Ch 3. PCS

- **Vision of PCS:**
  “PCS will allow communications with anyone, anywhere and anytime, with a single personal number”

- **The TIA definition for PCS:**
  “A mobile radio voice and data service for the provision of unit-to-unit communications, which can have the capability of PSTN access, and which is based on microcellular or other technologies that enhance spectrum capacity to the point where it will offer the potential of essentially ubiquitous and unlimited, untethered communications”

- **Another definition for PCS (according to D. Cox at Stanford):**
  “Pretty Confusing Situation”

- **How far off is PCS? The third generation systems are addressing the issues of terminal and personal mobility and microcell architectures.**
3.1 PCS Requirements

- PCS encompasses the concepts of terminal and personal mobility.

- **Terminal mobility**: ability of a terminal to access telecomm. services from different locations, while in motion, and the capability of the network to identify and locate the terminal.

- **Personal Mobility**: ability of a user to access telecomm. services at any terminal and the capability of the network to provide those services according to the user’s subscription.

- Terminal and Personal mobility are **independent** of each other and can exist without each other. PCS requires that **both exist**!

- Terminal mobility requires that 1) the **mobile** be small, lightweight, easy to use and with low power consumption, 2) the **access** be wireless to support mobility

- Personal mobility does not require terminal mobility. In the current networks, users are tied to a network access/termination point and communications are associated with such points of access to the networks rather than with the actual users (e.g. a telephone number, or an IP address!). PCS’s goal is to make communications **user-oriented** not device/access point oriented.
3.2 PCS Services

- Ability to accommodate multiple modes of operation:
  - public system (i.e., cellular network operation)
  - residential system (i.e., as a cordless phone)
  - private system (i.e., operating with a private branch exchange PBX)
- Ability to provide different types of services not just voice:
  - Enhanced telephony services
  - Teleconferencing
  - Voice Mail
  - Video telephony
  - Fax
  - Data transmission (not voice band data!)
  - Message services
3.3 Third Generation Systems - Design Goals

- **System capacity**: need to design the system to accommodate large communities of users that will access the system at different levels. The network will use different cell structures according to the operational environment (microcells in urban areas, picocells indoors, and the current macrocells). Goal is to have similar call blocking numbers as in the current PSTN and the call dropping rates must be very low.

- **Service quality**: use more complex protocols and enhanced signal processing schemes to guarantee a service quality similar to that of the wireline network.

- **Terminal mobility**: low power technology, lightweight, economical and pocket size devices that can be used in all kinds of environments (homes, office buildings, urban areas, fast moving vehicles, etc.), are easy to use and highly functional.

- **Personal mobility**: a single personal number that can reach a subscriber anywhere and an individualized feature profile that follows the user and provides a customized set of services at any location. The **SIM** card is a step in that direction. Roaming capabilities need to be enhanced to meet the second requirement, **DCS 1800** is a step in that direction. However DCS was not designed for microcell operation (as e.g. DECT). It cannot at this point handle rapid hand offs!
● **Service price**: as the goal of PCS is to become the principal means of communications for most people, i.e., a mass-market subscriber population, then this implies that the service prices should be comparable to those of alternative wire-line fixed networks, with some variations depending on where the subscriber is getting the service from, i.e., at home or on the road or at some remote location.

● **Privacy**: as the signals are travelling through the air they are vulnerable to eavesdropping. The PCS networks have to address 1) the issue of user privacy, i.e., the content of the user transmissions, and 2) the issue of network privacy, i.e., the behaviour of users, their locality, who they reach etc.

● **Security**: wireless systems are very vulnerable to fraud. PCS systems have to build in robust authentication technology to prevent unauthorized use of the system to non subscribers.
3.4 Third Generation Systems: System Operations

The principal task of PCS is to provide end to end connectivity and to transport the subscriber data streams. As such a system has to provide the appropriate network operations to support this task.

- **User information transport**: the air interface constitutes the most important feature of PCS. The choice of the technology to be used for the air interface reflects the tradeoffs among a large number of design goals: spectral efficiency, coverage area, infrastructure costs, mobility support, security/privacy, terminal price, infrastructure cost, etc.

- **Mobility management**: it influences the kind of services that the PCS will provide. It is responsible for all procedures associated with setting up a connection, and maintaining it, e.g., registration, paging, measurements, etc.

- **Authentication and Encryption**: to provide for a secure system, the systems must authorize users to prevent fraudulent behaviour. Because of the nature of wireless systems, authentication procedures must be much more elaborate. To protect user data transfers from eavesdropping the systems must incorporate strong encryption techniques. Privacy is paramount! Security and privacy are generally linked together.
- **Call management**: these procedures are very similar to fixed wireline networks. No new features or extra tasks are necessary.

- **Radio Resources Management**: it encompasses several tasks: 1) call admission control - which influences call blocking probability and transmission quality, 2) BS and channel assignment - which influences call dropping probability and transmission quality, 3) power control - which influences battery life and transmission quality and 4) handoffs - which influences the call dropping and the call blocking probability.
3.5 PCS operators and equipment vendors (in US)

- The major players in the US market are: local exchange carriers (LECs), interexchange carriers (IECs), cable operators, cellular operators, and new entrants.
- They each have a different driving force and strategy.
- There are around 20 PCS operators that have licenses to provide service.
- The five largest are: Sprint Telecommunications Venture, AT&T Wireless, PCS PrimeCo, Pacific Bell Mobile Services, and American Portable Telecommunications Inc. These 5 cover approx. 75% of the population.
- The major PCS equipment vendors are:
  - GSM systems - Nortel, Ericsson, and Nokia
  - CDMA systems - Lucent, Motorola, and Nortel/Qualcomm
  - NA-TDMA - Lucent and Ericsson