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A View into Mobile Communications in 2030

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Outline

- The past of other technologies.
- Putting applications into the context of systems and networks.
- Extrapolating to Mobile & Wireless Comms.
- Conclusions.

Learning from PCs (1)

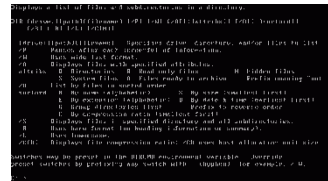
- Mainframes dominated, until PCs took over when computers were extended to the mass market.
- An operating system based on windows had a crucial importance in the spread of PCs.
- Easiness of use is essential for the mass market!



(IBM, 1972)



(Apple, 1986)



(Wikipedia, 1972)



(Microsoft, 2007)



(PhotosCom, 2008)



(Nokia, 2007)

Learning from PCs (2)

- Initially, PCs had performance metrics that were orders of magnitude below the current ones (ZX Spectrum, 1982, 3.5 MHz, 16 kB, 0 GB).
- There's a race in wireless systems between services made available to users and data rates made available by terminals/networks!



(Sinclair, 1982)



(Nadine Meade, 2000)

Learning from Cars

- In the beginning, the goal was for faster cars.
- Then, cars evolved for increased comfort and safety of passengers.
- Nowadays, cars are being sold for energy efficiency.
- Speed is no longer important!



(T Ford, 1927)



(BMW, 1978)



(Lexus, 2008)

Learning from Pens

- Writing began with feathers or sticks.
- In the 19th century, metal point pens start being used.
- Then, BIC introduced the ball point pen, and it became nearly worthless.
- But, Montblanc is well know for their luxury pens.
- There are many other examples (e.g., watches) of transforming ordinary products and services into luxury ones!



(Sutori, 2019)



(PenMarket, 2019)



(BIC, 2019)



(Montblanc, 2019)

Terminals

- Terminals are varied, serving different usages and services:



(BigCircle, 2012)



(Apple, 2014)



(techclones, 2013)



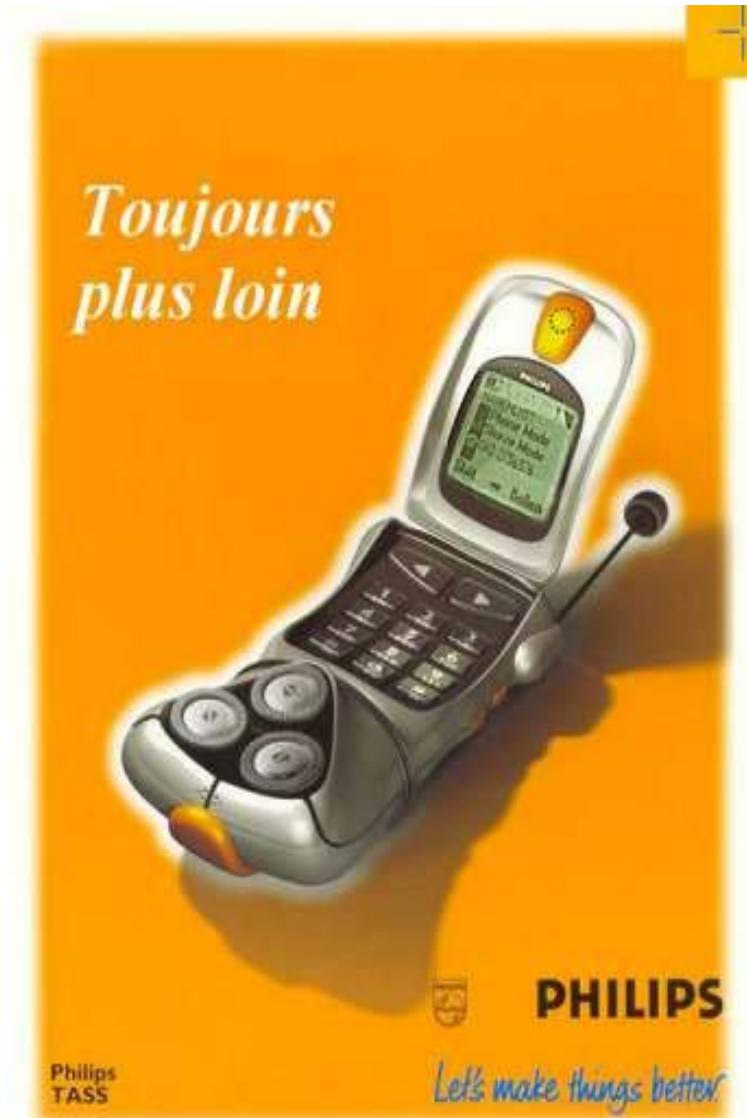
(tomsguide, 2013)



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More Terminals

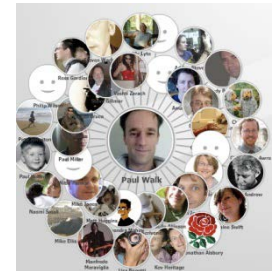


What services? (1)

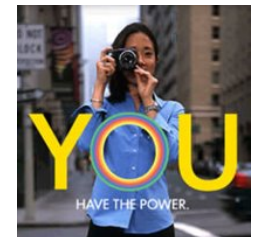
- Mobile 3D Internet:
visualisation of 3D images from a terminal.
- Real-time ad hoc communities:
extending social networks into happenings on the spot.
- Prosumers:
users playing a decisive role as producers and consumers of contents.



(BuilderAU, 2008)



(FutureLab, 2008)



(enriquedans, 2006)

What services? (2)

- Context aware mobile web:
physical and social awareness of users' experience.
- Interactive context aware games:
games adapted to the user's physical environment.
- Augmented and virtual reality:
addition of real and combination of virtual information to real life objects.



(DanceInternational, 2005)



(UniversalStudios, 2007)



(Spectrum, 2008)

Information Access

- The paperless society will have a huge impact on networks:
 - media is being consumed in portable devices;
 - daily commuters will need a lot of information on an instantaneous basis.
- Networks need to be prepared to carry enormous amounts of information in an efficient way!



(Apple, 2010)



(musingsfrommedway, 2010)

Location Awareness

- Location based services are being introduced these days, upon user demand.
- The opposite is being introduced as well, i.e., the environment being aware that the user is present.
- Networks needs to take advantage of terminals as sensors, so that knowledge about channel quality, user behaviour, etc., is used!



(Unwired, 2007)



(Minority Report, 2002)

Internet of Things

- Today's systems are still based on a person being the end user.
- Future systems are considering machine-to-machine communications as being, potentially, more important.
- Sensor networks are emerging as one of the “killer” network structures of the future.
- Differentiation between human and machine traffic is essential!



(Kenwood, 2007)



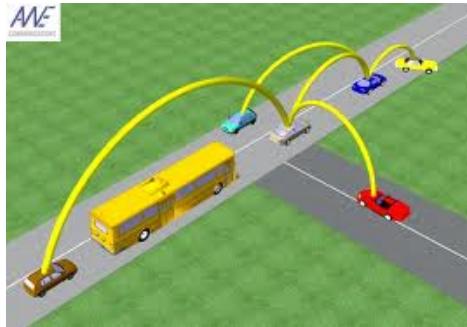
(DHD, 1998)



(SensorProd, 2007)

Vehicular Communications

- Vehicular communications are a major area under development:
 - vehicle-to-vehicle;
 - vehicle-to-infrastructure.



(awe, 2011)

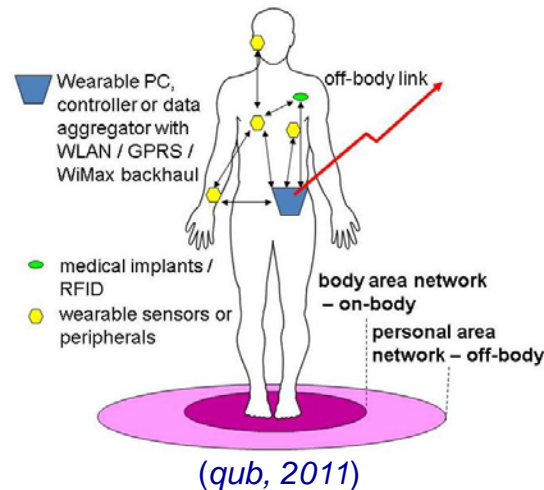


(car2car, 2008)

- Vehicles need to be looked at as terminals (e.g., multiple antennas)!
- The services on vehicles vary quite a lot!

Body Area Networks

- Several BAN application scenarios are envisaged.



- Medical applications are the usual foreseen ones, but well-being, assisted living, and entertainment put a lot of many different requirements!

Current Technology (1)



(Burton/Motorola, 2006)

Current Technology (2)



(Nike/Apple, 2006)

Current Technology (3)



(Voltaic Systems, 2006)



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Current Technology (4)



(Ermenegildo Zegna, 2009)

Smart Cities

- Smart Cities are getting a lot of attention lately, encompassing:
 - Public information and training
 - Emergency warnings
 - Health, inclusion and assisted living
 - Intelligent Transportation Systems
 - Environment, Energy Efficiency, and Smart Grids.
- The list of potential applications is endless, as is the variety of requirements!



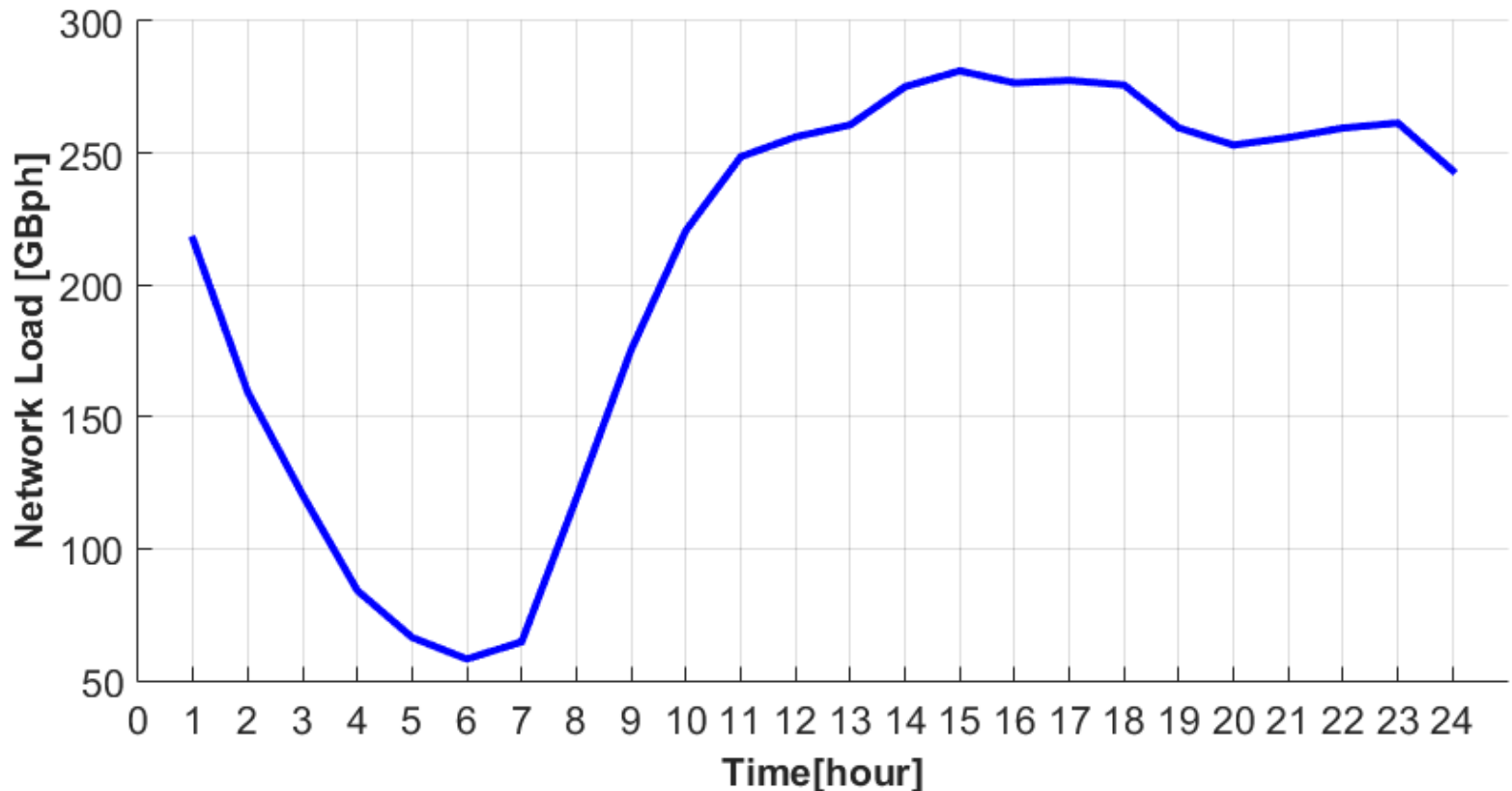
(colourdesign, 2010)



(photoaki, 2010)

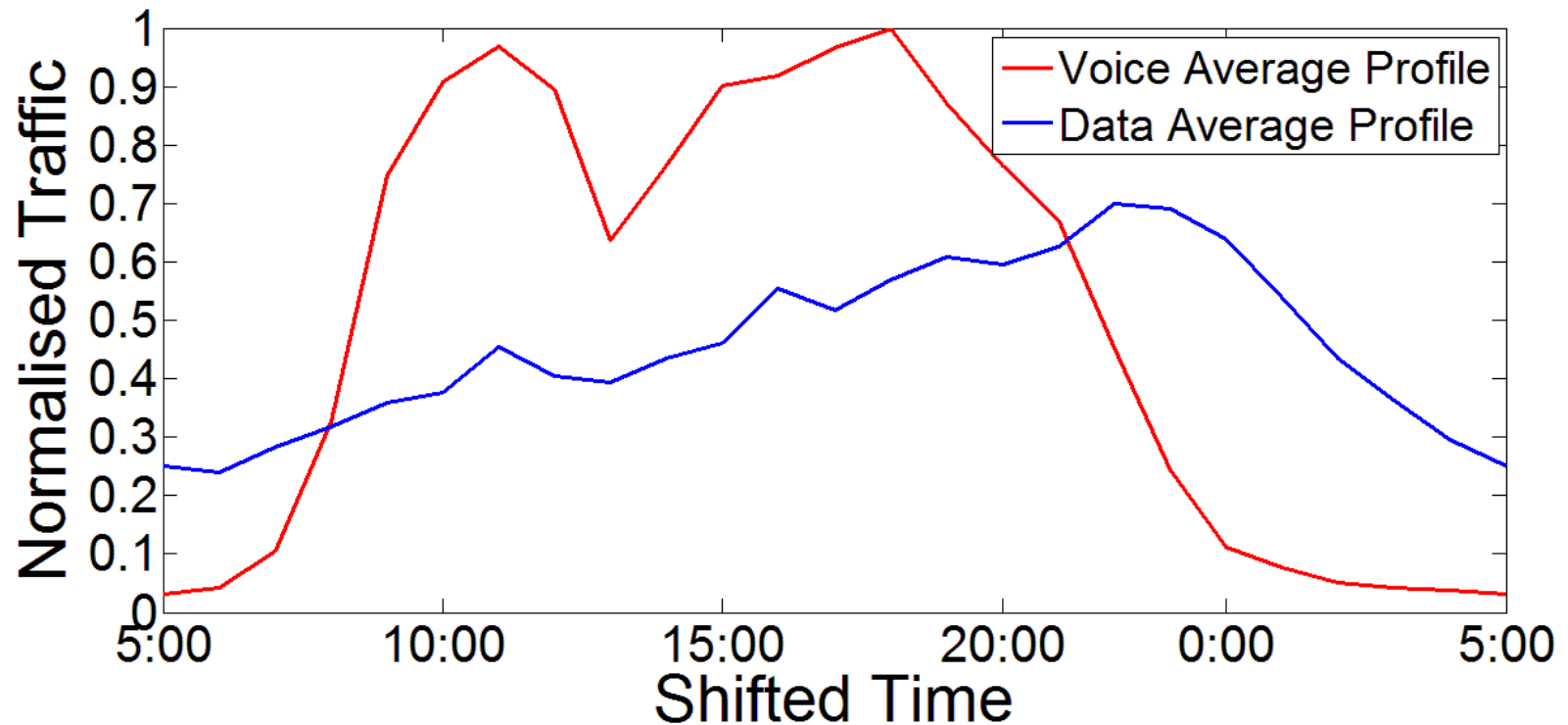
Human Service Usage (1)

- Network deployment and management need to take advantage of human service usage, which is very much associated with daily activities.



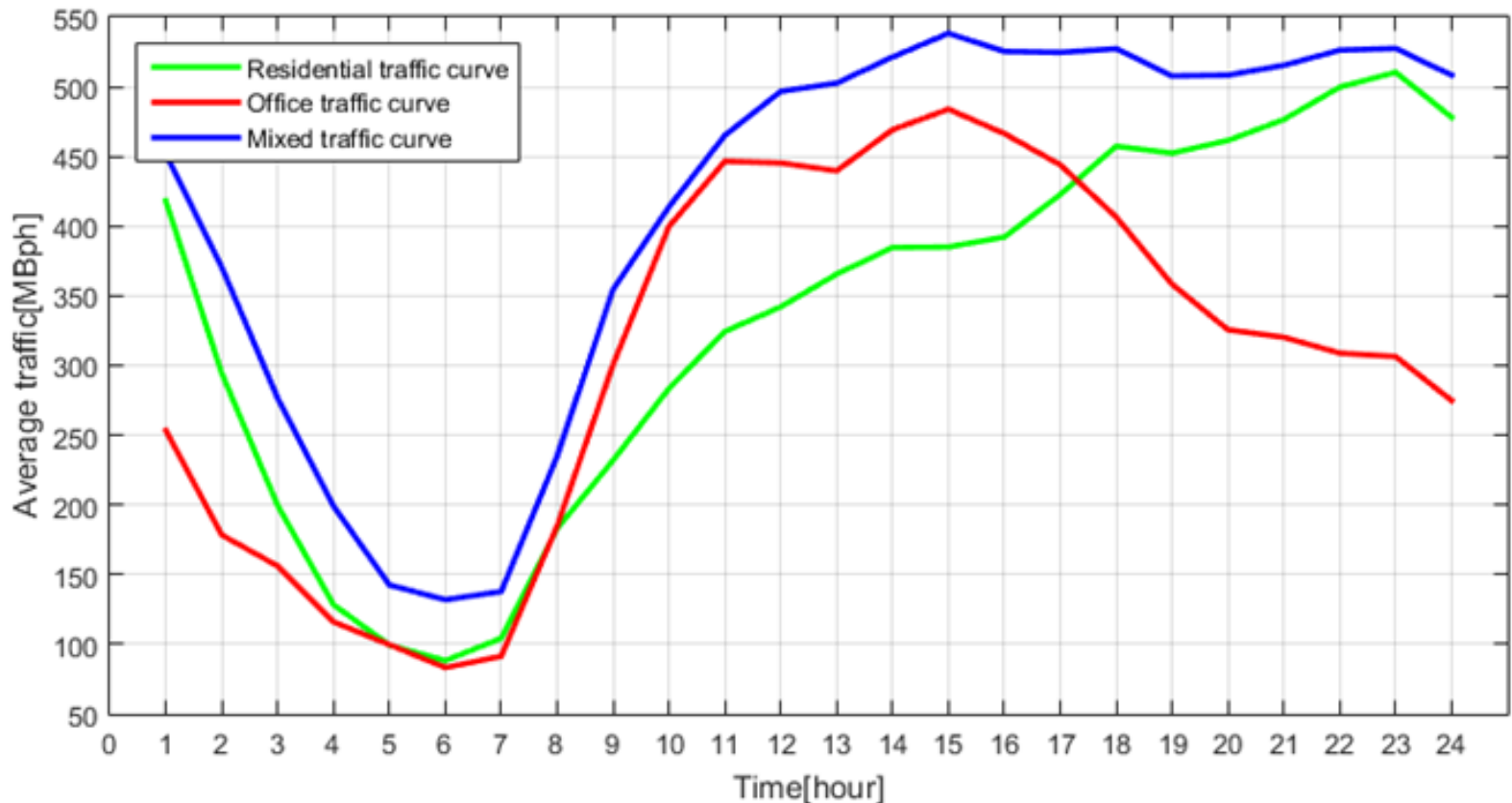
Human Service Usage (2)

- There is a different variation of voice and data traffic along the day.



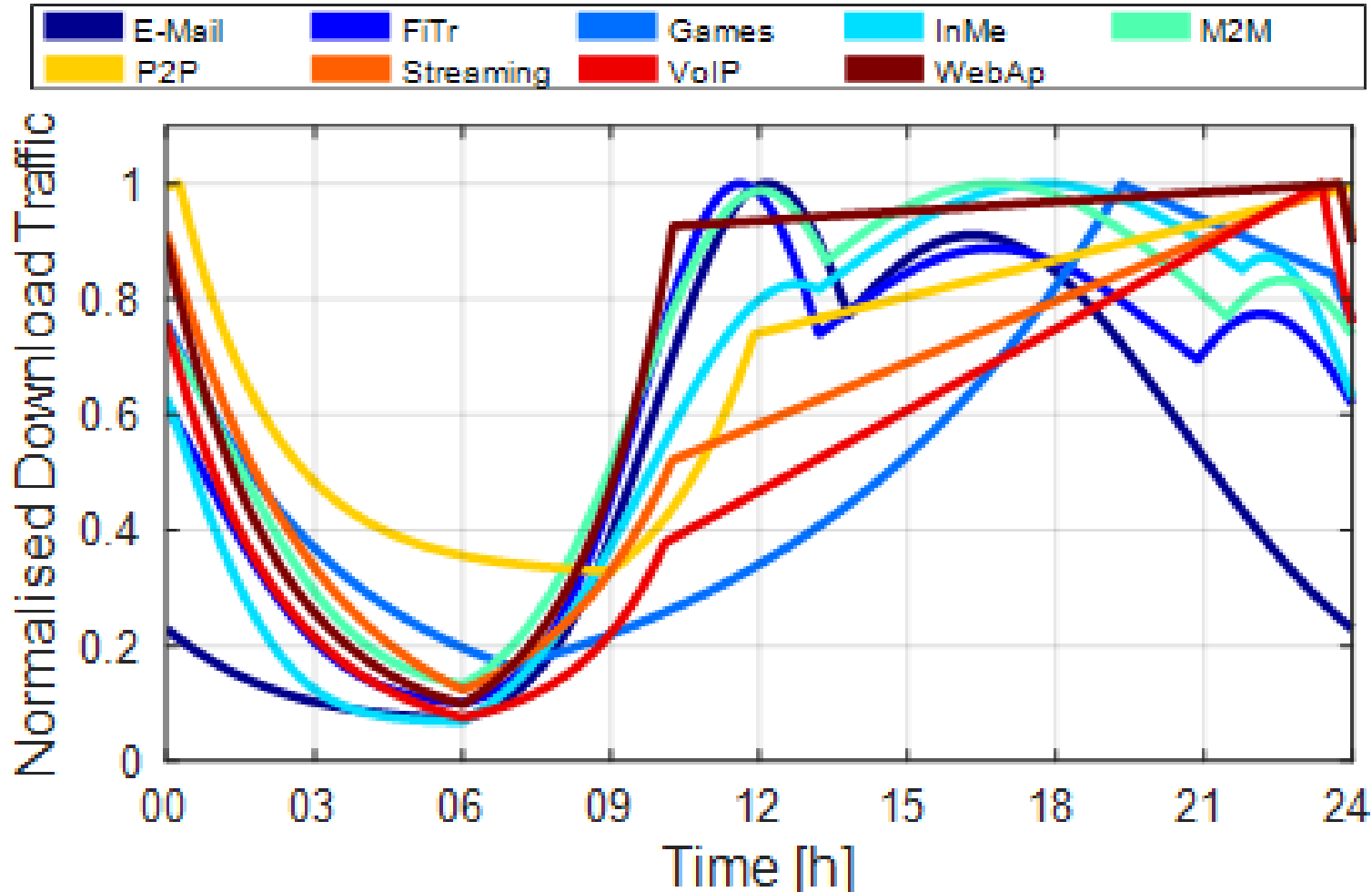
Human Service Usage (3)

- The type of urban occupation also has influence on the daily variation of traffic.



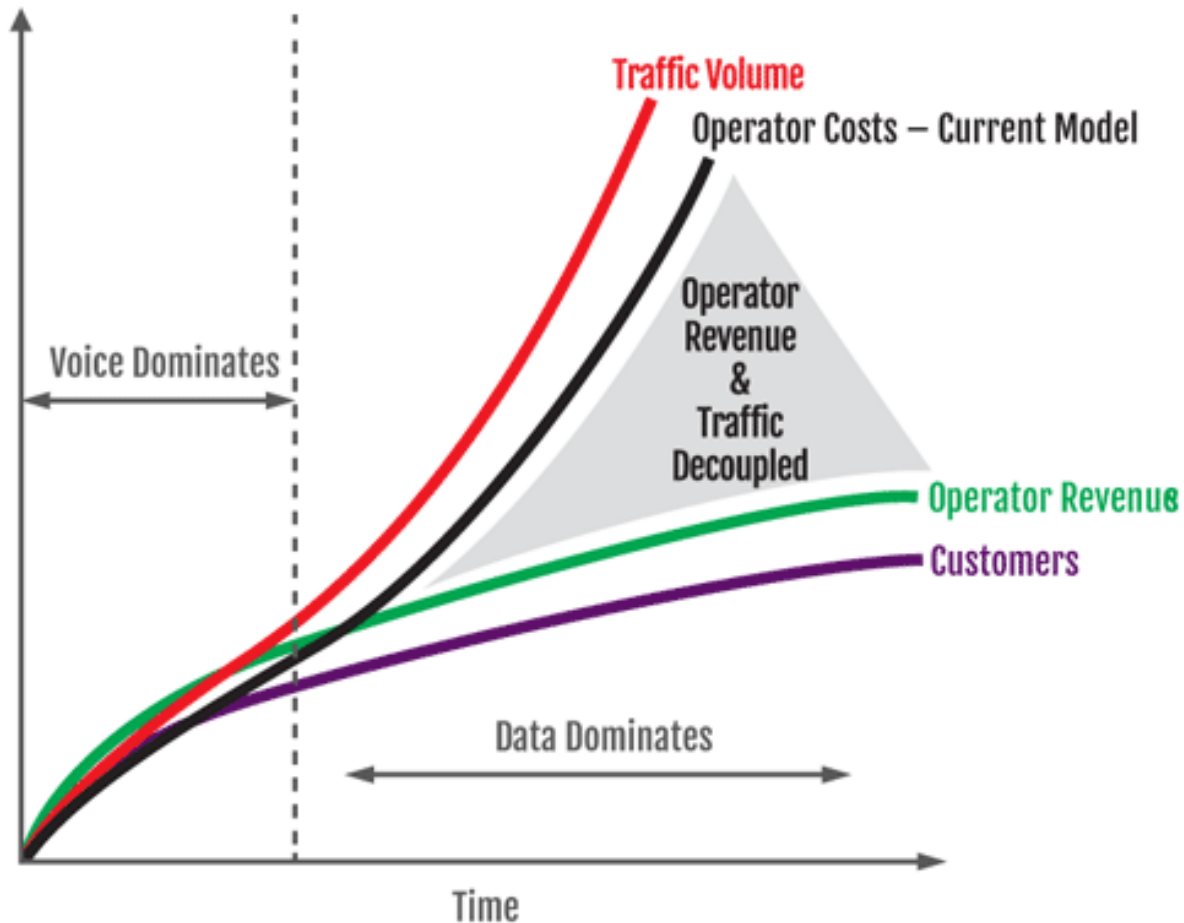
Human Service Usage (4)

- The various data services have a different usage.



Operators' Key Problem

- How to “break the laws of physics”?



Current Perspective

- Today's wireless systems are still very much used in the perspective of "one size fits all".
- We're no longer in the era of voice centric networks, hence, service differentiation must be used.



(AutomationClerc, 2013)

Which Perspective?

- The Olympic Games motto applied to current systems (i.e., more of the same, but just better), is a too shortfall goal.
- Now, more than ever, one should have a disruptive view of the future.



~~*Citius*
Altius
Fortius
(Faster
Higher
Stronger)~~

Another Perspective

- John F. Kennedy's perspective:
"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth." (1961/May/25)



(NASA, 1961)

- The next generation Mobile & Wireless Comm. systems and networks could be designed from (generalised) users goals, and not from the evolution of current ones.

The Goal in a Generation!?

Availability?

Intelligence?

Terminal Sharing?

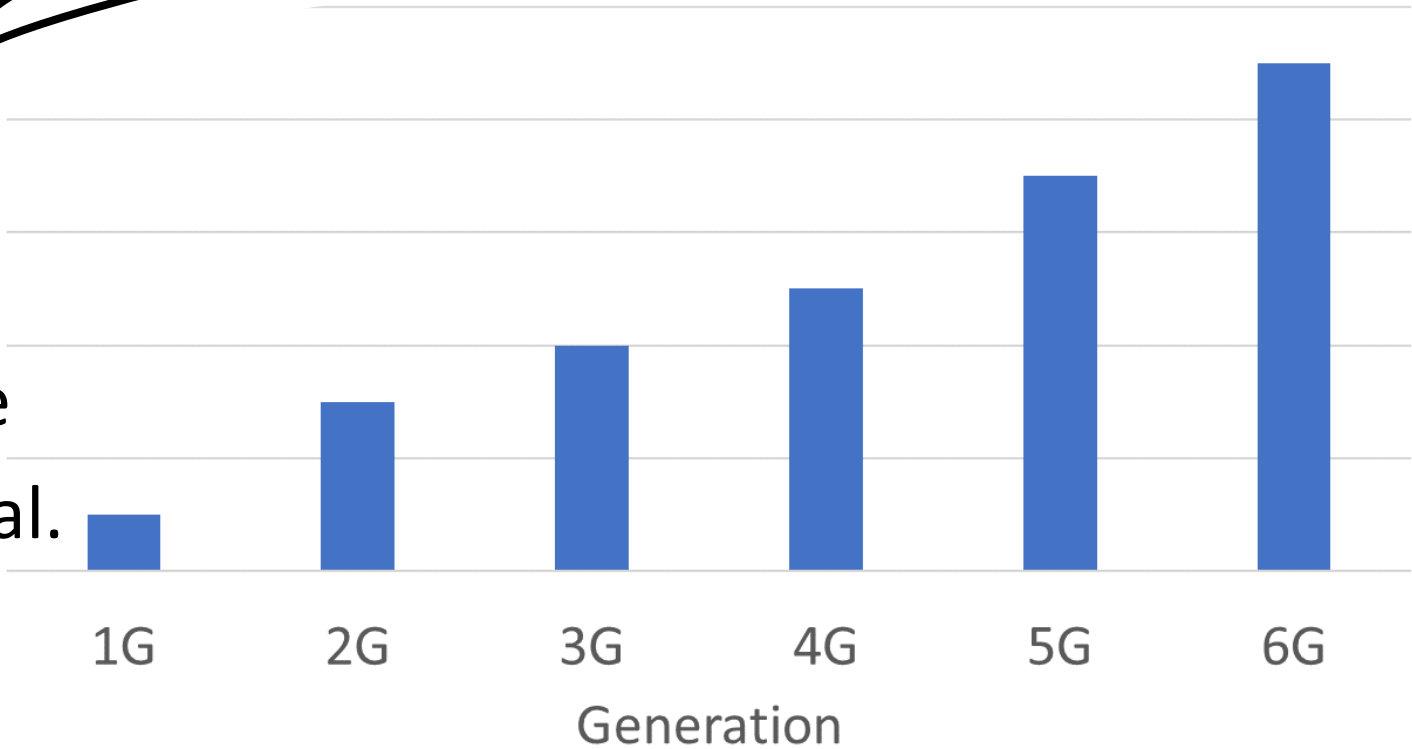


Latency

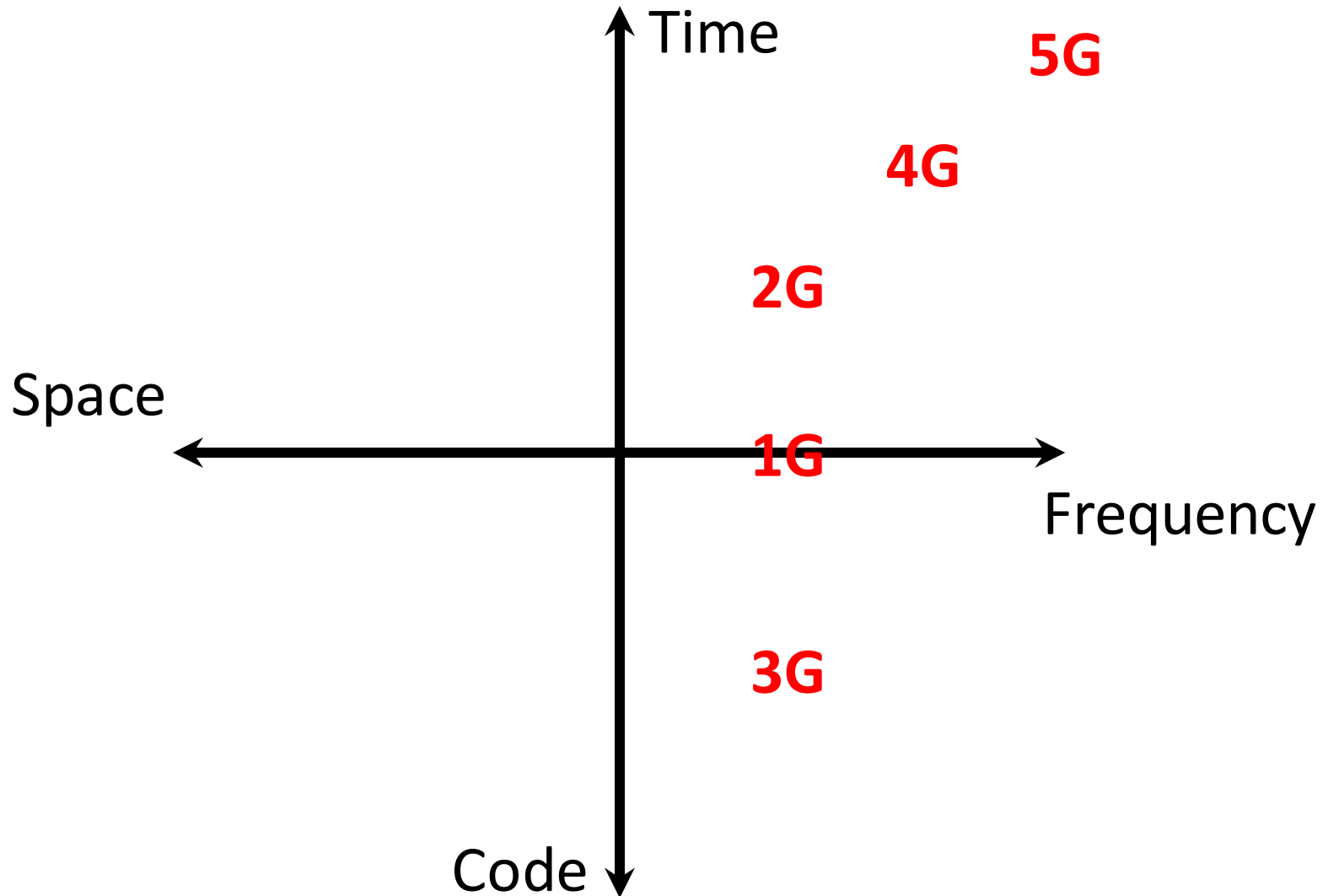
Capacity

Data rate

Voice qual.



Radio Interfaces Revisited



Sure Trends and Challenges

- A new Radio Interface (back to basics)!
- Use of higher frequency bands.
- Interference minimised by energy harvesting.
- Adaptive antennas.
- Network virtualisation and slicing, including radio.
- Cloud and edge networking.
- Networks with machine learning features.
- Security and privacy.
- Flexible and adaptive networks.

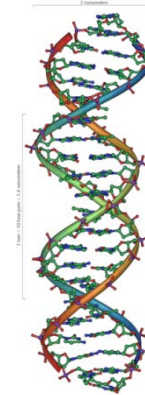
Regulation & Standardisation

- Traditionally, Europe has had an approach to standardisation/regulation different from the US one.
- Concerning future Mobile & Wireless Comms., which bodies should be addressed?
- Standardisation does not influence basic R&D, but it definitely guides its results.



Policy (1)

- Research on future Mobile & Wireless Comms., needs to interact with other areas (biology, sociology, psychology, construction, cars, ...).
- This interaction will increase the complexity concerning regulation and policy.
- Will there be ethical barriers, like those existing today in biology/medicine?



(Wikipedia, 2008)



(RICS, 2008)



(PBASE, 2008)



(Amazon, 2008)



Policy (2)

- Whether we like it, or not, some policy aspects do need to be taken into consideration, e.g., the possibility of Governments having access to data.
- How to comply with the interests of so many players (telecom operators and vendors, service and content providers, banks, goods distribution, ...), with different development cycles?



(Tecnotrekos, 2008)



(Swissbank, 2008)



(GeeAyBee, 2007)



Conclusions

- One should analyse the evolution of other industries in order to take perspectives for the future of Mobile & Wireless Comms.
- The evolution of services usage and profiles impose major changes on systems and networks, new perspectives being required.
- Many research challenges are still open, waiting for solutions to be found.

The End

- “I think there is a world market for maybe 5 computers”, Thomas Watson (IBM), 1943.
- “There is no reason anyone would want a computer in their home”, Keneth Olsen (DEC), 1977.
- “The best way to predict the future is to invent it”, Alan Kay (UCLA), 1971.



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Thank you!

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Detailed readings can be found at

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