Prof. Marco Avvenuti

Prof. Alessio Vecchio

Dipartimento di Ingegneria dell'Informazione

MOBILE AND SOCIAL SENSING SYSTEMS

(LM COMPUTER ENGINEERING, LM ARTIFICIAL INTELLIGENCE AND DATA ENGINEERING, #885II)

Founding ideas: from Ubiquity …

During one of his talks, Mark Weiser outlined a set of principles describing forthcoming computing:

- *Ubiquitous computing names the third wave in computing, just now beginning.*
- *First were mainframes, each shared by lots of people.*
- *Now (1991) we are in the personal computing era, person and machine staring uneasily at each other across the desktop.*
- *Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives.*
- *Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence.*

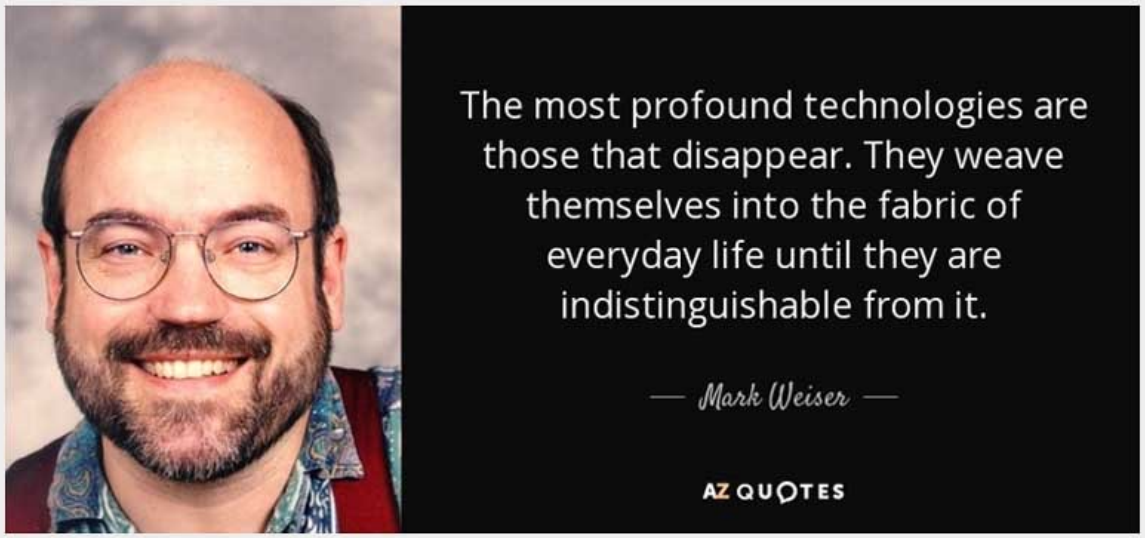
Mark Weiser

The computer for the 21th century

1991

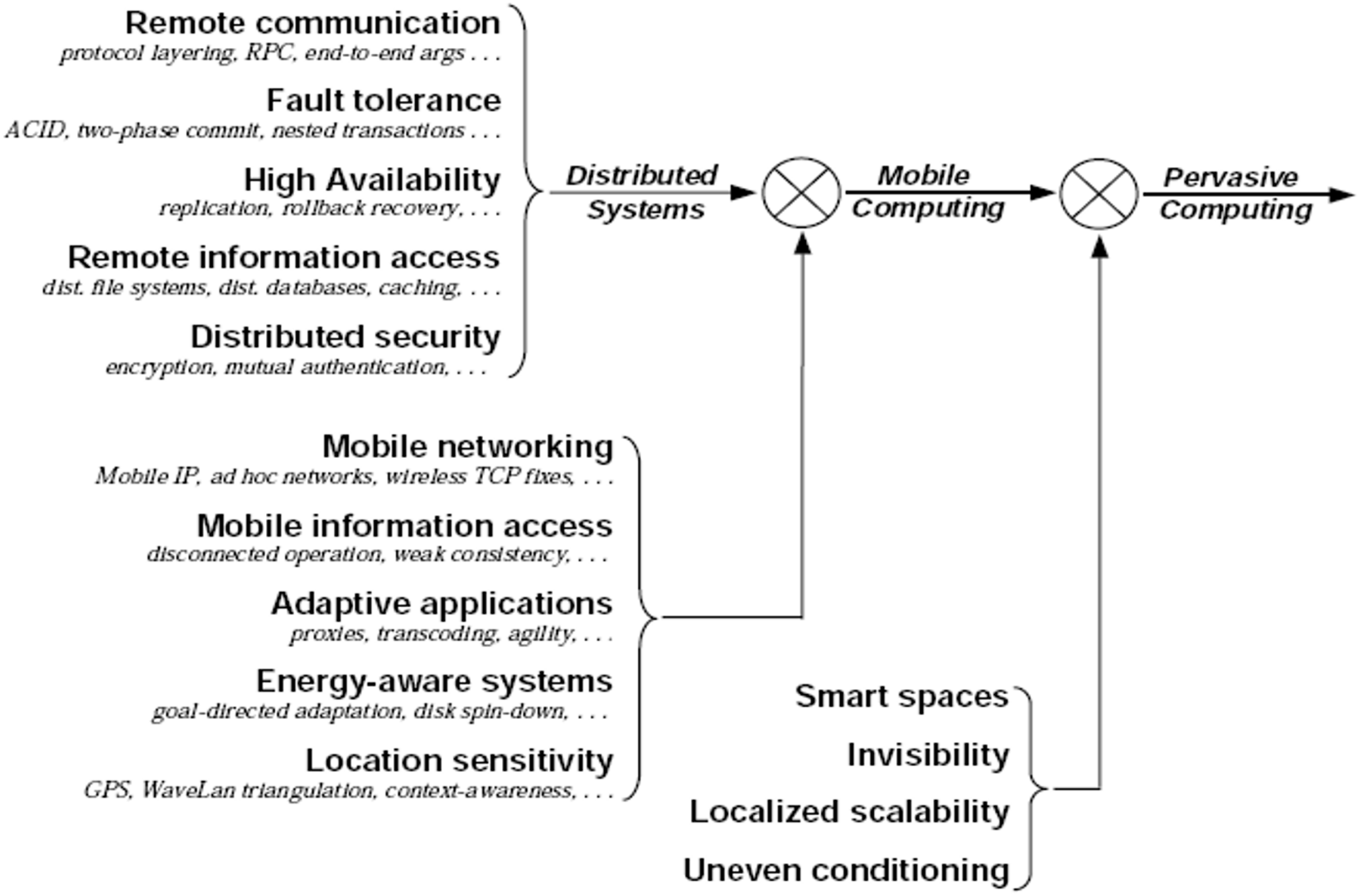
… to Invisibility

The purpose of a computer is to help you do something else (beyond computing)
The best computer is a quiet, invisible servant
The more you can do by intuition the smarter you are
The computer should extend your unconscious
Technology should create calm



Today we call it
Wearable and
Internet of Things

Distributed Systems evolution



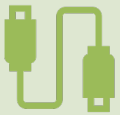
Mobility

- **Physical mobility:** hosts and users can change their geographical location while retaining the ability to communicate and perform computation

- **Logical mobility:** application components or data can relocate at runtime

Physical mobility is a requirement, logical mobility is a design choice

Mobile Computing



Mobile computers are generally battery powered. These include laptops, tablets, smartphones and wearable sensors

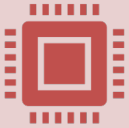
Mobile devices are connected wirelessly to and through the Internet or a private network through wireless LAN or wireless WAN technology

Wireless connection ties the mobile device to centrally located information infrastructure and application software (aka the “Cloud”)

Mobile Computing

- They move from location to location, while maintaining a connection to the fixed network
- The load of computation and connectivity procedures are mainly carried out on the fixed network
- Services are provided by the core network to the mobile clients

Pervasive Computing



The goal of pervasive computing, which combines wireless computing, voice recognition, Internet capability and artificial intelligence, is:

to create an environment where the connectivity of devices should be unobtrusive and always available

the creation of environments saturated with computing and communication capability, yet gracefully integrated with human users

Pervasive Computing

Computing devices become progressively smaller and more powerful

A trend towards all man-made and some natural products having hardware and software

Almost any device, from clothing, to tools, to appliances, to cars, to homes, to the human body, to your coffee mug, can be embedded with chips to connect the device to an infinite network of other devices

Context-awareness

A pervasive computing system that strives to be minimally intrusive has to be context-aware.

In other words, it must be cognizant of its user's state and surroundings, and must modify its behavior based on this information

A user's context can be quite rich, consisting of attributes such as *physical location*, *physiological state* (such as body temperature and heart rate), *emotional state* (such as angry, distraught, or calm), *personal history*, daily behavioral patterns, and so on

Wearable Sensors

- Smart devices, like smartwatches and fitness trackers, embed a wide range of sensors
- They are potentially worn continuously throughout the day
- Unprecedented opportunity to constantly monitor users' movements
- This massive amount of information has led to an increasing interest in the development of applications related to health and well-being

Wearable Sensors

A key challenge is represented by the reliable extraction of relevant patterns from collected signals

For instance, gait analysis applications should devise appropriate signal processing techniques to detect walking activity as well as to analyze and classify gait patterns

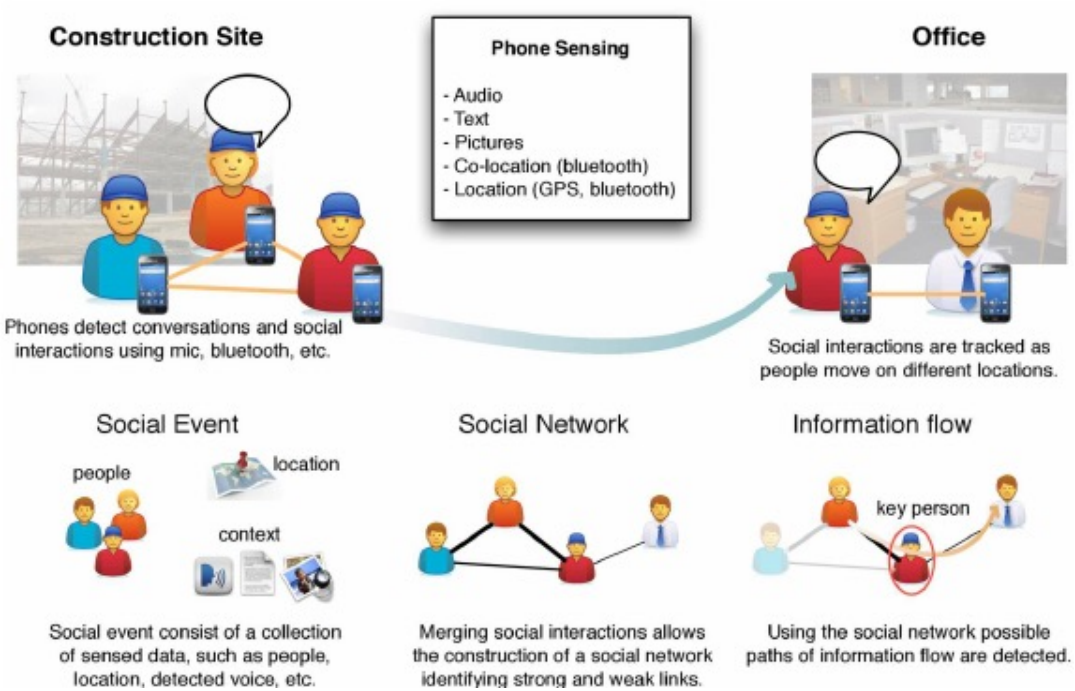
Learning goals:

a practical glimpse into the emerging field of human activity monitoring by means of wearable sensors

a description of relevant signal processing methodologies aimed at achieving accurate and unobtrusive wearable systems

Social Sensing

https://youtu.be/S8u7FFyR1Sg



Social Sensing

Online Social Networks (OSN) are the most effective way to gather preferences, tastes and activities of large groups of users

OSN are mostly accessed through mobiles

Social media users can be considered as "social sensors":

sources of information about situations and facts related to the users and their social environment

Social Sensing

- The huge amount of data that is continuously shared in social media, represents a rich mine of information for many topics of interest (e.g., politics, emergencies, advertisement, etc.)
- Humans-as-sensors: how to reliably collecting actionable information from humans
- (Coordinated) Information Operations: inauthentic ?

Learning goals: to practice with techniques for collecting and analyzing data from social media, thus touching topics such as *social media crawling* via APIs, *machine learning*, and *social bot detection*