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Challenges for a data-driven society

Toward the Data-driven "Smart" and "Green" Hospital-care

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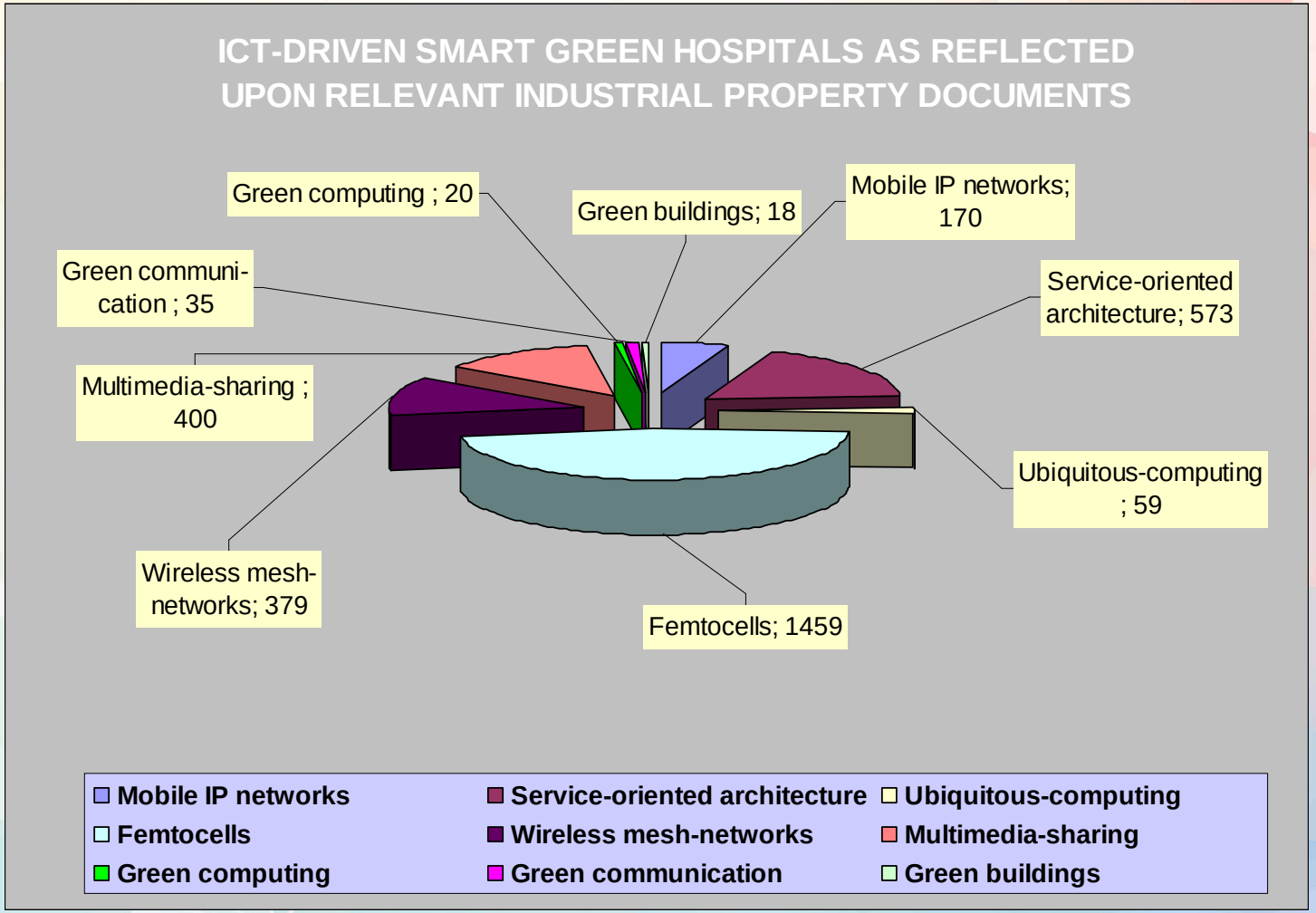
ICTs and the modern Hospital

- The Hospital is the most complex and representative establishment of the society, and nowadays, the most costly one.
- ICTs may rationalize personnel-efforts and reduce energy and material-wasting, to enable health-care coverage, of unprivileged social-groups.
- This collective paper resumes a new creative and innovative method of collective examinations of our ICT & Biomedical Engineering (BME) graduate students.
- By assigning them a set of appropriate topics, they are setting up a useful “mini-compendium”, in our case the emerging “ICT-driven Smart Green Hospital”.

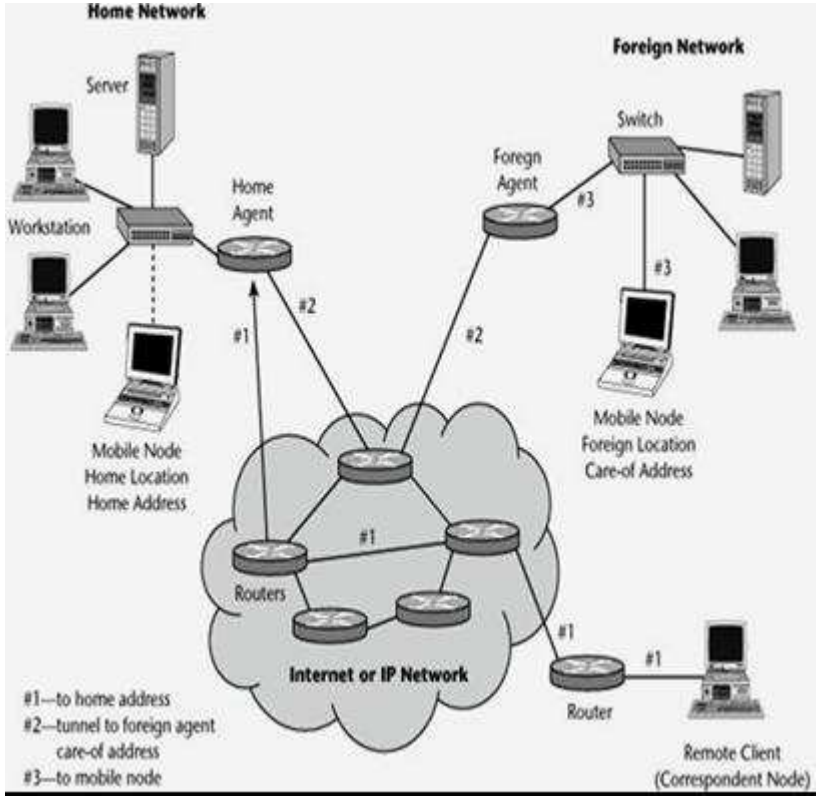
Effective and efficient ICT-means and tools reducing unnecessary Hospitalization cost

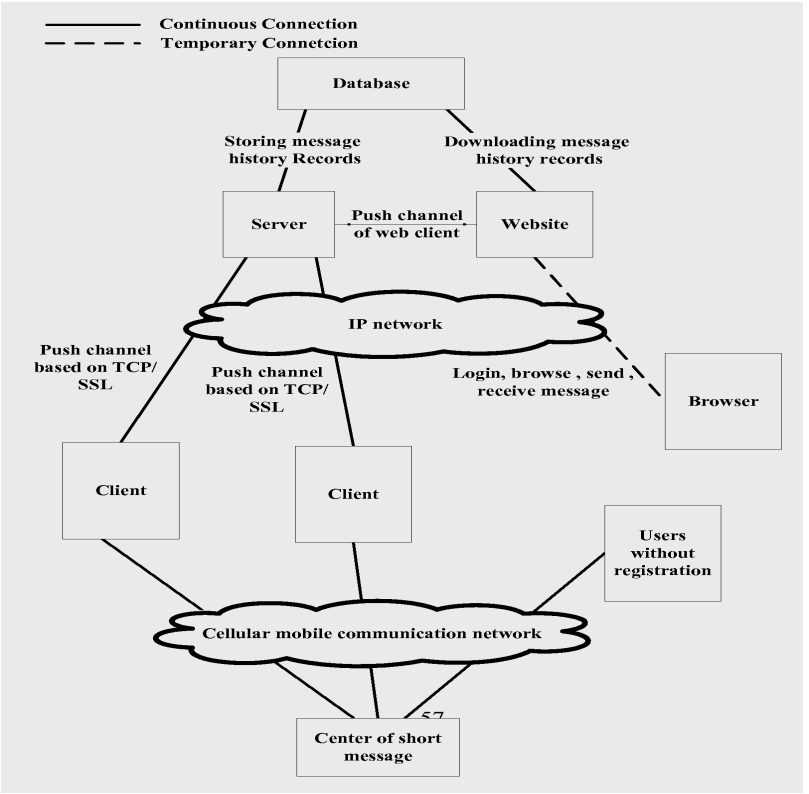
- **Mobile IP-networks** IETF-standard communication allowing mobile-device users to move from a network to another maintaining IP.
- **Service-oriented architecture**, provided to other components by application-components, by a communication protocol, over a network.
- **Ubiquitous-computing** appearing anytime and everywhere, by embedding microprocessors into objects, allowing for communication and task-performing.
- **Femtocells**, small, low-power cellular base-stations, typically designed for use in a hospital-department, ward-room or unit.
- **Wireless mesh-networks**, made-up of radio-nodes, organized in a mesh-topology, supporting intra-hospital data-exchange.
- **Multimedia-sharing over wireless networks** for PACS, ICU, Lab etc. data-streaming over IP/wireless-networks.
- **Green-computing in wireless-networks**, limiting useless material intra-hospital “circulation”, enabling friendly and smooth procedures.
- **Standardization, policy and regulation** for green communications and computing and Communication Technologies for “green” buildings.

ICT-driven Smart Green Hospitals as reflected upon retrieved & evaluated relevant IP-Docs



System and Method for Automatically Switching Based on Cellular Mobile Communication Network IP-Network

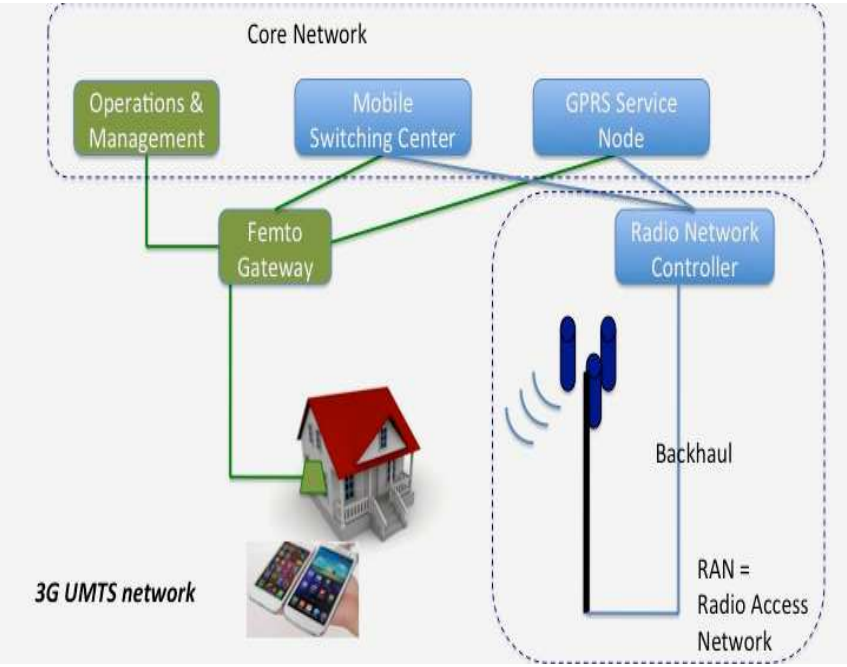


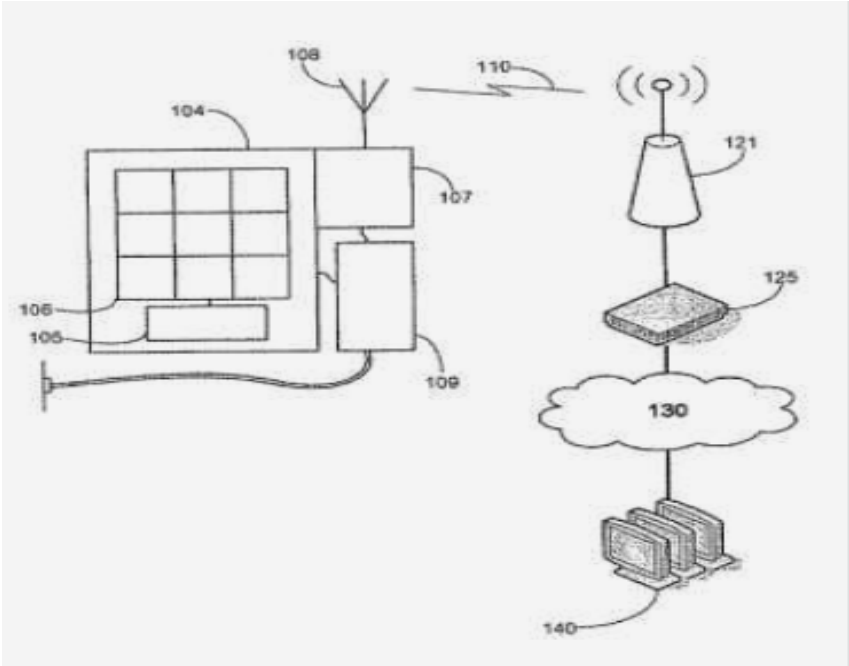


System and Method for Automatically Switching Based on Cellular Mobile Communication Network IP-Network. US 20140187240 A1

Femtocell networks: low power and low-cost small base-stations that operate in a licensed spectrum

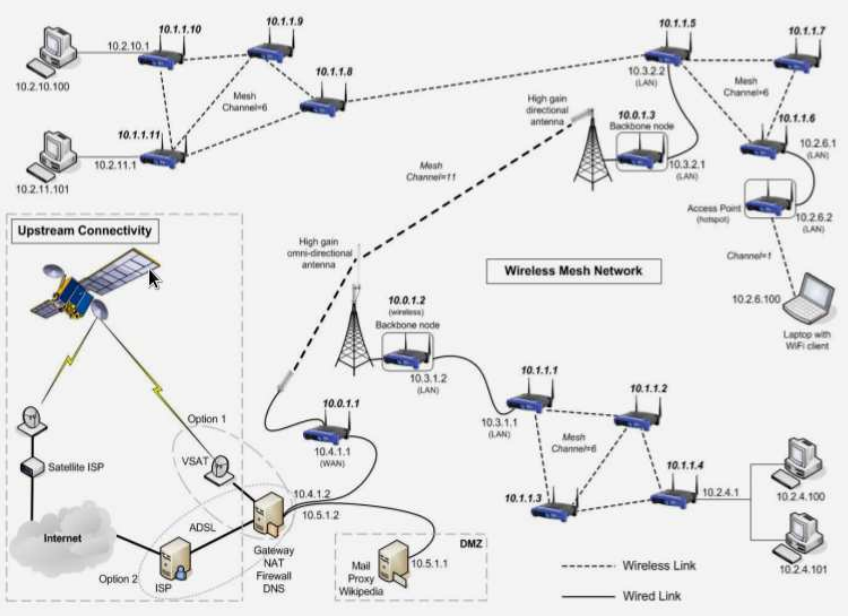
They usually have coverage of 30-40 meters and use the services of the existing broad-band connection to connect to the operator core network, such as digital subscriber line (DSL).

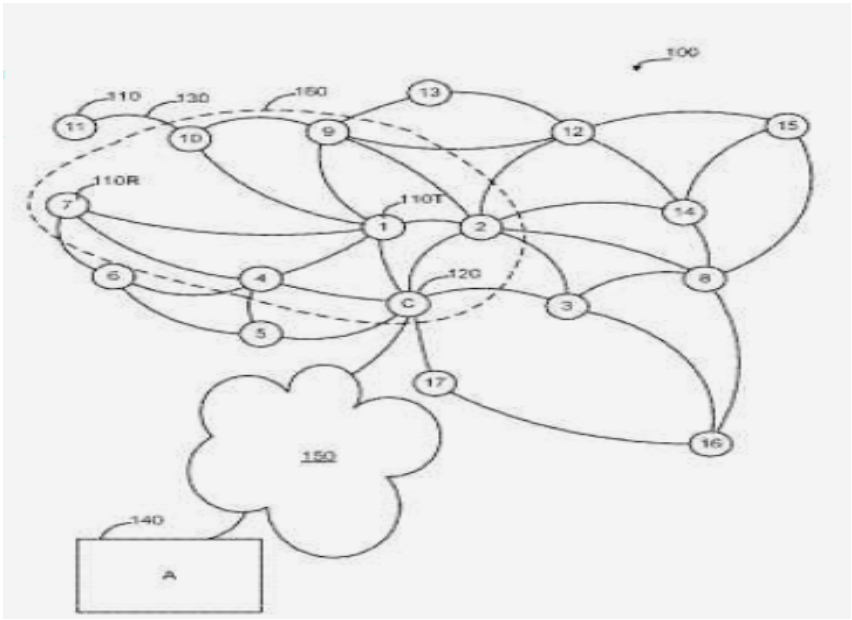




Left: A typical residential Femtocells Architecture. Using fixed mobile convergence Femtocells for alarm reporting, US2009273462 (A1), 2009-11-05. Right: An alarm reporting system and method for reporting alarms, to a central monitoring station, via low-power femtocells.

A Wireless Mesh Network created by self-organized wireless nodes using multi-hop wireless relaying for data transfer





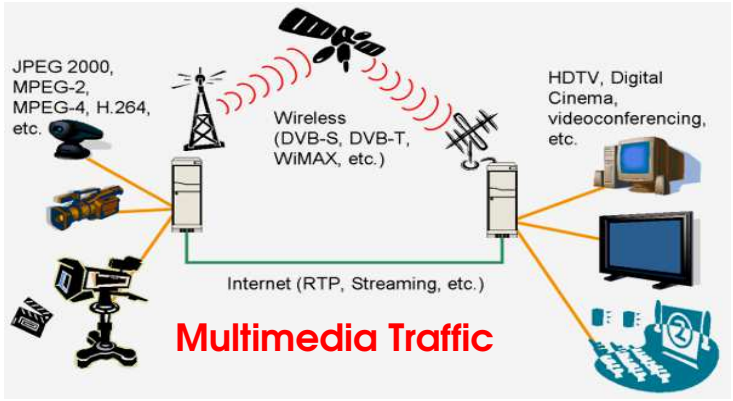
Left: A typical wireless mesh network diagram, D. Johnson et al., Building a Rural Wireless Mesh Network: A do-it-yourself guide to planning and building a Freifunk-based mesh network, Meraka Institute, South Africa. Right: Methods and system to determine the "health" of WMNs are provided, US2017093663 (A1), 2017-03-30.

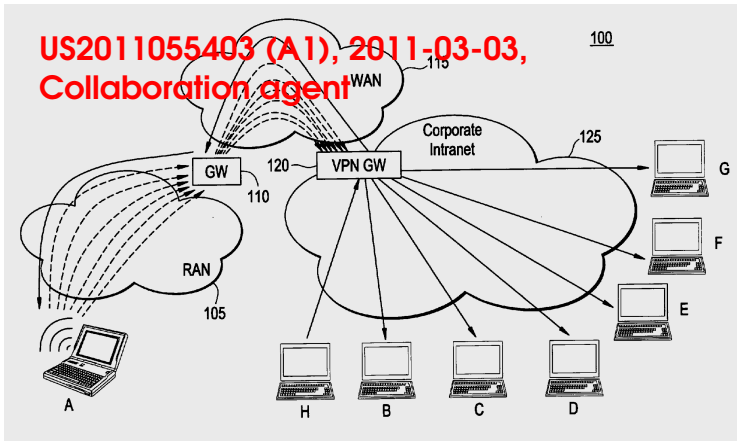
Multimedia over Wireless Networks

Hospital networks have played an important role in healthcare environment, with new apps that improve patient care and lead to dropping of unnecessary healthcare costs.

Such networks provide initial connectivity for a wide range of services, including:

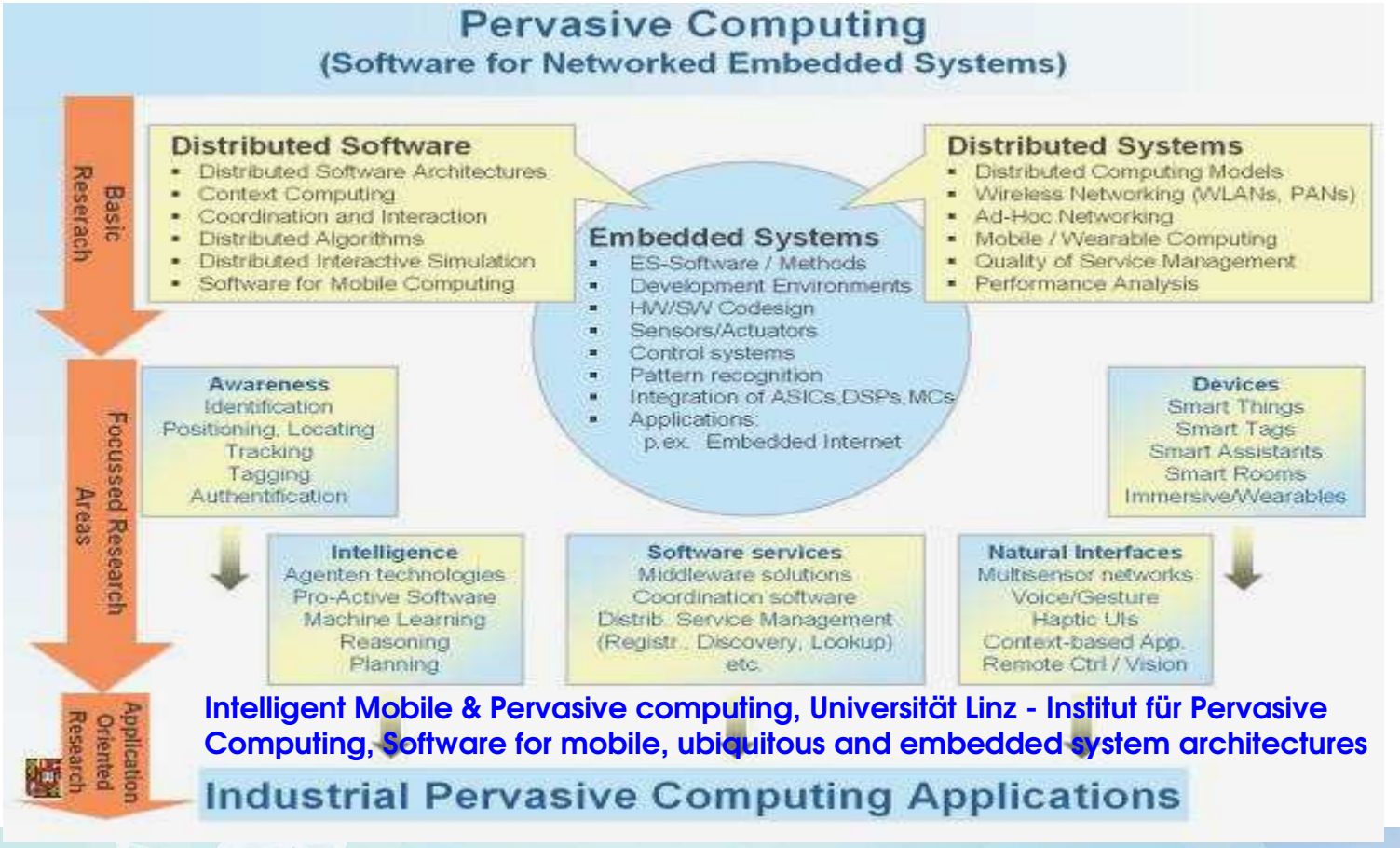
- Patient admission and patient records tracking
- Electronic Health Records (EHR).
- Wired/wireless communications for hospital staff.
- Real-Time Locations Systems (RTLS) (patient monitoring equipment-ICU).
  - Diagnostic imaging RIS, PACS.
  - Laboratory results (LAB).
  - Pharmacy.





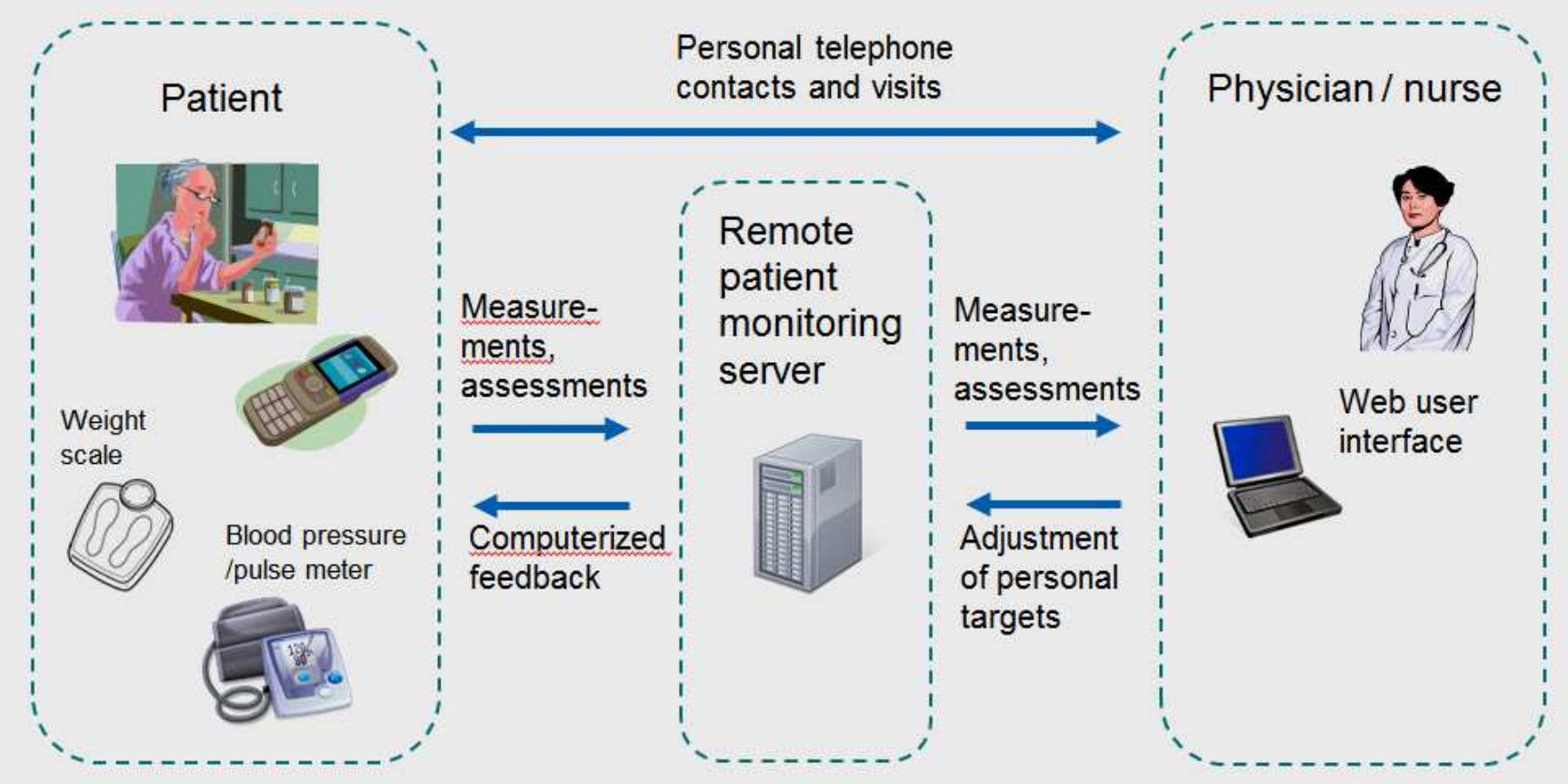
Ubiquitous computing services and applications

Ubiquitous computing envisions a world where embedded processors, computers, sensors, and digital communications are inexpensive commodities that are available everywhere



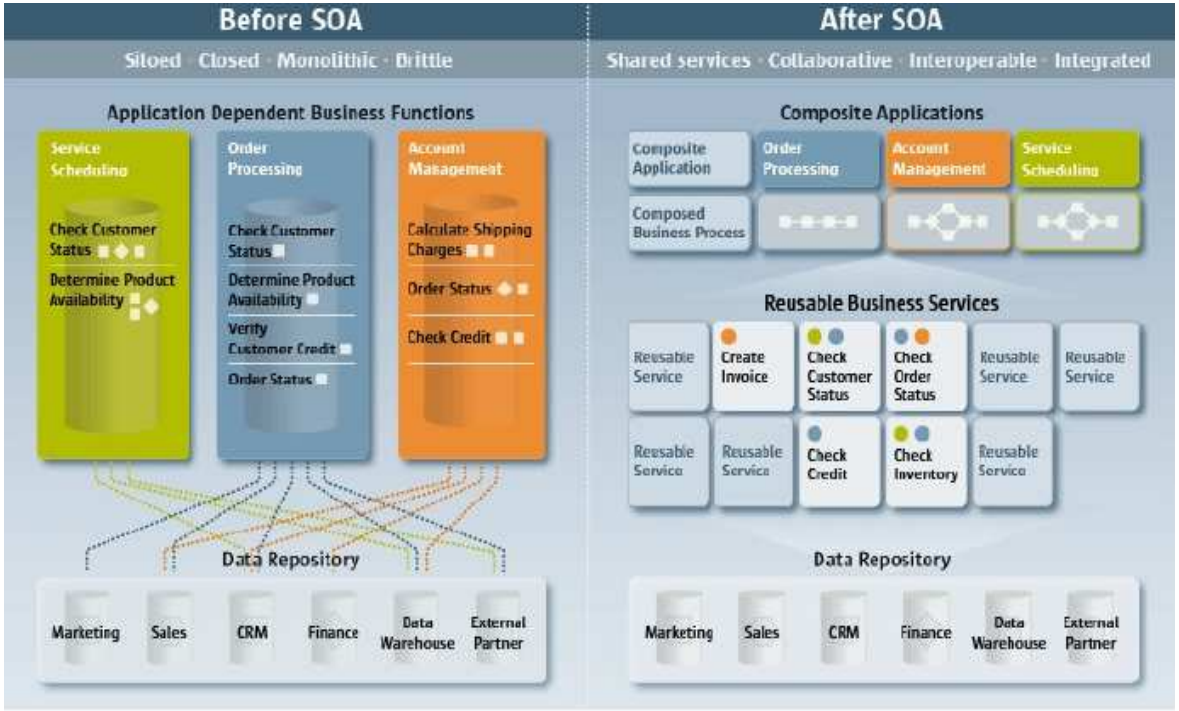
Overall architecture for remote patient monitoring

Anna-Leena Vuorinen et al., Use of Home Telemonitoring to Support Multidisciplinary Care of Heart Failure Patients in Finland: Randomized Controlled Trial



Service Oriented Architecture (SOA)

SOA is a style of designing applications in such a way that they are composed of discrete software agents that have simple and well defined interfaces and are orchestrated through a loose coupling, to perform a required function



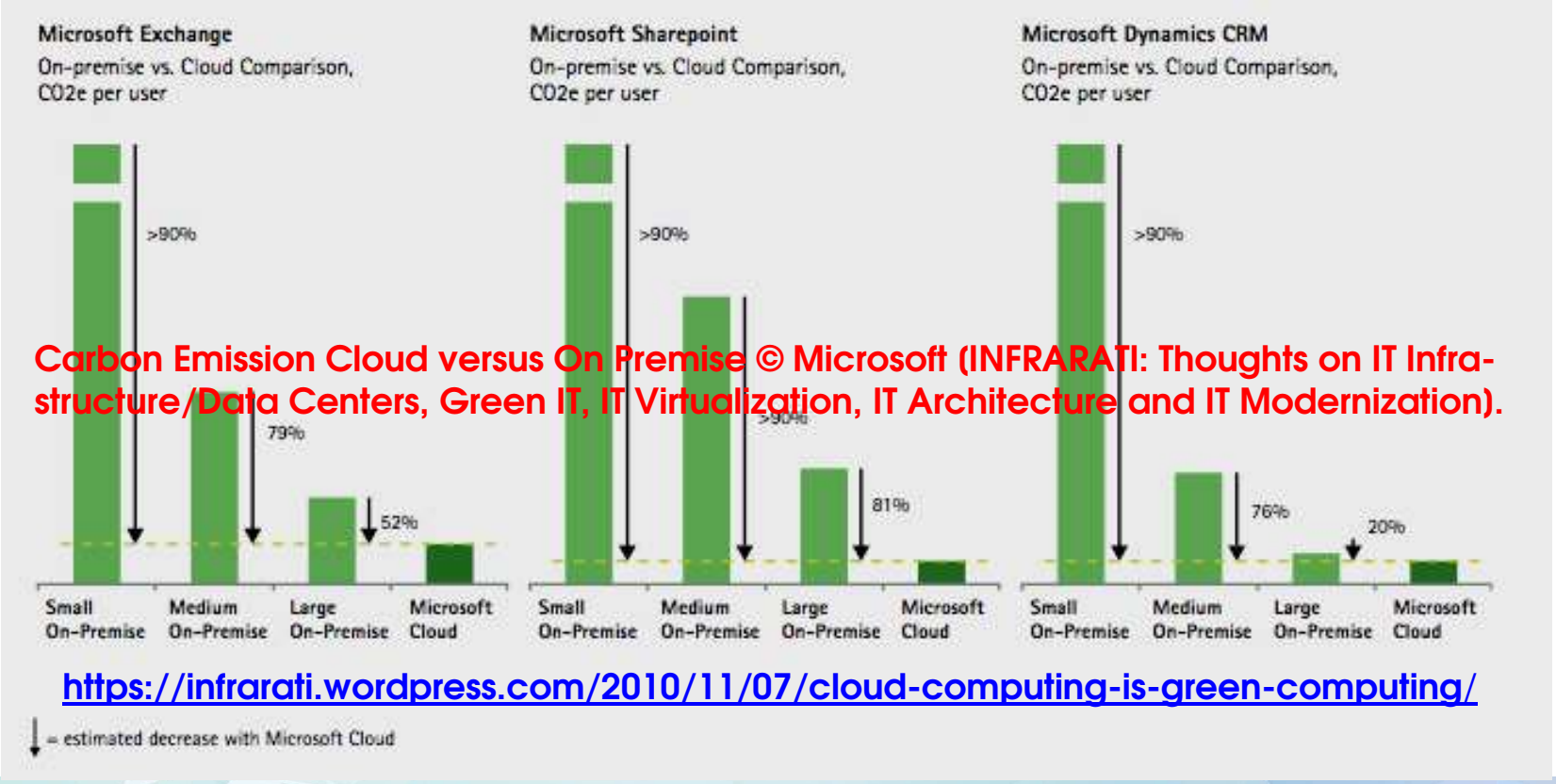
Service Oriented Architecture and Business Process Modeling: Before and after SOA.

Green Computing in Wireless Networks

"Green antennas" that minimize transmission power of the proximal station.

Cloud-computing could become an, however disputable, approach for Green-computing.

Lower consumption sensor-networks and routing-applications have been developed.



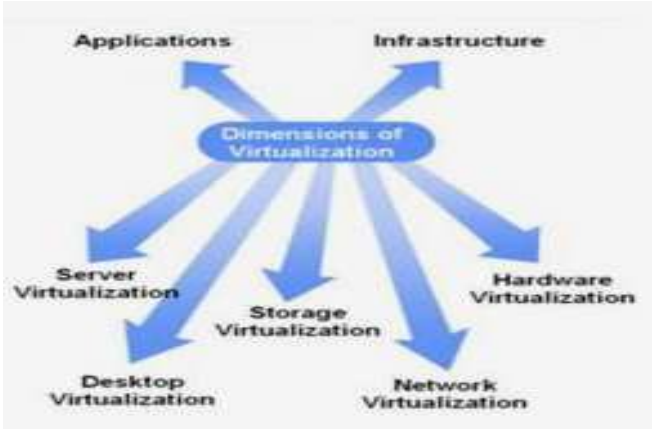
Carbon Emission Cloud versus On Premise © Microsoft (INFRARATI: Thoughts on IT Infrastructure/Data Centers, Green IT, IT Virtualization, IT Architecture and IT Modernization).

https://infrarati.wordpress.com/2010/11/07/cloud-computing-is-green-computing/

Communication Technologies and Standardization for "Green- buildings"

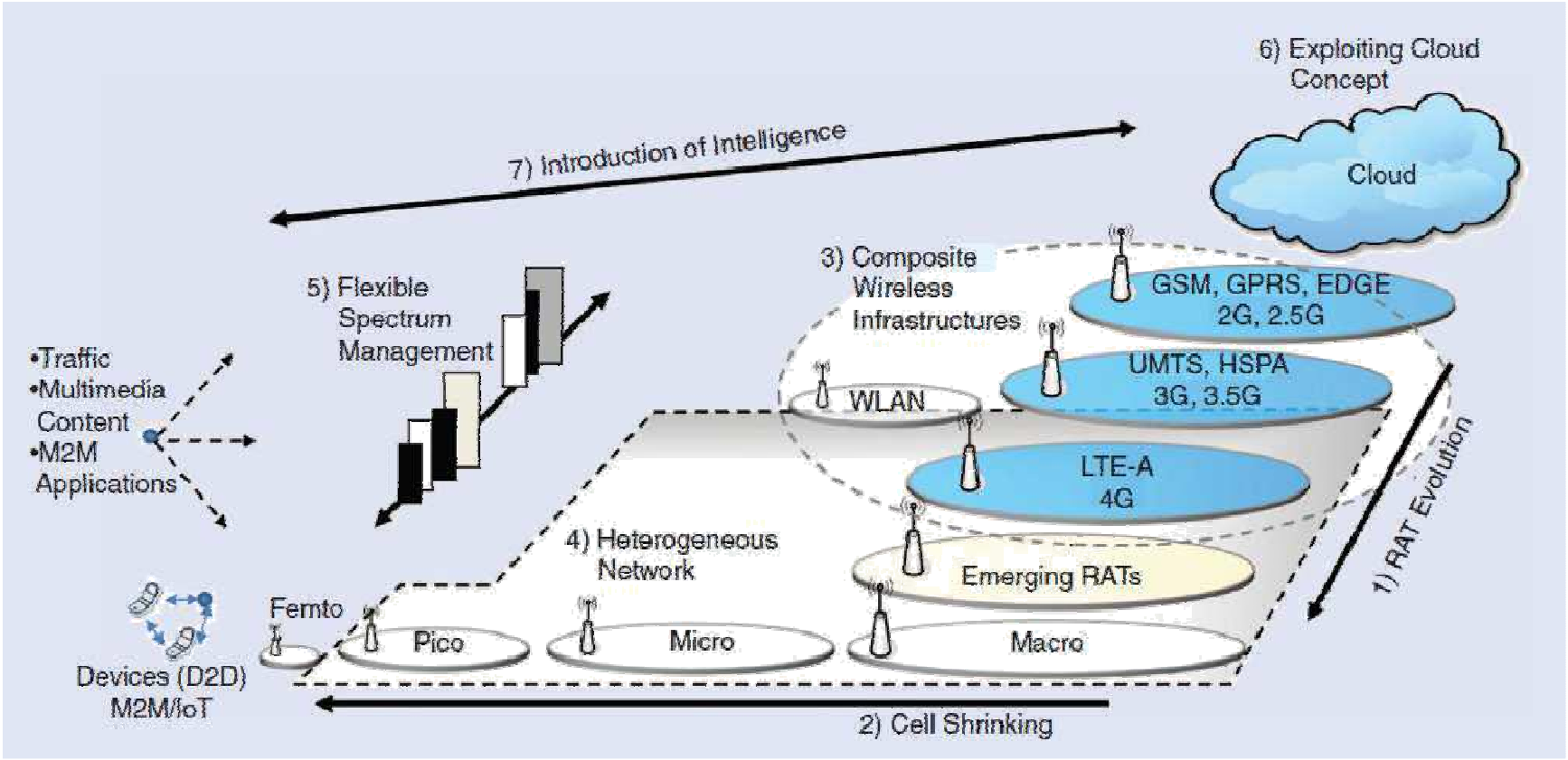
Several attempts to decrease the environmental impact of increased Power consumption

- Pomona Valley Hospital Medical Center resolve the cooling problem by investing $500.000 to overhead air conditioners
- Totally their data center is 6.000 square-foot and before solution the temperature skyrocketed to 100 degrees
- Their aim is keep the data centers at 60 degree



- Virtualization reduces the number of servers required to run a firm's applications
- The University of Pittsburgh Medical Center and Swinerton Construction are using virtualization
- Swinerton saved $140.000 by using virtualization

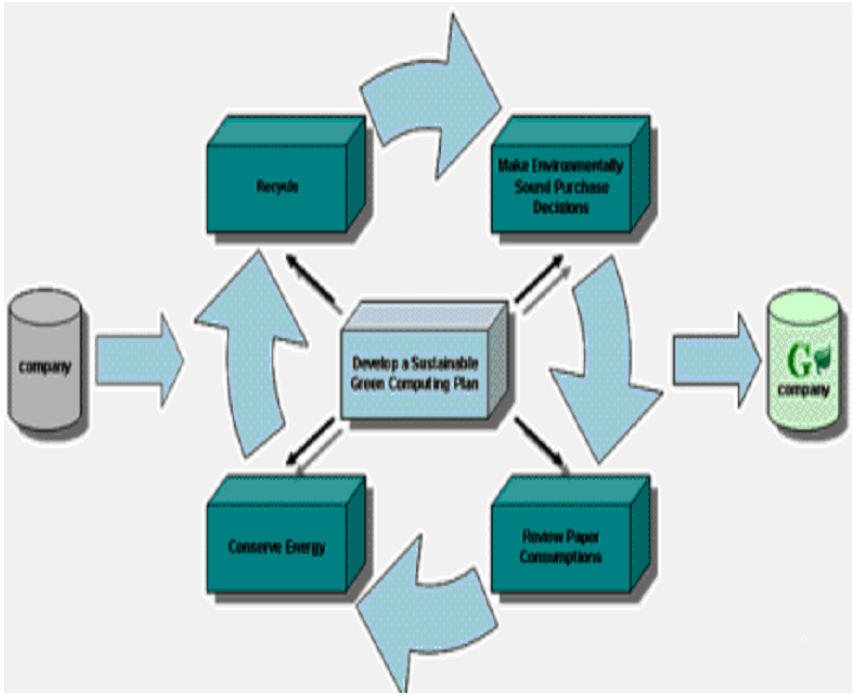
An overview of the wireless world toward the 5G of wireless/mobile broadband (5G on the Horizon)



https://www.researchgate.net/publication/300484775_Leveraging_SDN_for_the_5G_Networks/figures?lo=1

Need for Green Computing: why should a company promote efficient computing?

- Microsoft together with Accenture and WSP have conducted a study to the saving of energy and carbon emission by cloud computing.
- They developed a quantitative model to calculate the energy use and carbon footprint of the IT applications Microsoft Exchange, Sharepoint and Dynamics CRM) for both cloud and on-premise deployment.
- This approach aligns with the assessment methodology developed by the Global e-Sustainability Initiative (GeSI).



The ICT-Ecosystem meets-up Health-Care

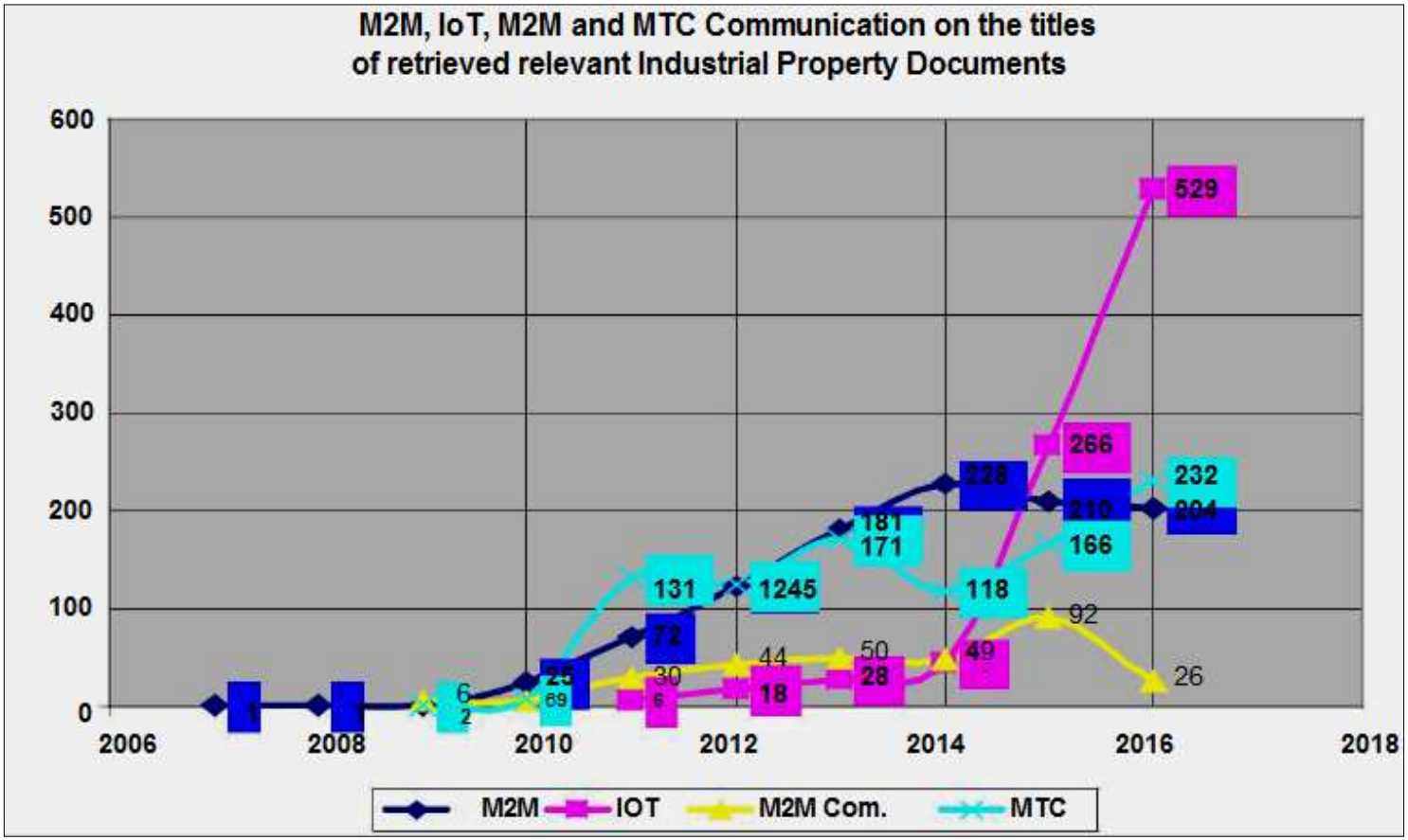
Major Clinical Departments

- The Emergency and the Outpatient Departments.
- The Imaging and the Radio-therapy Departments.
- The Surgical Departments, the Intensive Care Units (ICU/CCU, NICU etc.) and the Wards.
- The in vitro Diagnostics, Hematology, Transfusion Medicine, Cell Therapy Laboratories and Units.

The Supporting Facilities

- Sterilization & Asepsis.
- Protective clothing and gear.
- Bioactive wastes.
- Laundry.
- Food-services.
- Pharmacy.
- Electro-mechanical Networks.
- Building Engineering etc.

The time-dependent evolution of the IoT and the related Technologies affecting modern Hospital during the last 10 years



Procuring and employing "green" ICT and BMT in the modern Hospital

- One of the key tasks of the Health-systems is to translate needs into Health-services, by procuring and employing ICT, BMT and other Technologies and Services, in order to translate them into appropriate facilities, i.e. Hospitals and other Healthcare Institutions.
- In Europe there are at least 28 different National Health-systems frameworks, within which public and private Hospitals operate.
- This multifarious and multifaceted "picture" of Health-care, combined with the explosion of the ICTs, creates a "boom" of interdisciplinary Technologies that are already altering radically the social reality.

Concluding remarks

- We are all already moving toward the big-data driven "smart" and "green" Hospital and Health-care in general, with different starting-points and speeds and all of us carrying the burden of our historical, cultural and political tradition.
- A number of Healthcare indicators are being shifted from the 20th Century centralized model toward the 21st Century "networked-Society", wired or wireless, spread and multi-faceted model.
- The social and cultural versatility of our global society is new and much promising; however, it constitutes a rather terrifying emerging environment.
- The Hospital, is an important ancient "progress flagship".
- Nowadays, it is more than ever in the human History, the most complex and concurrently the most representative system, this society has given birth to…

Thanks for your patience to hear our estimations…