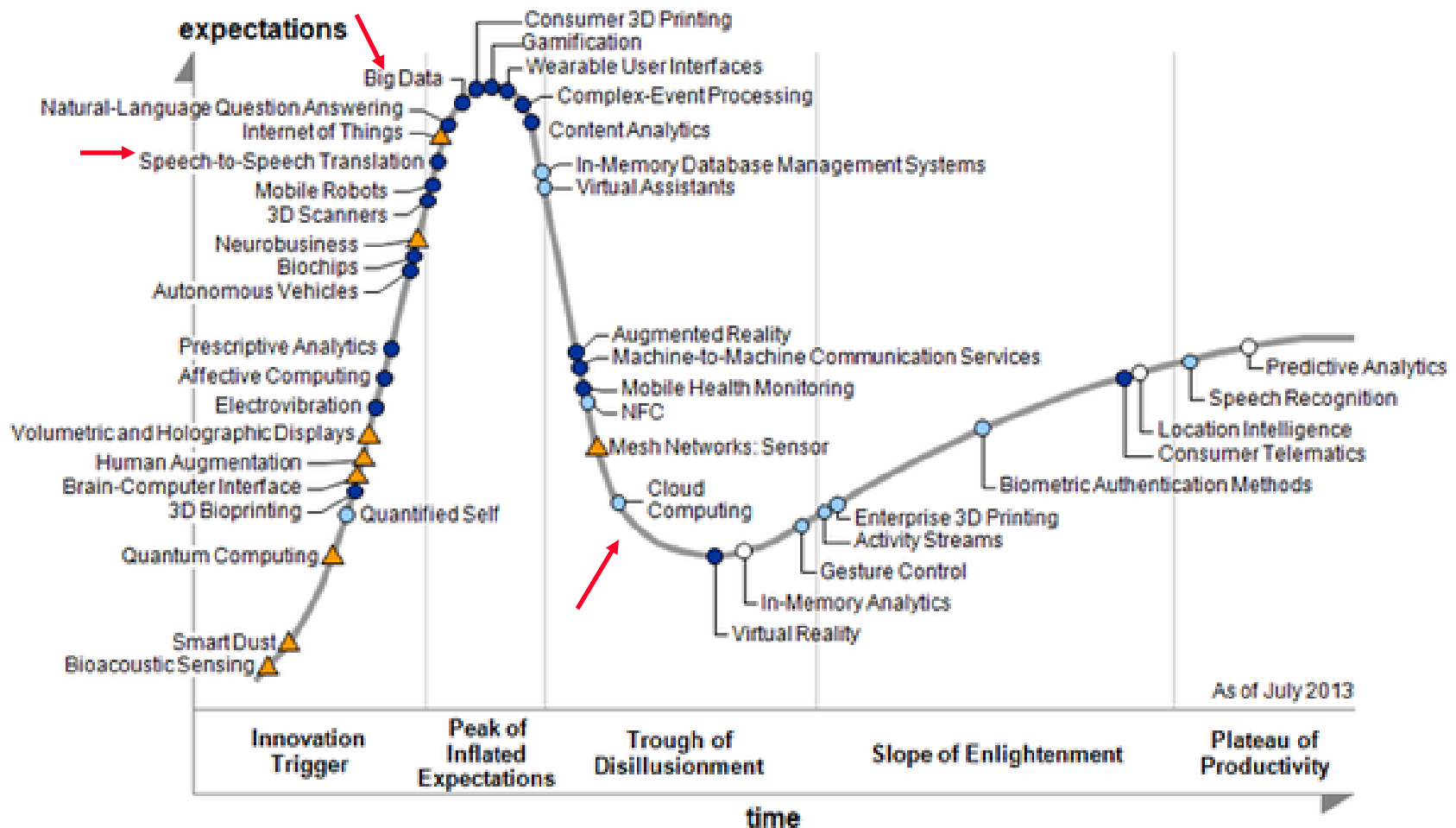
Ref: <http://www.forbes.com/sites/gartnergroup/2014/09/17/digital-business-technologies-dominate-gartner-2014-emerging-technologies-hype-cycle>

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Gartner Hype Cycle 2013



Plateau will be reached in:

○ less than 2 years ● 2 to 5 years ● 5 to 10 years ▲ more than 10 years ⊗ obsolete before plateau

Ref: <http://www.zdnet.com/gartners-2013-emerging-technologies-hype-cycle-focuses-on-humans-and-machines-7000019564/>

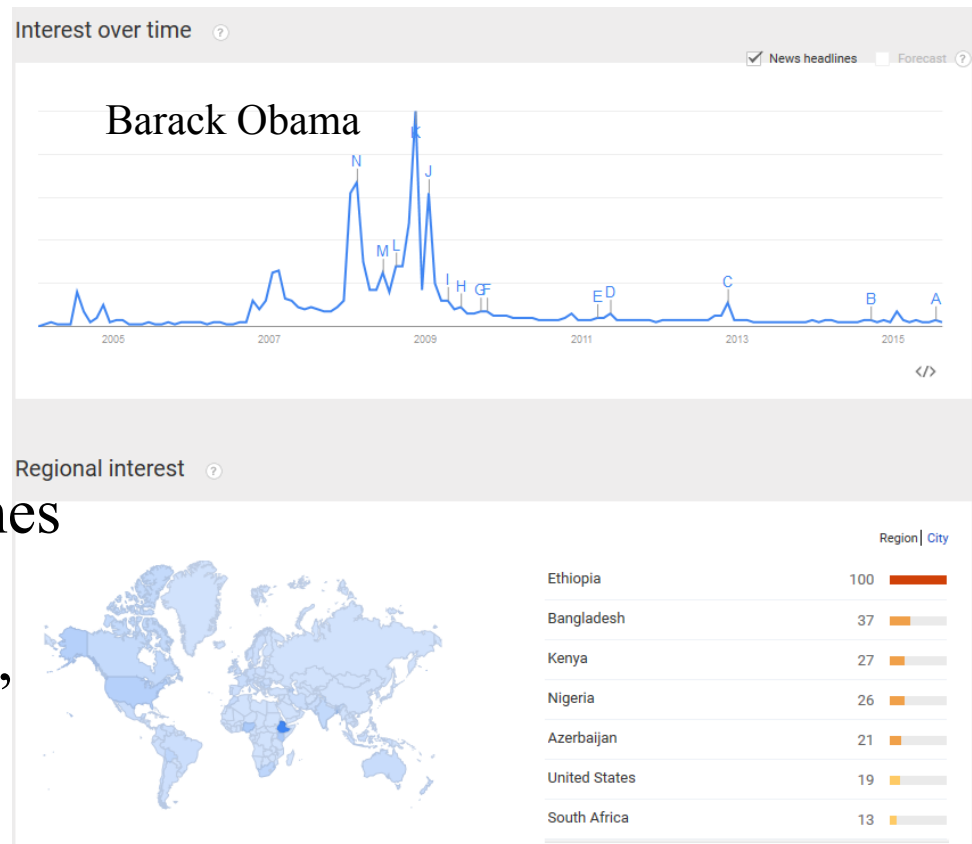
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What is Google Trends?

- ❑ A time series graph of number of searches on any term of your choice
- ❑ Scaled to 100%.
100=Maximum over time
- ❑ Includes geographical distribution of those searches
- ❑ Includes major news items
- ❑ Example: “Barack Obama”
K: Nov 2008 election
B: Nov 2012 election
Popular in Ethiopia



<https://www.google.com/trends/explore#q=barack+obama>

Google Trends and GDP

- ❑ Internet users from countries with higher GDP are more likely to search for future topics than about the past.
- ❑ Economic indicators are correlated to on-line behavior.

Ref: C. Johnston, "Google Trends reveals clues about the mentality of richer nations,"

<http://arstechnica.com/gadgets/2012/04/google-trends-reveals-clues-about-the-mentality-of-richer-nations/>

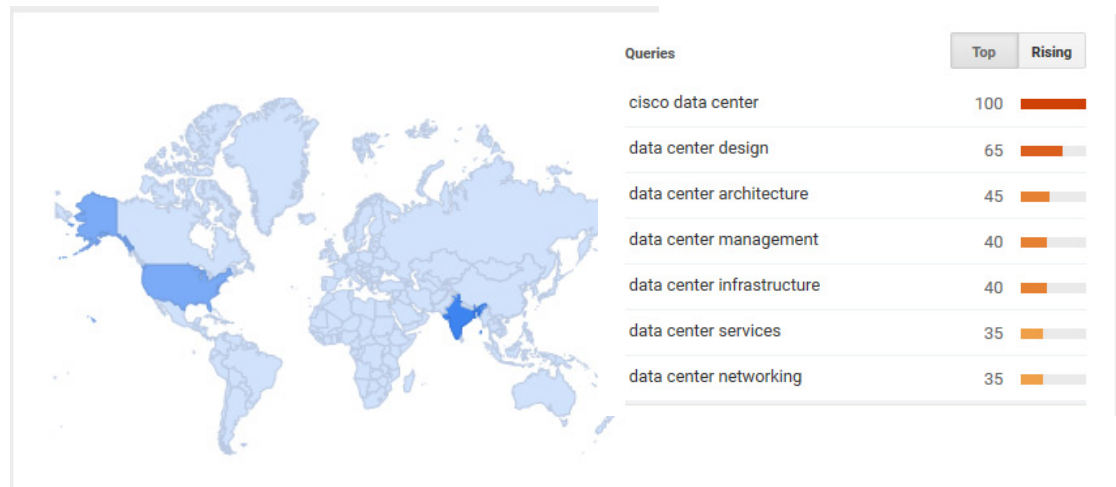
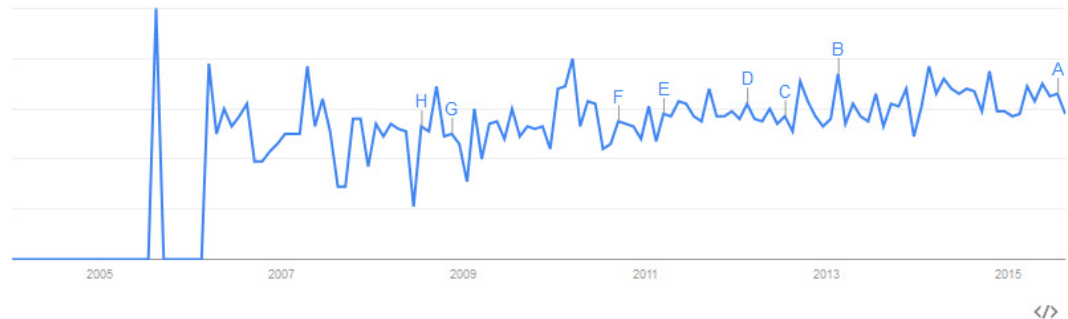
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Data Center Network: Google Trends

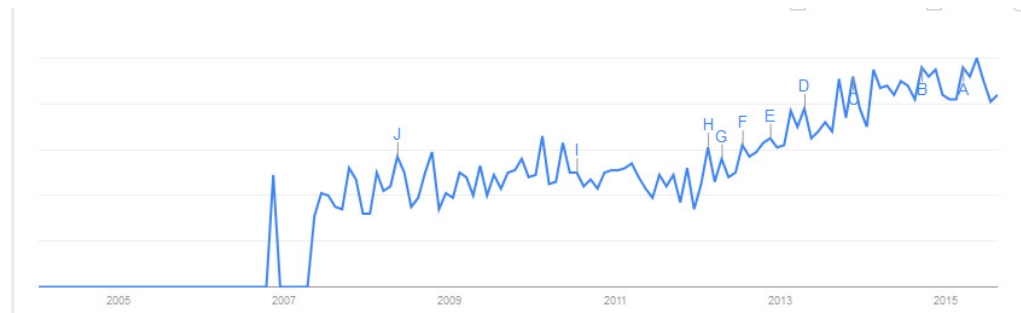
- ❑ Stable, Neither declining nor increasing
- ❑ Mostly in USA and India
- ❑ As much interest in Europe as in Africa
- ❑ USA and India are highly correlated probably because Indian IT industry services US companies



Snapshot: Aug 25, 2015

Network Virtualization: Google Trends

- ❑ Still before the knee
- ❑ Interest in USA, India



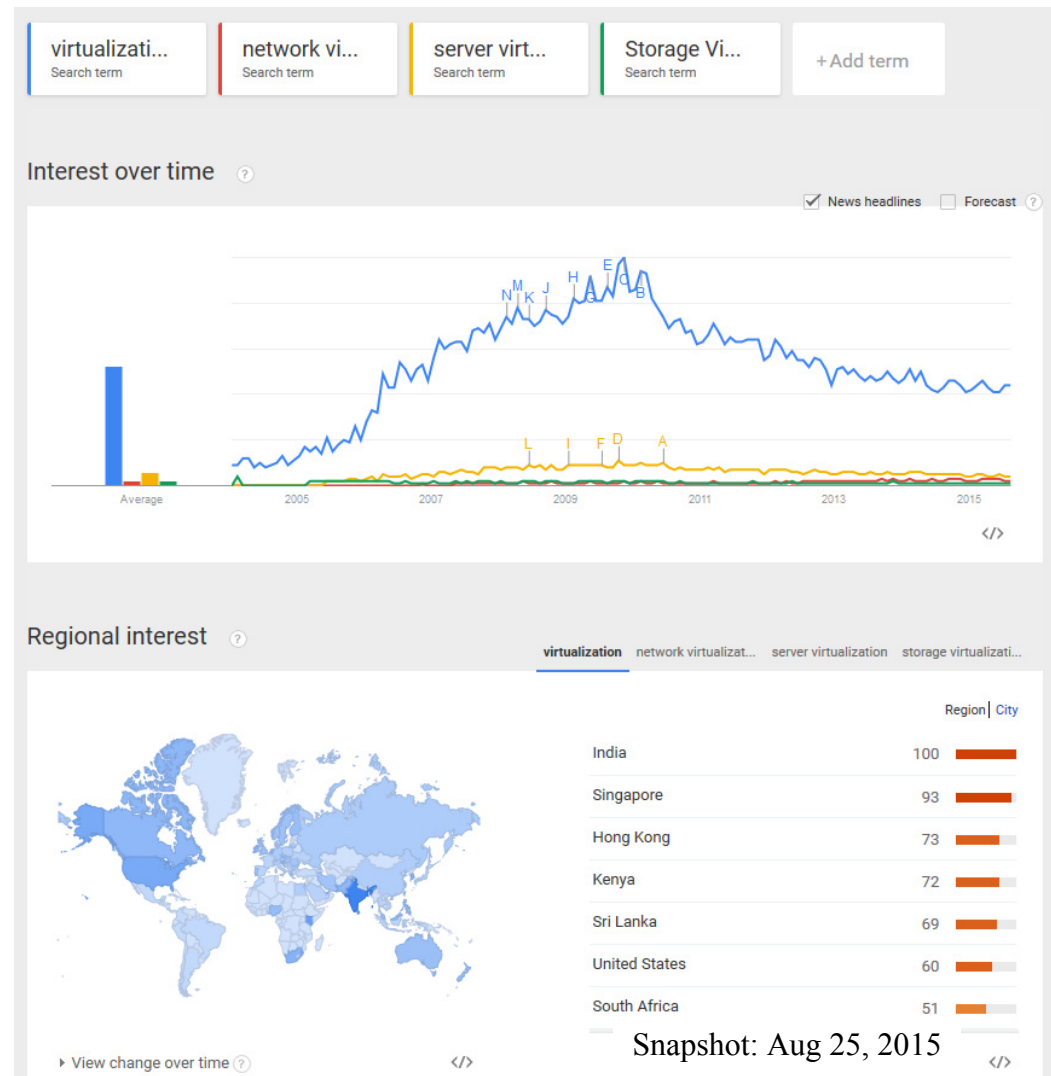
Queries

	Top	Rising
server virtualization	100	<div style="width: 100%;"></div>
vmware network virtualization	80	<div style="width: 80%;"></div>
vmware virtualization	80	<div style="width: 80%;"></div>
network function virtualization	65	<div style="width: 65%;"></div>
virtualization software	55	<div style="width: 55%;"></div>
what is virtualization	55	<div style="width: 55%;"></div>
storage virtualization	45	<div style="width: 45%;"></div>

Snapshot: Aug 25, 2015

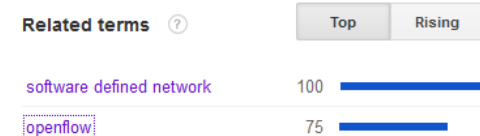
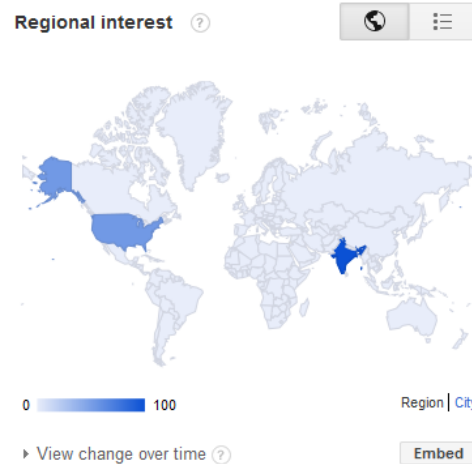
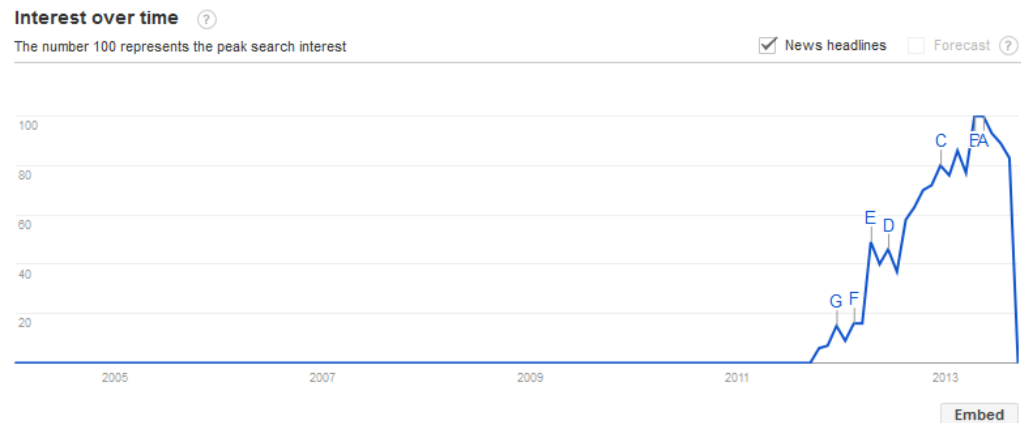
Virtualization: Google Trends

- Virtualization
 - Server
 - Storage
 - Network
- World is still learning about server virtualization



SDN: Google Trends

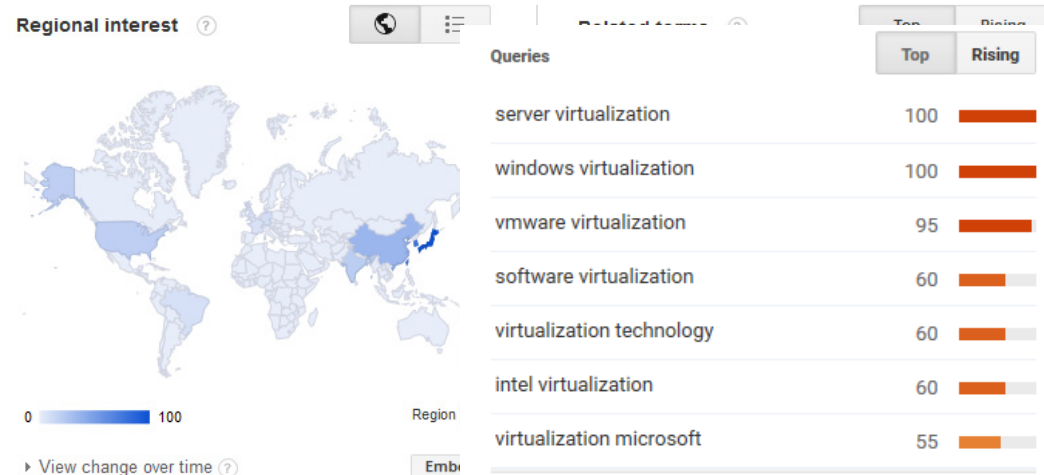
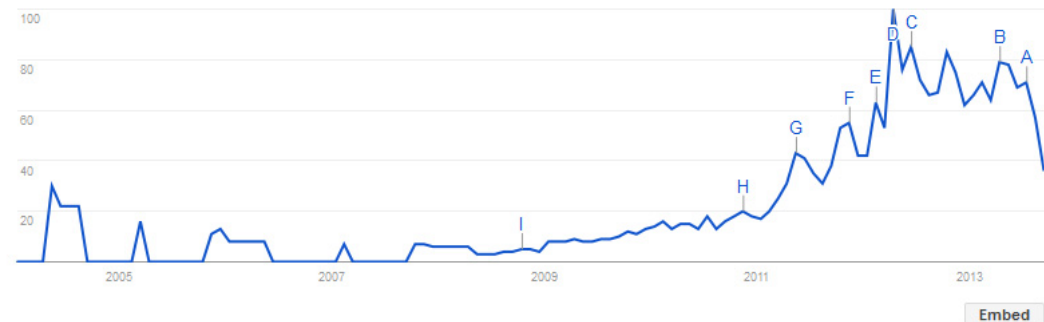
- Started May 21, 2011:
Open Networking Foundation formed
⇒ Announced
standardizing
OpenFlow
- Mostly USA and India
- Software defined networking, Software defined network, SDN have slightly different trends



Snapshot: Aug 25, 2015 Embed

OpenFlow: Google Trends

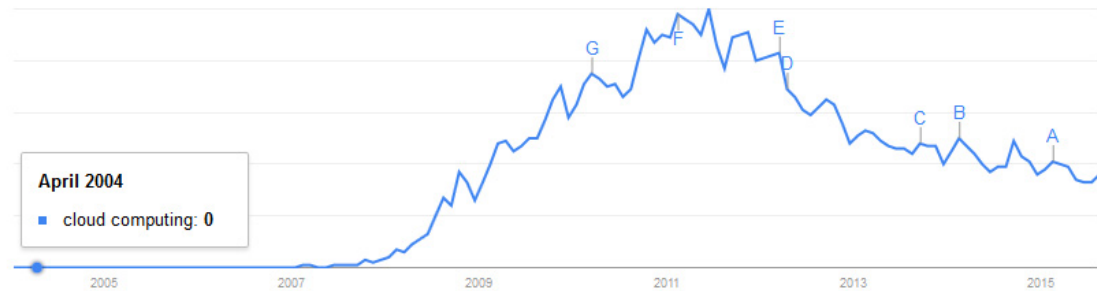
- ❑ Started April 2004
- ❑ Past the peak
(Everyone who needs to know knows)
- ❑ Peak at Open Networking Summit
(D: April 2012)
- ❑ High interest in Japan, Korea, Taiwan
- ❑ Some interest in China



Snapshot: Aug 25, 2015

Cloud Computing: Google Trends

- ❑ Past-Hype phase
As in Gartner graphs
- ❑ Mostly in India



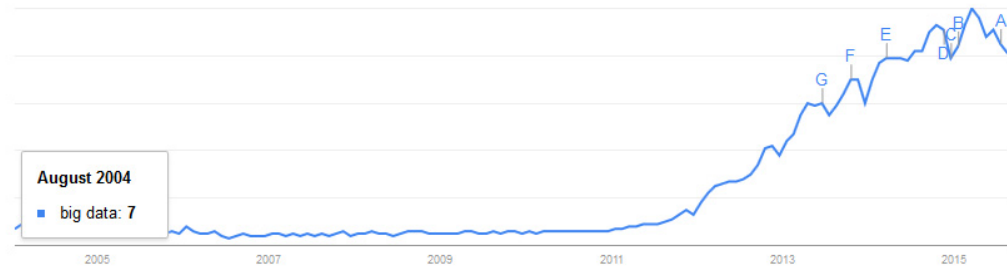
Queries

	Top	Rising
what is cloud	100	<div style="width: 100%;"></div>
the cloud	70	<div style="width: 70%;"></div>
google cloud	45	<div style="width: 45%;"></div>
google cloud computing	45	<div style="width: 45%;"></div>
cloud computing ppt	35	<div style="width: 35%;"></div>
cloud computing pdf	35	<div style="width: 35%;"></div>
cloud security	35	<div style="width: 35%;"></div>

Snapshot: Aug 25, 2015

Big Data: Google Trends

- Near the peak
- Knee on March 27, 2012 (Point G): Obama goes big on big data. Federal agencies host a webcast outlining their plan for big data.

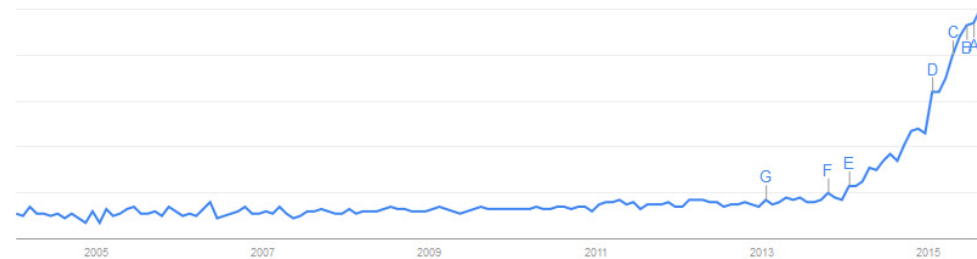


Queries	Top		Rising	
	Value	Progress	Value	Progress
big data analytics	100	██████████		
data analytics	95	██████████		
hadoop big data	70	██████████		
hadoop	70	██████████		
google big data	35	██████████		
big data pdf	25	██████████		
dangerous big data	25	██████████		

Snapshot: Aug 25, 2015

IoT: Google Trends

- ❑ Still before the knee
- ❑ High interest in South Korea, Taiwan, Vietnam



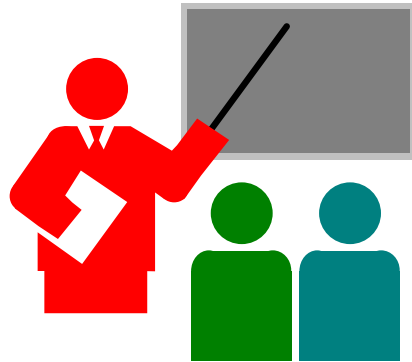
Queries	Top		Rising	
	Score	Bar	Score	Bar
internet of things	100	██████████		
windows iot	90	██████████		
windows 10 iot	60	██████████		
iot joinville	55	██████████		
iot passo fundo	55	██████████		
google iot	55	██████████		
what is iot	50	██████████		

Snapshot: Aug 25, 2015

Other Trends

- ❑ IT/Network Automation
- ❑ Open Networking
- ❑ Mobility
- ❑ Security
- ❑ Analytics
- ❑ Containers – Docker
- ❑ DevOps: Developers and Operational personnel cooperation

Summary



1. Google trends is an interesting easy way to find world interest on a topic of your research interest
2. Gartner hype cycle, Google trends, and Standards activities seem highly correlated
(Does Gartner look at Google trends before publishing their graphs? It would be unwise not to.)
3. IoT is at the peak. Cloud is main stream.
Network virtualization, SDN are just beginning.
4. All forecasting is based on the past \Rightarrow Continuous.
Real future is invented \Rightarrow Discontinuous

Reading List

- ❑ Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014-2019, Feb 3, 2015, http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.pdf

Acronyms

- ❑ EC European Continent
- ❑ GDP Gross Domestic Product
- ❑ IEEE Institution of Electrical and Electronics Engineers
- ❑ IETF Internet Engineering Task Force
- ❑ IoT Internet of Things
- ❑ IT Information Technology
- ❑ ITU International Telecommunications Union
- ❑ NSF National Science Foundation
- ❑ PB Peta Byte
- ❑ PC Personal Computer
- ❑ SDN Software Defined Networking
- ❑ VCs Venture Capitalists
- ❑ WiFi Wireless Fidelity