LASER SATELLITE COMMUNICATION

INTRODUCTION

a)Transmission at frequencies in 10^{14}

b)Advantage

- Greater bandwidth
- Smaller beam divergence angles
- Smaller antennas

c)Modes of communication

- Aerial
- Fiber optical communication
- Optical computer

ARIEL

- Ariel :data and images are transferred using low power beams
- Impossible to jam by known means
- Weather dependent
- Clear day – several miles
- Rain ,fog ,mist -- limited to shorter distance

Fiber optical communication& optical computers

- Guided media
- 4 Giga bits of information/sec over a span of 120Km

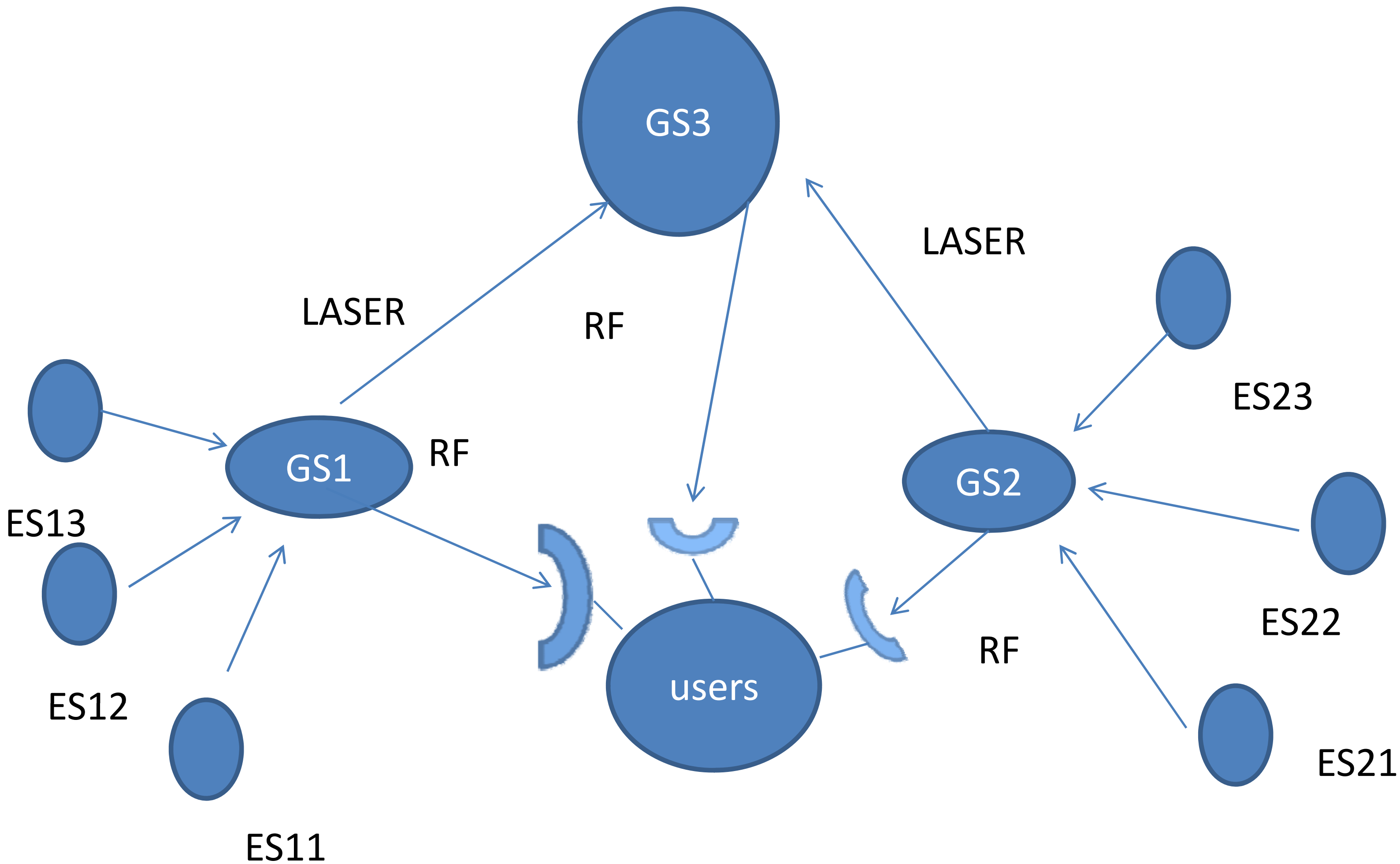
Optical computers

I. Light is used instead of electrical circuit
II. Light can be encoded with much more information
III. Zero resistance to flow ,more information than the equivalent sized electric circuit
IV. Optical signal can be used in parallel

Use

- Communication between the satellite themselves
- Can not be used between earth station and geostationary satellite being atmospheric dependent

LASER SATELLITE COMMUNICATION



GSS =GEAOSTATIONARY SATELLITE
ESS= EARTH OBSERVATION SATELLITE

LINK ANALYSIS

Atmospheric Effects:

- Attenuation due to energy absorption
- Beam spreading due to scattering of light waves
- Beam bending due to refocusing of optical beams
- Beam break up due to loss of coherence

ATMOSPHERIC

- Dependent on wavelength
- Dependent on elevation angle

Complete link design

- Up link and downlink RF is used to satellite
- Two satellite cross link (optical link)
- RF up link wave form

$$s(t) = u(t) + n_u(t)$$

$$u(t) = uplink\ .carrier$$

$$n_u(t) = uplink\ .Noise\ .and\ .Interferen\ ce$$

$$P(t) = P_r(1 + \beta s(t))$$

$P_r isaveragep \ owerand \ \beta i \sin tensity \ \mathrm{mod} \ ulation \ \beta \leq 1$

The reciever satellite the signal of optical reciever by photo detecting it the photo detector detects the intensity modulated signal as

$$R\left[\beta P_r s(t)\right] = R\beta P_r\left[u(t) + n_u(t)\right]$$

$R = photo$ detector responsiti vity

$\mathrm{P_s} = satellite \ - downlinkpo \ wer$

$$P_s = \alpha_s{}^2 P_t[(R\beta P_r)^2 P_{cu}]l$$

$$Pns = \alpha_n^2 P_t[(R\beta P_r)^2 P_{nu} + P_{PD})]L$$

α is signal and noise suppression Pns =total downlink retransmitted noise power

L is the downlink losses

Pcu is the uplinkpower ofu(t)

Ppd is photo detector noise

Pnu additional noise by the down link

$$(C/N)_T = \frac{P_s}{P_{ns} + P_{nd}}$$

$$(C/N)_u = \frac{P_{cu}}{P_{nu}}$$

$$(C/N)_{op} \approx \frac{P_s}{P_{PD}}$$

$$(C/N)_r \approx \frac{LP_t \alpha^2}{P_{nd}}$$

$$\alpha_s^2 = \left[1 + \left(\frac{1}{C./N}\right)_{op}\right]^{-1}$$

$$(C/N)_T = \left[(C/N)_u^{-1} + (C/N)_{op}^{-1} + (C/N)_r^{-1}\right]$$