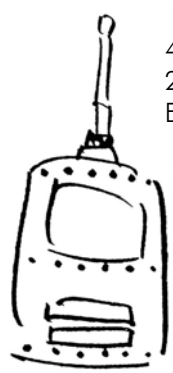
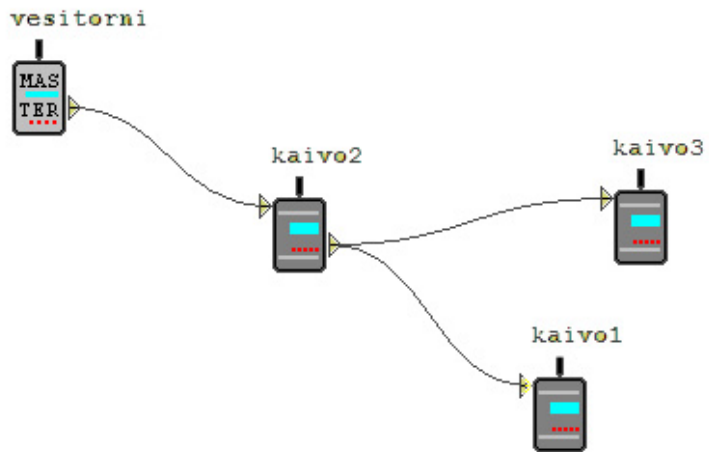


SATELLINE Radio Data Modems

SYSTEM DESIGN



409.3125 MHz/12,5 kHz
2 Werp
EN 300 113

V.24/RS-232C
ModBus
24 Vdc

Radio Communications System

$$\text{Mismatch Loss} = -10 \lg \left\{ 1 - \left[\frac{\text{VSWR}-1}{\text{VSWR}+1} \right]^2 \right\}$$

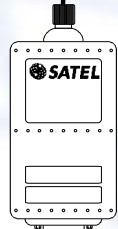
Antenna

- Height
- Gain [up to 15 dBi]
- Radiation Pattern
- Polarization
- Matching
- Materials
- Structure
- Lightning Protection

$$[x \text{ dBd} = (x + 2.15) \text{ dBi}]$$

RF-Cable

- Loss
- Impedance
- Connectors
- Assembly of connectors
- resistency to UV-light, mechanical stress etc.



Transmitter

- Output power [double power = + 3 dB]
- Spectral purity
- Output impedance
- Duty Cycle

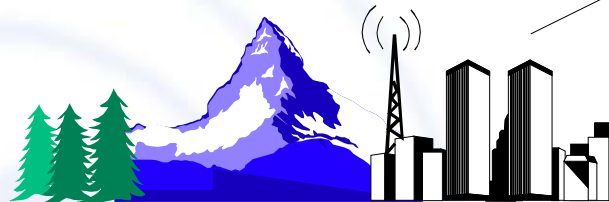
Signal Propagation

- Free space propagation attenuation
- Basically line-of-sight propagation on UHF, no ionosperic reflections
- Attenuation through walls etc.
- Shadowing by hills
- Reflections from obstacles
- Diffractions on edges
- ⇒ fading
- Weather conditions

$$\text{Radius of the 1st Fresnel zone} = \text{SQRT} (\lambda \times d1 \times d2 / d)$$

$$\text{Free Space Loss} = [20 \lg(d/\text{km}) + 20 \lg(f/\text{MHz}) + 32.4] \text{ dB}$$

$$\text{Distance to the horizon} = 112.88 \text{ SQRT} (h) ; h \text{ in km}$$



Link Budget

- TX Output Power
- Cable Losses
- + TX Antenna Gain
- Propagation Loss
- + RX Antenna Gain
- Cable Losses
- other losses
- Safety Margin
- Additional Margin
- RX Sensitivity

Interference

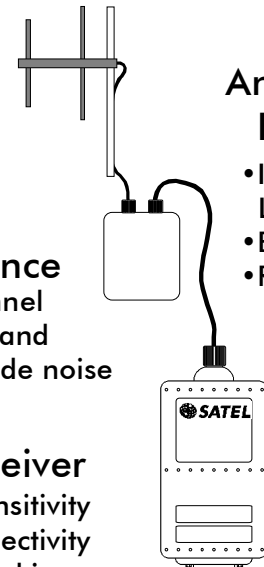
- On channel
- Out of band
- Man-made noise

Receiver

- Sensitivity
- Selectivity
- Blocking
- Co-channel Rejection
- Intermodulation Response

Antenna Filter

- Insertion Loss
- Bandwidth
- Rejection



DESIGN PROCEDURE

1. Evaluation of the Limitations

- serial interface type: (V.24/RS-232C or V.11/RS-422)
- data protocol
- radio channels available
- maximum acceptable response times
- locations of the stations
- topographic profile over the area

DESIGN PROCEDURE

2. design of network structure

- theoretical design of the radio links
- additional repeaters
- number of channels to meet the data capacity requirements
- specifying the antenna types and heights, and feed cables
- > *commercial quotation*

DESIGN PROCEDURE

3. data protocol tests at the laboratory
 - to ensure the compatibility of the terminal devices and radio modems

4. radio propagation tests
 - to make sure of reaching sufficient signal margins
 - to avoid over specifying with mast heights, antennas etc.

DESIGN PROCEDURE

5. radio interference tests

- important at the base station
- information needed for selecting the antenna filters

6. final data communication tests

- factory tests
- on-site tests during the installations