

# Mobile and Ubiquitous Computing - Introduction

- **Where do we stand?**

- We have **near-constant access** to computing power and online services - **near-ubiquitous computing**;
- Thanks to **cellular and Wi-Fi networks**, we can be **online** almost everywhere;

- **Where are we going to?**

- **Calm computing** - computing that **moves into the background** of our lives, doing its job without requiring our full attention;
- However, today's technology is more likely **jittery technology**:
  - \* Constant beeping, vibrations, and interruptions;
  - \* Phantom vibrations - feeling your phone vibrating when it's not.

- **Pros:**

- **Convenience** - access to information and services anywhere, anytime;
- **Cheap** access;
- Increasing **productivity**;

- **Cons:**

- **Privacy** concerns;
- **Security** concerns;
- **Distraction**.

## Definitions

- **Mobile computing:**
    - Deals with **computing and communication** software and hardware aspects related to the use of **mobile devices**;
    - **Mobility**: devices can be easily moved from one place to another;
  - **Ubiquitous computing:**
    - Deals with **computing and communication** software and hardware aspects related to the use of **ubiquitous devices**;
    - **Ubiquity**: devices are **everywhere** and **always on**.
    - **Ubiquitous devices** are devices that are **everywhere** and **always on** - most of these devices are mobile, but we can also have an **ubiquitous system** with devices that are not mobile;
    - E.g. **smart homes**, **smart cities**, **smart cars**.
  - **Pervasive computing:**
    - **Pervasiveness**: stupid devices with embedded computing.
    - In some literature, there is a distinction between ubiquitous and pervasive computing, where the latter implies the **embedding of computing devices into everyday analog objects**.
  - **Localized scalability:**
    - Large number of devices may co-exist in a small space;
    - A system must be able to handle a growing amount of devices and the resulting interaction;
    - **Smart-space**: a space where devices are interconnected and can interact with each other.
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## Challenges

### Location

- Triangulation:

- Lateration - distance to known points;
- Angulation - angle to known points;
- Proximity: nearness to known points;
- Scene analysis: recognizing landmarks;
- **Challenges:** privacy, scale, cost, accuracy and precision.

## Support Variability

- **Context-awareness:**
  - System needs to be **pro-active** and **correct**;
  - Gather information about the user's context, and **predict** what the user will need next;
  - **Context information** can be: location, time, user activity, temperature, etc.
- **Adaptability:**
  - System must be capable of dealing with the variability of the environment;
  - Adapting the environment while remaining **transparent** to the user;

## Deal with Resource Constraints

- **Resource Discovery:** protocols to discover nearby resources;
- **Cyber foraging:** offloading computation to nearby resources;
  - E.g. lack of network connectivity, can be solved with a shared hotspot;

## Provide Constant Access to Devices

- **Replication and Consistency:** maintaining multiple consistent copies of data for accessibility and fault tolerance;
- **Offloading:** moving computation to a more powerful device;

- Implies deciding if **it is worth** the cost of moving the computation;
- **Energy**: find where battery is being wasted and optimize it;
  - **Challenges**: battery life, energy consumption, energy harvesting.