

CHAPTER II :

SATELLITE CONSTELLATION

NETWORKS

II.1. A SATELLITE CONSTELLATION



II. SATELLITE CONSTELLATION NETWORKS

II.1. A SATELLITE CONSTELLATION

1. Introduction

- ✓ A single satellite can only cover a part of the world with its communication services.
- ✓ A satellite in geostationary orbit above the Equator cannot see more than 30% of the Earth's surface .
- ✓ For more complete coverage you need a number of satellites – a satellite constellation.

II. SATELLITE CONSTELLATION NETWORKS

II.1. A SATELLITE CONSTELLATION

2. Definition :

*“ A **satellite constellation** is a group of similar satellites that are synchronized to orbit the earth in some optimal way. “*

3. Current satellite constellations :

Currently, satellite constellations fall into one of two classes,

- (i) Navigation satellites
- (ii) Telecommunications satellites.

II. SATELLITE CONSTELLATION NETWORKS

II.1. A SATELLITE CONSTELLATION

The table summarizes the properties of four of these constellations.

Parameter	GPS	Iridium	Globalstar	Orbcomm
Purpose	Navigation	Telecom	Telecom	Data Comm.
Number of planes	6	6	8	4
Plane spacing (degrees)	60	30	45	45-112
Satellites per plane	4	11	6	8
Total satellites*	24	66	48	32
Orbital altitude (km)	20,181	775	1414	802
Semi-major axis (km)	26,559	7,153	7,792	7,180
Inclination (degrees)	54.8	86.4	52.0	45.0

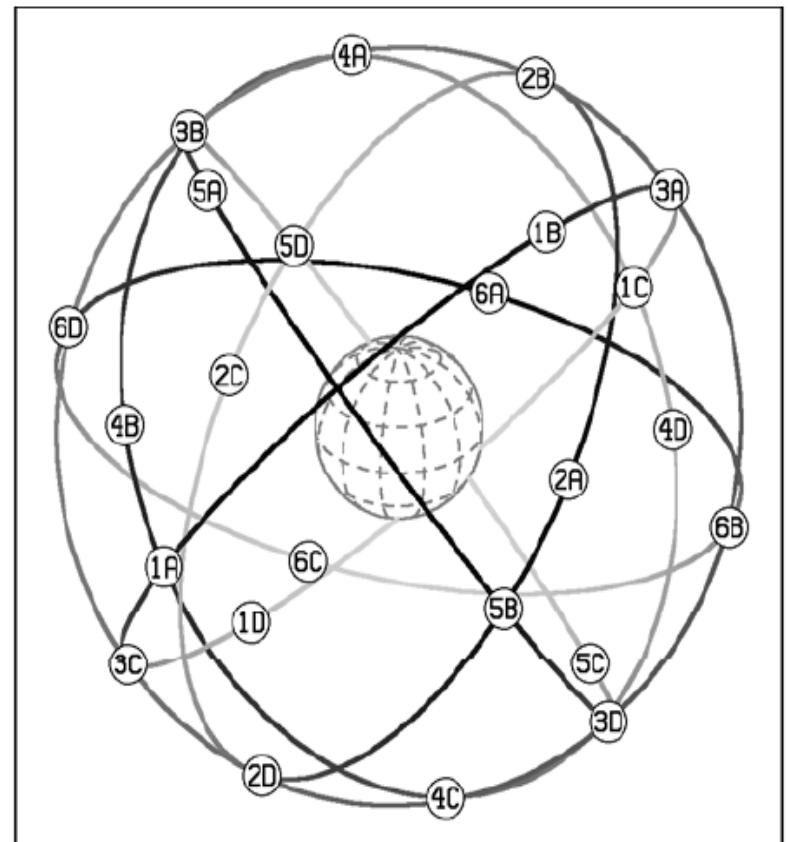


Figure 2. The GPS constellation. The satellite numbers

II. SATELLITE CONSTELLATION NETWORKS

II.1. A SATELLITE CONSTELLATION

3.1 Navigation satellites (NS):

- **The best** known constellation is that of :
 - “ *the **Global Positioning System (GPS)*** “
- **The GPS** is a constellation of **24 satellites** :
 - “ *Four satellites in each of six orbital planes* “
- **Two** other **NS** launched by Russia :
 - “ **Global Navigation Satellite System (GLONASS)** “
 - “ **Low earth orbit navigation system** “

II. SATELLITE CONSTELLATION NETWORKS

II.1. A SATELLITE CONSTELLATION

3.2 Telecommunications satellites:

- The best known of the telecommunication satellite constellations is the Iridium **constellation**:
 - “ It consists of **66 satellites** arranged in **six orbital** planes “
- A second telecommunications constellation is Globalstar:
 - “ It consists of **48 satellites** in **8 orbital** planes “
- A final constellation is the **Orbcomm constellation**, which provides data (**not voice**) communications

II.1. HANDOVER

II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER

1. Definition :

- In cellular telecommunications :

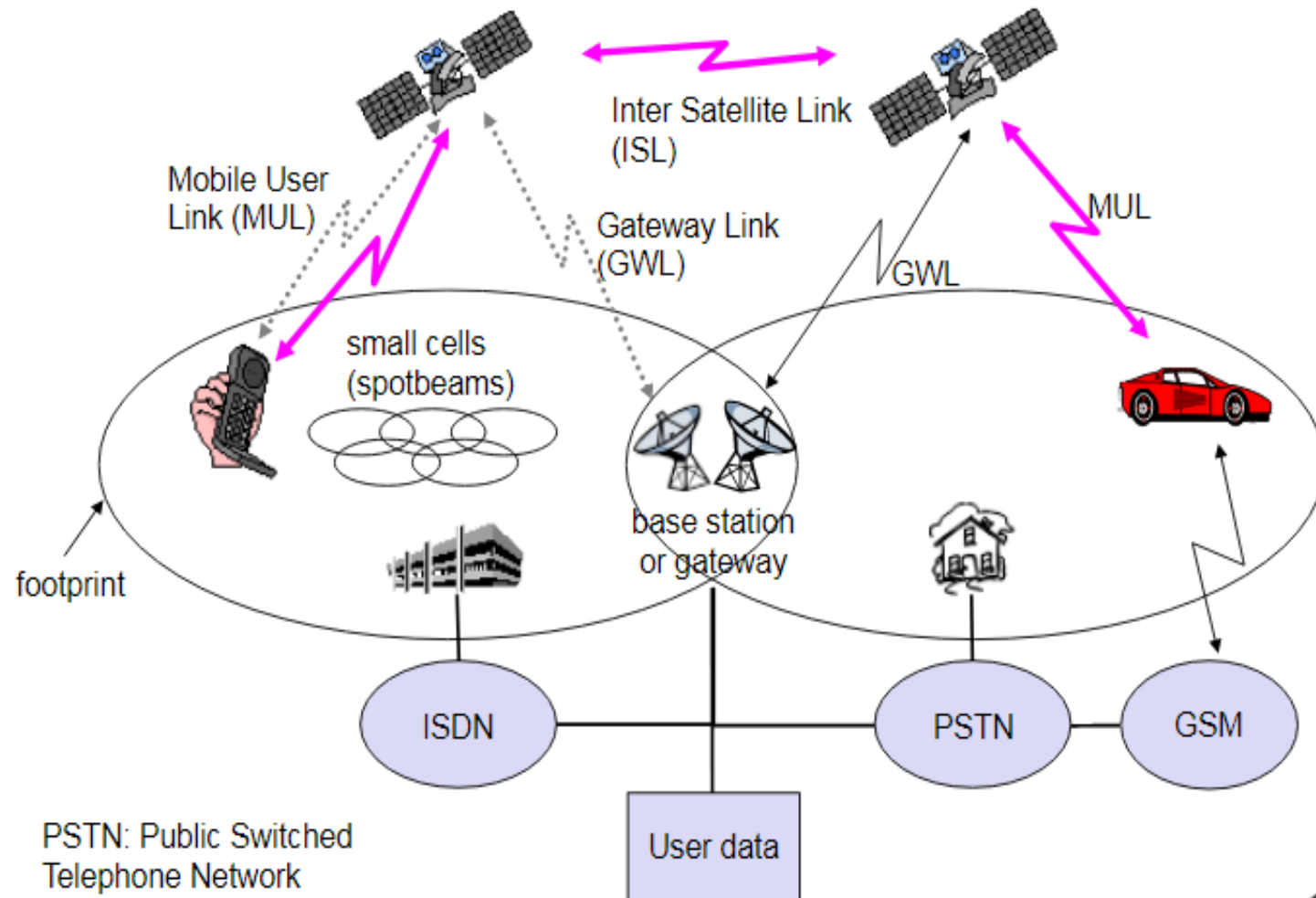
“ handover, is the process of *transferring* an *ongoing call* or *data session* from *one channel* connected to the core network to *another channel* ”

- In satellite communications :

“ It is the process of *transferring* satellite *control responsibility* from *one earth station* to *another* without loss or interruption of service.”

II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER



II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER

2. Classes of HANDOVER in satellite networks:

Handovers in satellite networks can be classified as follows:

2.1. Link-Layer Handover:

“ Link-layer handover occurs when we have to change one or more links between the communication endpoints due to dynamic connectivity patterns of LEO satellites. “

II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER

* It can be further classified as:

- ✓ **Spotbeam Handover:** (*boundary between the neighboring spotbeams of a satellite*)
- ✓ **Satellite Handover:** (*transferred to another satellite*).
- ✓ **ISL Handover:** (*interplane ISLs would be temporarily switched*)

2.2. Network-Layer Handover:

“ When one of the communication endpoints changes its IP address due to the change of coverage area of the satellite or mobility of the user terminal “

II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER

3. Situations for handover in satellite systems:

Several additional situations for handover in satellite systems compared to cellular terrestrial mobile phone networks caused by the movement of the satellites:

3.1 Intra Satellite Handover:

- ✓ Handover from one spot beam to another
- ✓ Mobile station still in the footprint of the satellite, but in another cell

II. SATELLITE CONSTELLATION NETWORKS

II.2. HANDOVER

3.2 Inter Satellite Handover :

- ✓ Handover from one satellite to another satellite.
- ✓ Mobile station leaves the footprint of one satellite.

3.3 Gateway Handover :

- ✓ Handover from one gateway to another
- ✓ Mobile station still in the footprint of a satellite,
but gateway leaves the footprint

3.4 Inter system handover:

- ✓ Handover from the satellite network to a terrestrial cellular network
- ✓ Mobile station can reach a terrestrial network