

# Satellite Communication (TC-612)

Lecture # 10

## Interference

### Interference in Satellite

- Interference is mainly concern on;
  - Interference Type
  - Sources of Interference
  - Causes of Interference

### Interference

#### Interference Type:

- Digital
- Spike
- Cross Polarization
- TDMA
- FM TV
- Intermodulation
- Unknown

### Interference

#### Source of Interference:

- Neighboring Customer
  - Adjacent Satellite
  - Self-Customer
  - Opposite Polarization
  - Others
- External Factors: **40.22%**  
Internal Factors: **59.78%**

### Interference

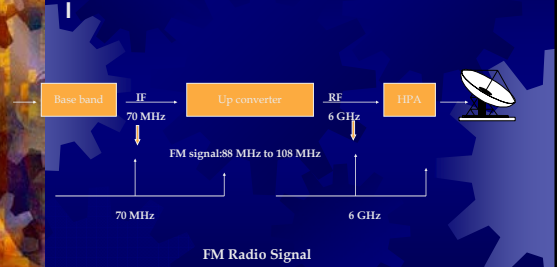
#### Cause of Interference:

- Human Error: 29.89%
  - Equipment Error: 21.74%
  - Adjacent Satellite: 16.85%
  - Customer Cooperation: 8.15%
  - Others: 23.37%
- Internal Factors: **59.78%**

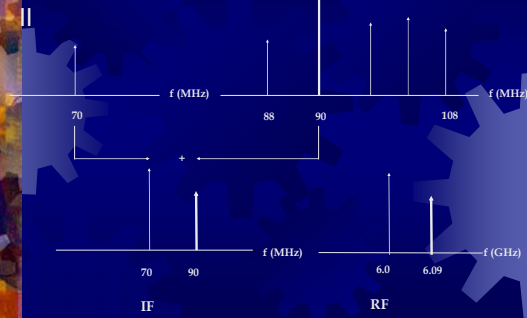
## Types of Interference

- FM
- Cross Polarization
- Digital
- CW
- Intermodulation
- Raised Noise Floor
- TV/FM
- TDMA
- Spikes & Unknown

## FM Interference



## FM Interference



## FM Interference

### Source:

- Terrestrial FM Radio Broadcast
- Introduced at the IF level of the Earth Station

## FM Interference

### IV Cause:

- Poor Connection between BB and RF equipment, so FM broadcast is induced into the system and eventually transmitted to the satellite.
- Poor quality accessory between BB and RF
- Poor grounding system

## FM Interference

### V Prevention:

- Select accessories with standard specifications
- Good Earth Station installation
- Good grounding system
- Coordinate with PCNS to perform UAT and interference checking when a new station is installed

## Cross Polarization Interference

### Source:

- If XPD level of an uplink antenna is less than 30 dB, antenna will transmit both vertical and horizontal polarizations
- Therefore, cross pole will occur at the other satellite or transponder with opposite pole and will interfere the existing carrier

## Cross Polarization Interference

### Cause:

- Poor antenna pointing
- Poor cross pole isolation
- Sudden change in the antenna pointing due to mistake or storm
- Carrier uplink without performing proper UAT with PCNS

## Cross Polarization Interference

### Prevention:

- Do not uplink the carrier without performing UAT with PCNS
- DO not uplink un-modulated carrier for UAT before PCNS's directions
- Perform Regular Preventive maintenance

## Digital & CW Interference

### Source:

- Earth Station Equipment

## Digital & CW Interference

### Cause:

- Transmission of wrong carrier frequency by the user
- Unauthorized access
- Uplink CW for UAT before calling PCNS
- Equipment malfunction

## Digital & CW Interference

### Prevention:

- Verify U/L frequency before transponder access
- Do not uplink un-modulated carrier (CW) before PCNS directions
- Perform UAT
- Request PCNS if customer wants to uplink a new carrier for special purpose at some vacant slot
- Perform Preventive Maintenance periodically

## Intermodulation Interference

### Description:

- If more than one carrier are transmitted by a single HPA, mixing or Intermodulation (IM) processes take place
- This results in Intermodulation products which are displaced from the carriers at multiples of the difference frequencies
- The power level of the Intermodulation products are dependent on the relative power level of the carrier and the linearity of TWTA or SSPA

## Intermodulation Interference

### Description:

- The frequencies of the Intermodulation products are:
  - $2f_1 - f_2$        $f_1$ : frequency of carrier #1
  - $2f_2 - f_1$        $f_2$ : frequency of carrier #2
- It can occur at both E/S and Satellite

## Intermodulation Interference

### Cause:

- U/L power level of the each carrier is set so high that the Intermodulation occurs
- U/L power level is increased without considering the the possibility of intermodulation
- Increasing the U/L power without informing PCNS

## Intermodulation Interference

### How does it affects

- It reduces the  $E_b/N_o$  of your carrier using at the same frequency
- May raise the Noise Floor of some slots
- Existing uplink power at E/S would be used more than normal
- Therefore, you have to replace new RFT to get more power when you would want to put new carriers into it

## Intermodulation Interference

### Prevention:

- Verify the link budget of the station transmitting more than one carrier before transponder access
- Aggregate input back-off for HPA or RFT at E/S must be defined and informed to up linker
- Do not increase U/L power without informing PCNS
- Do not operate with overused power

## Raised Noise Floor

### Source:

- Earth Station Equipment

## Raised Noise Floor

### Cause:

- E/S equipment configuration was not set up properly
- The gain of U/L equipment such as U/C or HPA was not set suitably
- The U/L power is too high

## Raised Noise Floor

### Prevention:

- Use good E/S setup
- Set suitable gain of E/S equipment
- Do not increase the U/L power without informing PCNS
- Verify uplink noise level at the output of HPA before transponder access

## Spike and Unknown

### Description:

- Unpredictable Frequency, Bandwidth, Time
- Some of them may occur at out of assigned transponder

## Spike and Unknown

### Cause:

- Most of them are caused by the U/L equipment error (both base band and RF equipment)
- It does not affect all carriers transmitted by itself

## Spike and Unknown

### Investigation:

- Only RF equipment such as U/C, HPA, Transceiver needs turning off
- Turning of Base band equipment such as Modem, Exciter, Modulator cannot prove the source of interference

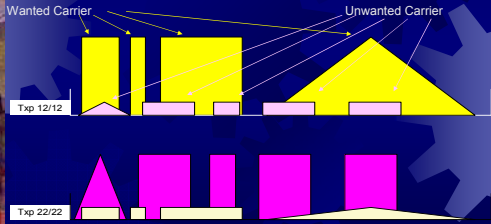
## Spike and Unknown

### Prevention:

- Perform Preventive Maintenance periodically
- Operate all U/L equipment under suitable conditions as directed by operational manual of the equipment
- Find out root cause if it disappeared with unknown reason or equipment reset in order to perform prevention

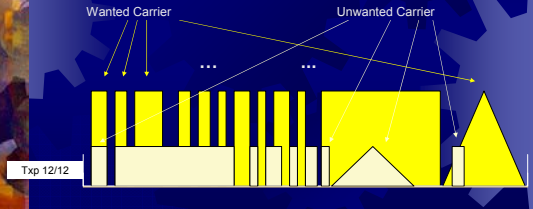
## Sources of Interference

### Co-Channel Interference



## Sources of Interference

### TWTA Intermodulation



## Transponder Parameters

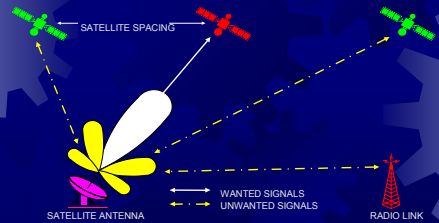
### Intermodulation (IM)

- What is it? - Potential source of noise
- Why does it exist? - Different signals are sent simultaneously
- How is it avoidable? - By reducing the saturation E.I.R.P.

$$E.I.R.P._{Operation} = E.I.R.P._{Saturation} - OBO$$

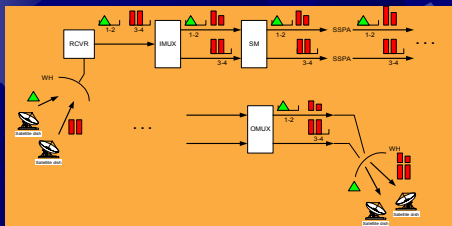
## Sources of Interference

### Adjacent Satellite Interference (ASI)



## Sources of Interference

### Adjacent Transponder Interference (Multipath)



## Sources of Interference

- Satellite:
  - Co-Channel Interference
  - TWTA Intermodulation
  - Adjacent Satellite Interference
  - Adjacent Transponder Interference - "Multipath"
- Earth Station:
  - HPA Intermodulation
- Outside:
  - Sun Interference
  - Terrestrial Interference
- Path Losses:
  - Up link thermal Noise
  - Down link thermal Noise

Questions?

