Συστήματα Υπολογιστών (Computer Systems)

Άγγελος Μπίλας, Καθηγητής
Πανεπιστήμιο Κρήτης και ΙΤΕ-ΙΠ
bilas@csd.uoc.gr

Computing infrastructure

- Typically PCs on desks
- No more! Instead:
- Small – mobile
- Large
  - Datacenters

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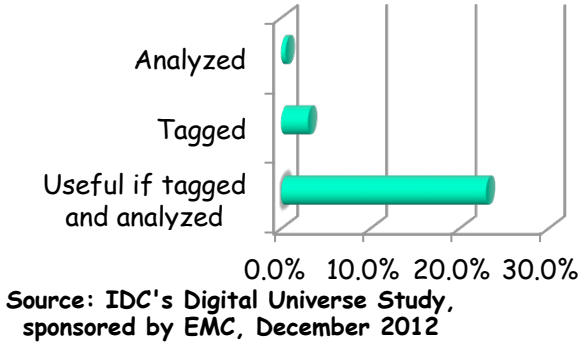
Small devices (embedded)

- Access points
  - People, appliances, sensors
  - Machine2machine
- An interface between digital and physical world
- Need a lot of processing, memory, storage, communication
  - A simple mobile device much more powerful than the computers used by NASA to go to the moon
  - GBytes of memory, 10s Gbytes storage, Gbit speeds, many cores
  - Need more and more…
- But: Limited by energy / battery
- Goal: Performance at certain power

Devices generate a lot of data

- Most actions consume but also generate data
  - Every minute: 300H video
  - Machine2machine
- Data requires processing
  - Processing happens on servers
- How much information?
  - How much processing?

Phenomenal rate of data growth



Source: IDC's Digital Universe Study, sponsored by EMC, December 2012

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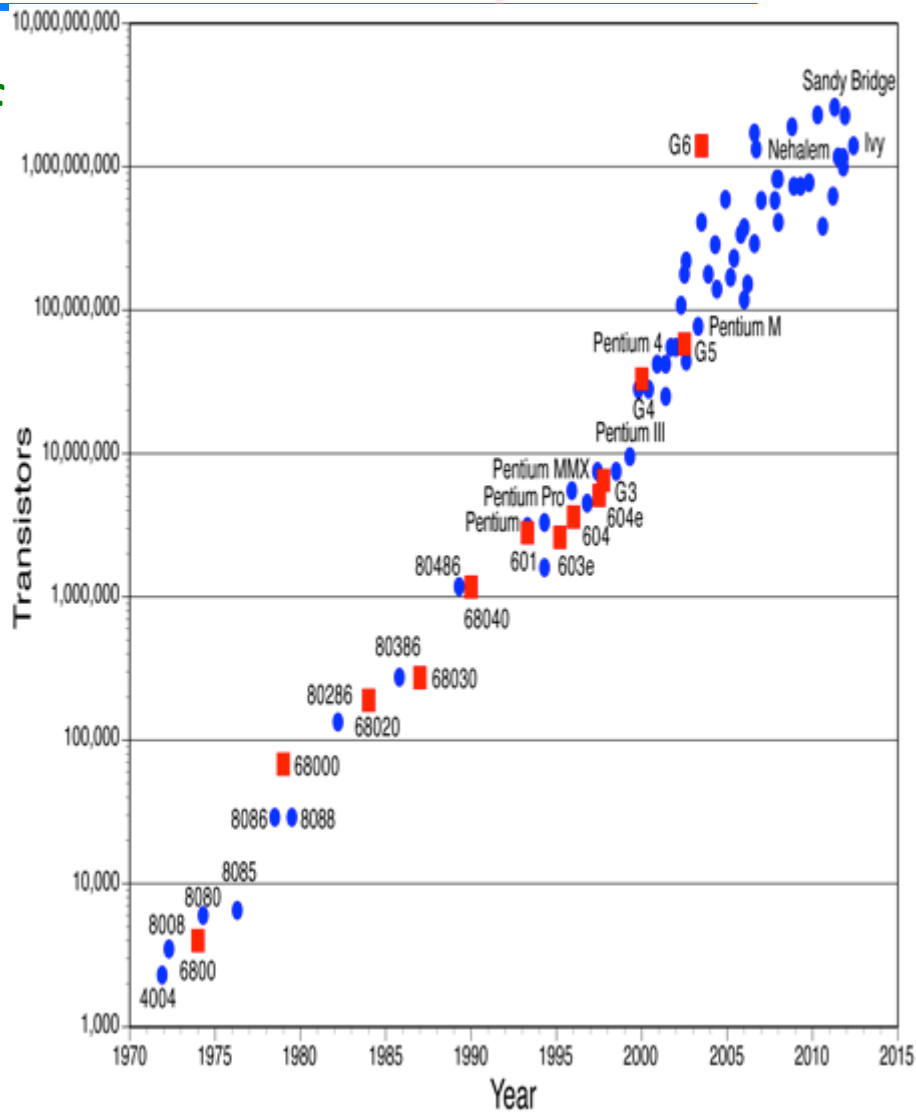
- Data grows at more than 2x/2 years
  - By 2020, 4x more data (today ~10 ZB, by 2020 ~40 ZB)
- Only 0.5% is analyzed today
  - Today, 23% of data is valuable
  - Need to process 50x more data
- In total, 200x more processing by 2020

Better servers (2x / 18months)

- Systems get better because of technology
  - E.g. faster clocks or more cores
- How much better?
  - Roughly 2x faster every ~18 months
  - Gordon Moore in the 70s
- Assuming this will continue
  - It will require a lot of research and engineering
- By 2020 systems will be ~4x faster
  - Still missing 50x improvement



Use more servers (2x / 2years)

- Let's buy more servers
  - "If we need more cars, let's build them"
- Problem
  - 1. High cost – capital and operational
    - Not possible to increase by 50x datacenters
  - 2. We cannot feed them with electricity (power)
    - Typically today we place servers in data centers
    - A typical DC = electricity of a town (1000 people, 10 MW)
    - Limited by power and latency to users
- Let's say we can have 2x new DCs by 2020
  - Still left with a factor of 25x or so

Challenge ahead (in Computer Systems)

- Achieve additional ~25x improvement in ~4years
  - "More than Moore" era - exciting for computer systems
  - Impact on society: work, entertainment, social, science
- Direction 1: Increase server utilization
  - Systems today are not utilized as much they should
  - E.g. one person/bus – need to run more apps per server
- Direction 2: Embrace customization
  - All vehicles the same – in fact, closer to planes
  - Need to start customizing computers for different tasks

Systems Software

- Software that controls resources
- Central role in this transformation

Interest from Industry (chronological)

- Important problems in EU and the world
- The last few years a lot of interest from industry
- **Local presence**
- OnApp
  - Virtualization, cloud management infrastructure
  - Development office in Heraklion
- Neurocom
  - Telecom analytics
  - Development office in Heraklion/STEP-C
- IOFabric
  - Datacenter storage
  - Startup company in North America
  - Development office in Heraklion/STEP-C
- Catalyst in all cases
  - Expertise of people in our environment

Thank you!