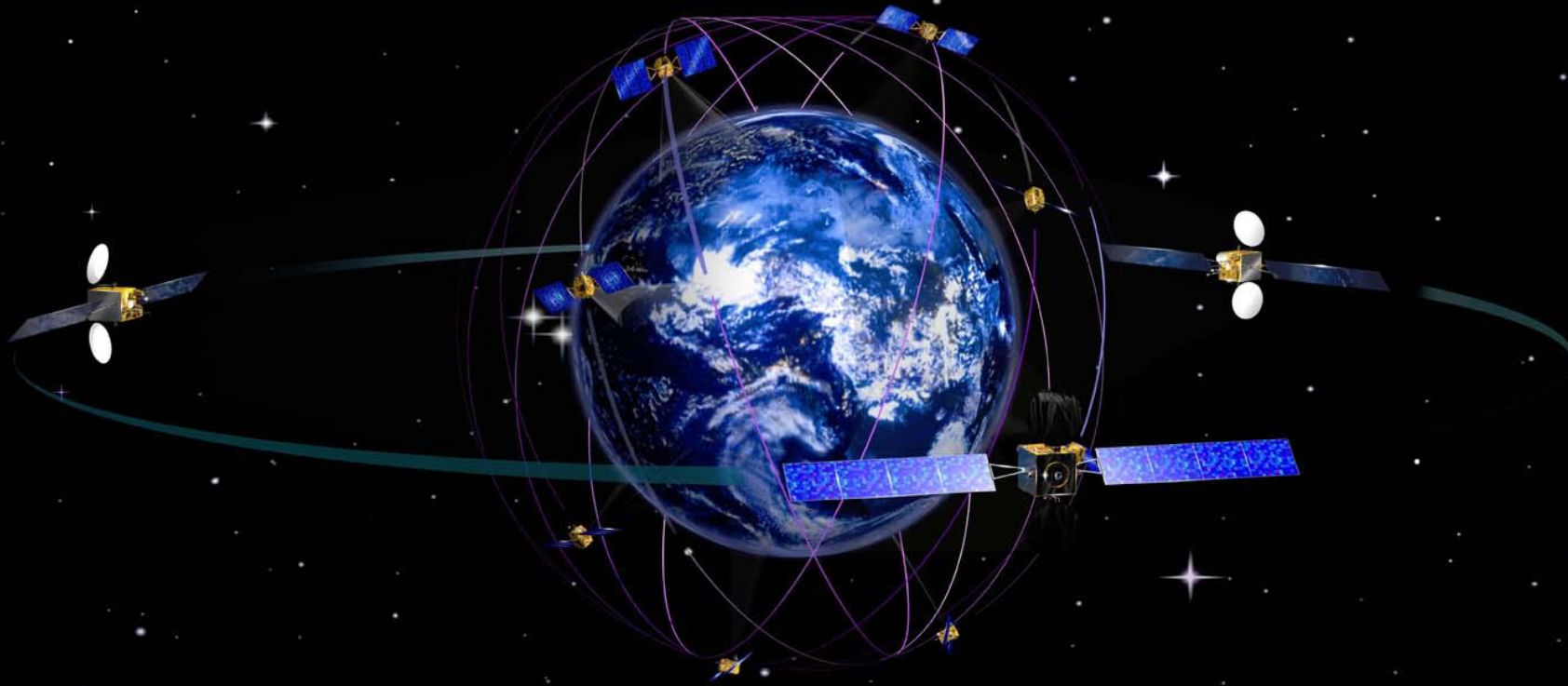


# Satellite Communications

## – RRY100 –



# RRY100 2024 – Oral exams, Monday, 2024-10-28

DG-A:

**2024-10-28, 13:00-14:00**

- Jahanavi Bhadrashetty Dinesh (MPICT)
- Johan Ålbraten (MPWPS)
- Duarte Barreto (Erasmus)
- Rui Su (Bilateral)

DG-B:

**2024-10-28, 14:15-15:15**

- Muhammad Uzair (MPICT)
- Yusheng Yang (MPICT)
- Filip Bergqvist (MPWPS)
- Ivan Bukac (Erasmus)

DG-C:

**2024-10-28, 15:30-16:30**

- Ludvig Tvingby (MPICT)
- Emma Ödman (MPWPS)
- Sri Sai Satyanaray Damaraju (MPCOM)
- Simon Björklund (TKELT)
- Arven Mannaert (Erasmus)

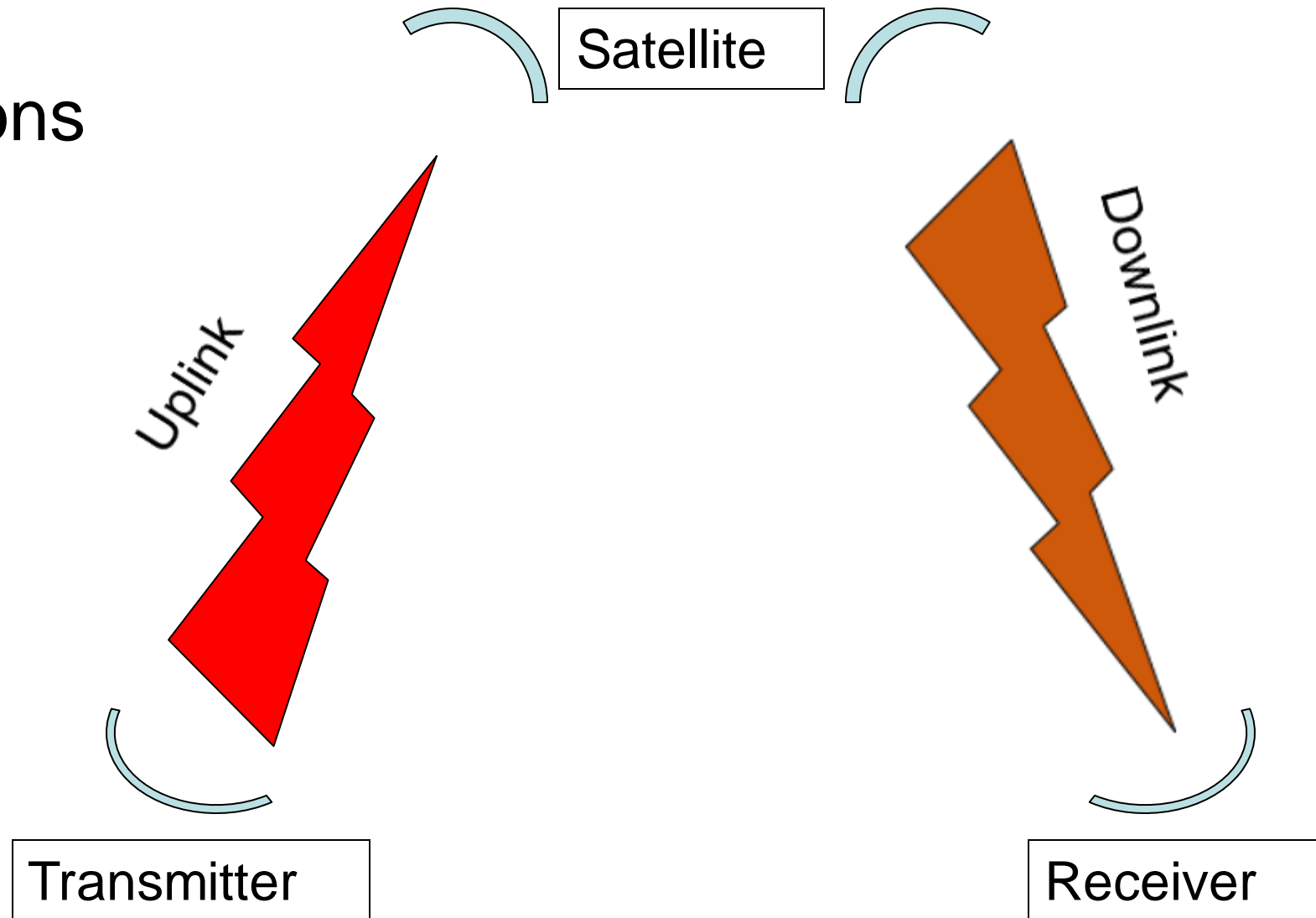
**Room: SEE "Lilla mötesrum", 4th floor, enter from staircase "Maskingränd"**

# Concerning the course evaluation

- You/we can add questions to the questionnaire
- Talk e.g. to the course evaluation students:
  - Johan – Duarte – Filip – Muhammad –
- Or send me your additional questions directly via email

=> latest by Thursday this week, 2024-10-17, 12:00!

# A satellite communications system



# This year's problem (1/6)

## “A communication system for “Avancez Cruises”

Imagine that you have finished your master's education at Chalmers successfully and now start a job as a consultant in the area of Satellite Communications.

You are contacted by the shipping company "Avancez cruises" to develop a company-internal satellite communication system for their fleet of cruise liners which operate between Europe, the Caribbean and around South America, and around Africa (see Fig. 1).

# **This year's problem (2/6)**

Avancez cruises operates a fleet of  $>10$  ships.

Each ship should be able to communicate with the company's headquarter in Göteborg, independent from its current position on the cruise network.

Each of the ship should also be able to communicate with the other ships operating on the cruise route network.

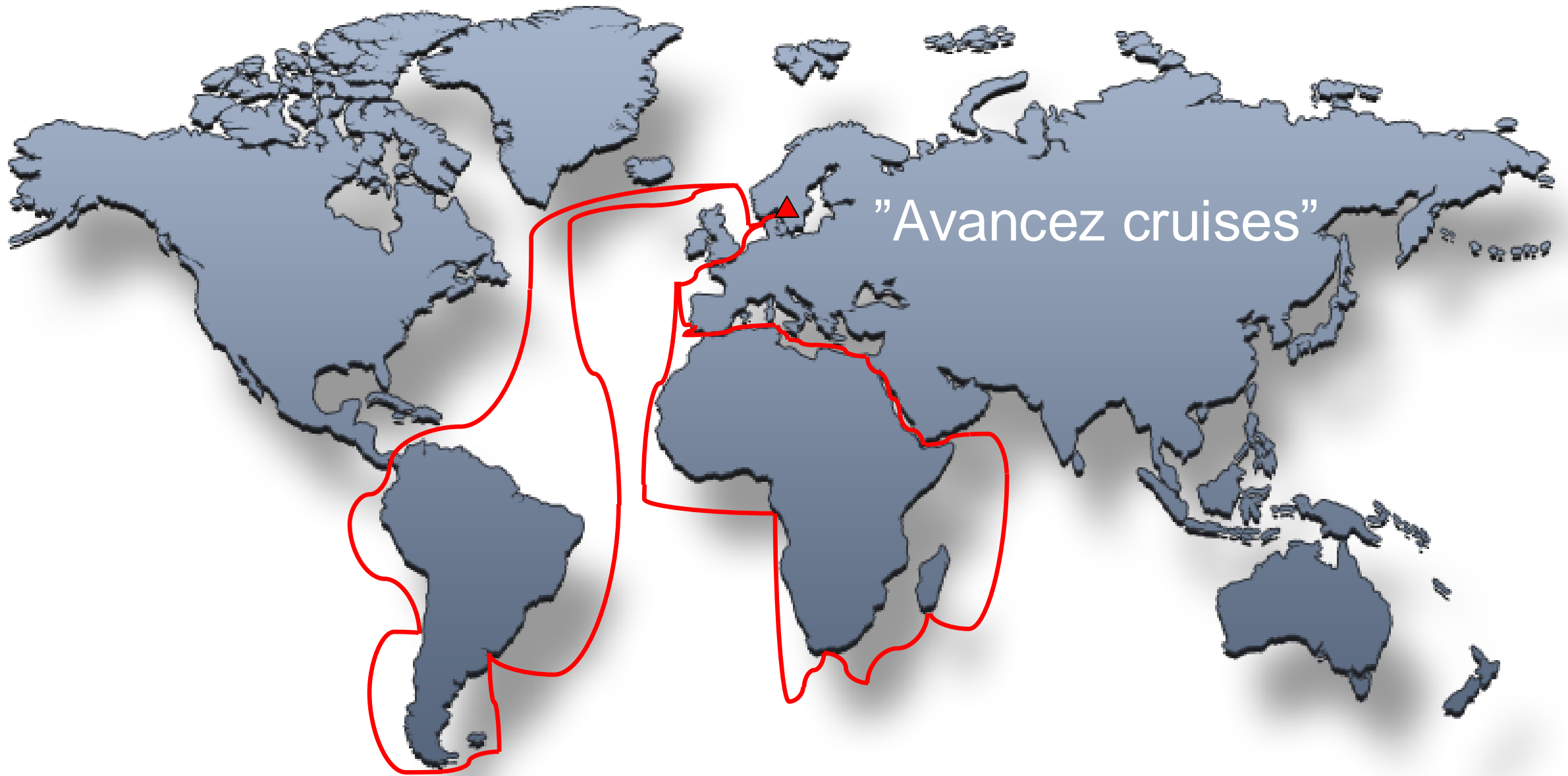


Fig. 1 Example of "Avancez cruises" possible route lines.

# **This year's problem (4/6)**

Each ship should provide basic internet service for their guests as well as for the on-board staff. Note: "Avancez cruises" operates in the high-price market and their ships have usually less than 500 passengers (incl. staff).

The headquarter should be able to send information such as weather charts and software updates to any of the ships.



# **This year's problem (5/6)**

Your task is to design a complete satellite communications system for this purpose, assuming that all aspects of the infrastructure needed (e.g. launching of satellites and financial issues) have been taken care of already.

The system must meet the requirement of a very high availability. It must be duplex and the data transfer must be working for more than 99.999 % of the time, and allow high data rates (several Mbps).

# This year's problem (6/6)

This (rather vague) problem is meant as a red thread to help you formulating your acquired knowledge on the application of satellites in communications.

Thus, you are encouraged especially to include simulations and a thorough discussion of your preferred approach as well as alternative solutions in your written examination report.

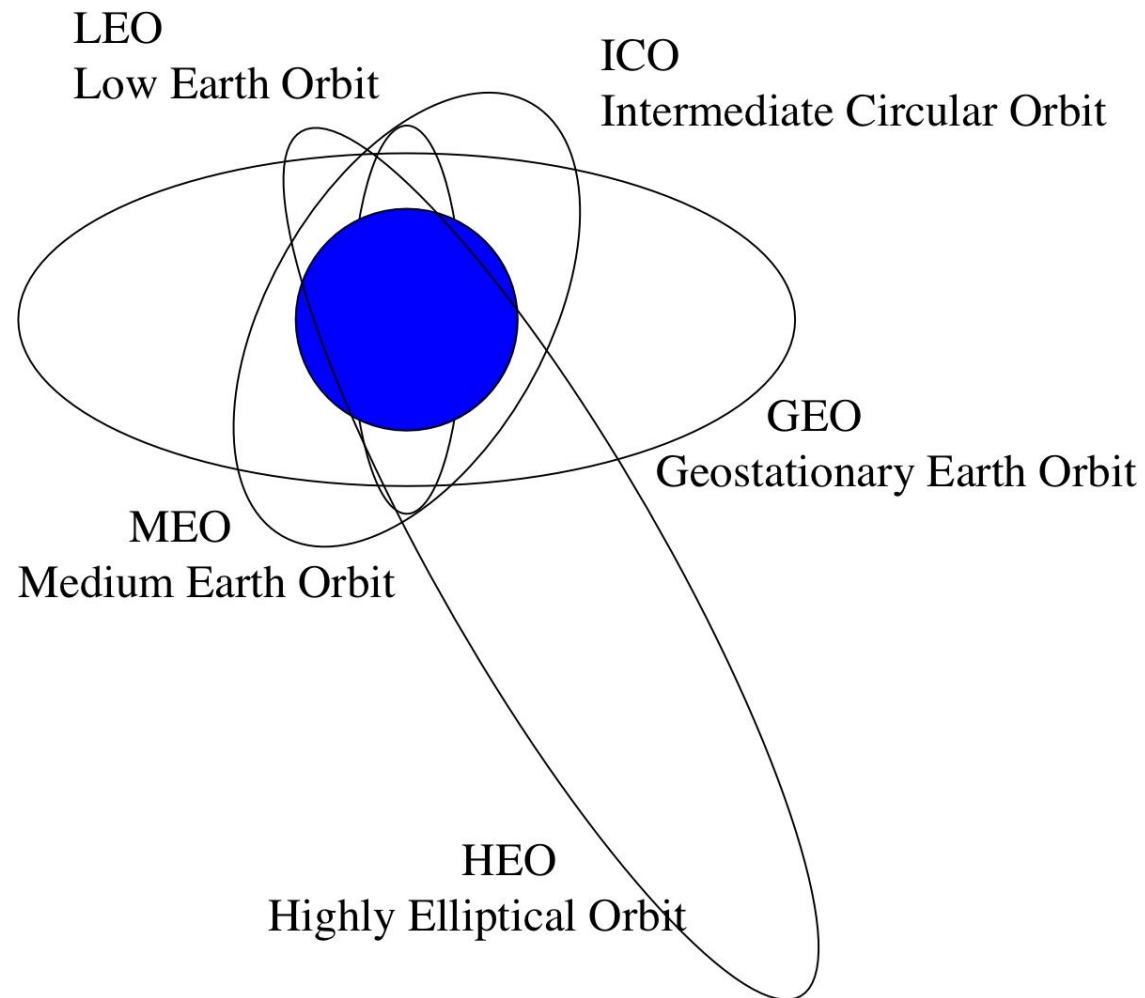
Make use of extensive discussions with your group members.

**OBS:** The examination reports are individual reports!

# Summary of RRY100

- Satellite orbits
- Electronic equipment (ground & space)
- Antennas
- Signal propagation effects
- Multiplex/modulation/multiple access
- Link budget calculations, link performance

# Satellite orbits



# Satellite orbits

- What kind of orbits exist?
- What advantages and disadvantages?
- Motivate your choice!
- Explain consequences, e.g. number of satellites, visibility conditions, access possibilities, handover, etc.
- Calculations and graphical explanations

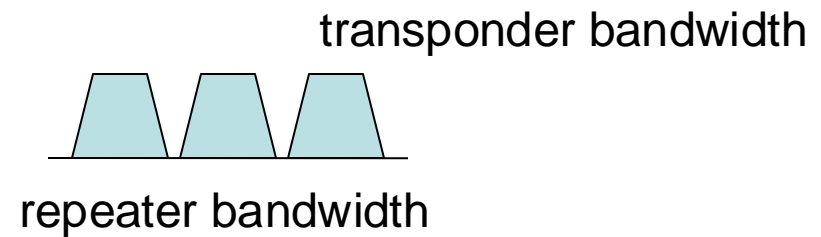
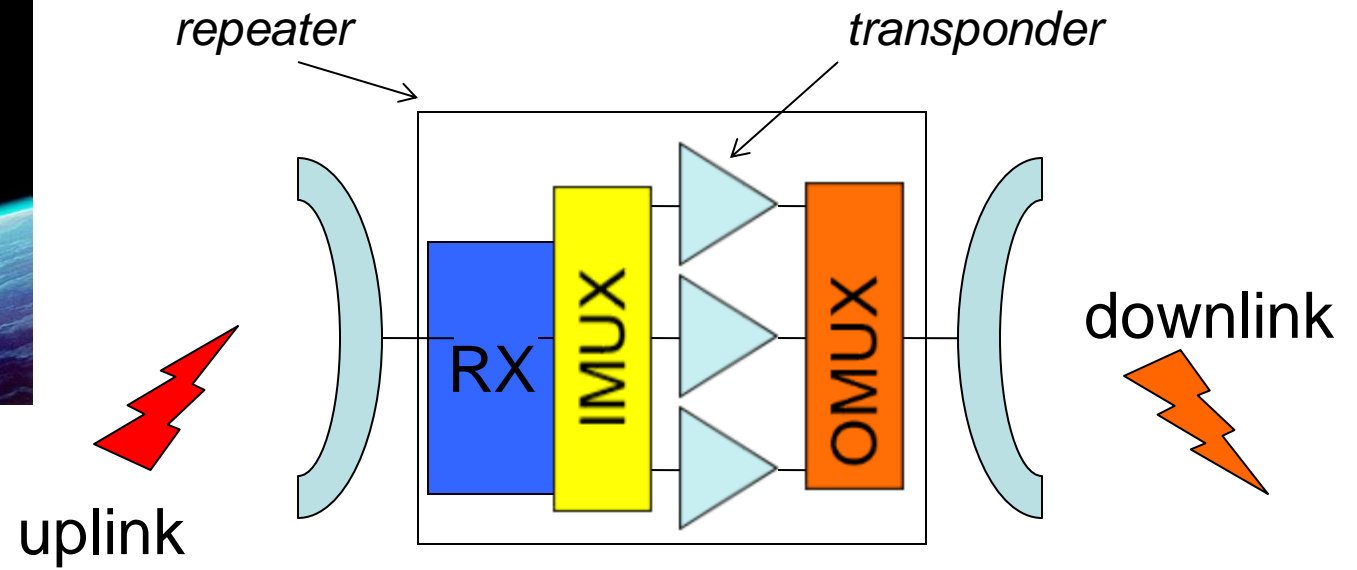
# "Ground" units



# Ground units

- Type of users? (mobile – fixed)
- Necessary sending and receiving equipment?
- What restrictions, e.g. power, antenna size, etc.?
- System noise temperature?
- Explain, motivate choices, describe consequences

# Satellites



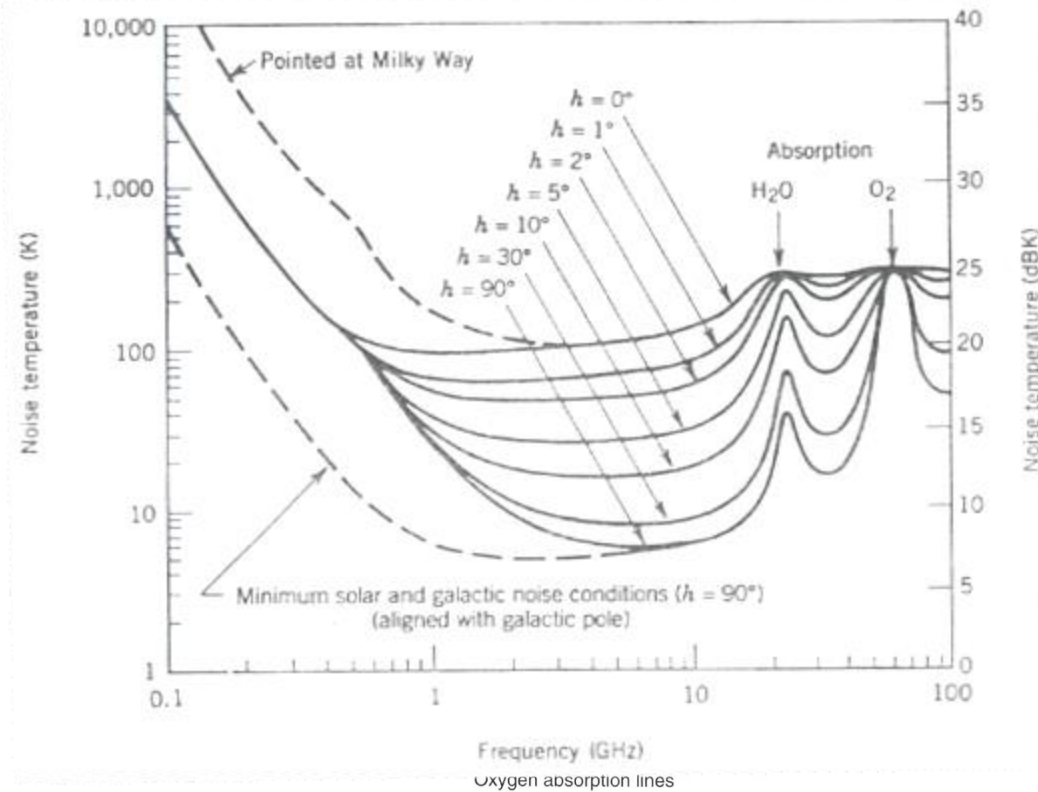


# Satellites

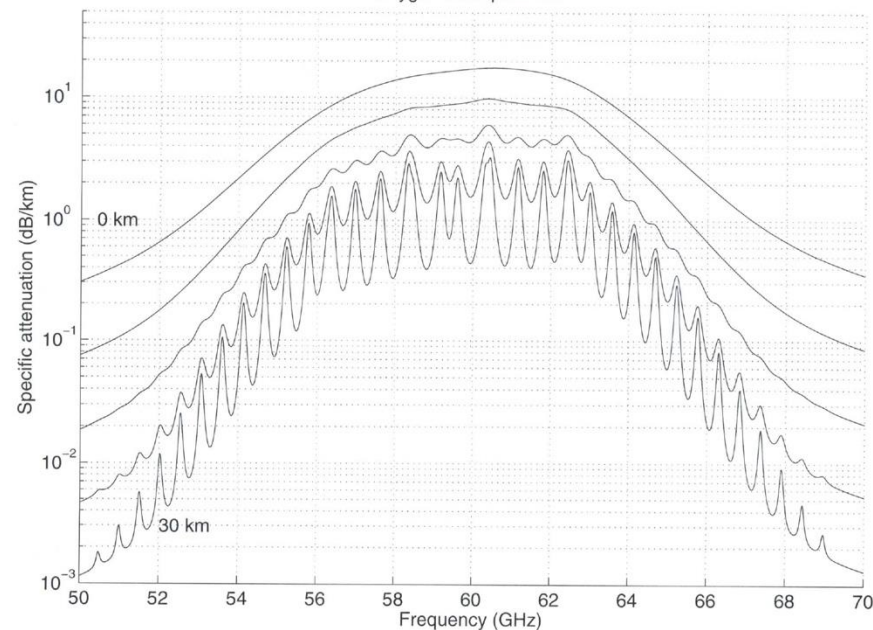
- Sending and receiving equipment?
- System noise temperature?
- Transparent or regenerative repeater?
- Antennas?
- Footprint size up- and downlink?
- Inter-satellite links?
- Explain, motivate choices, describe consequences

# Signal propagation





Gases and rain  
in the Earth's  
atmosphere

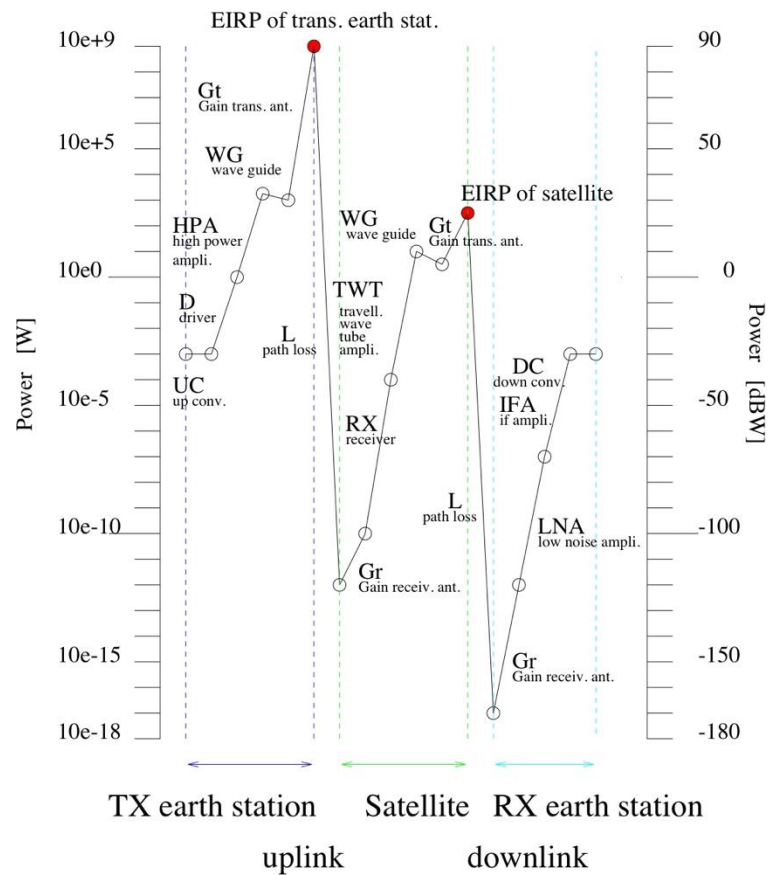


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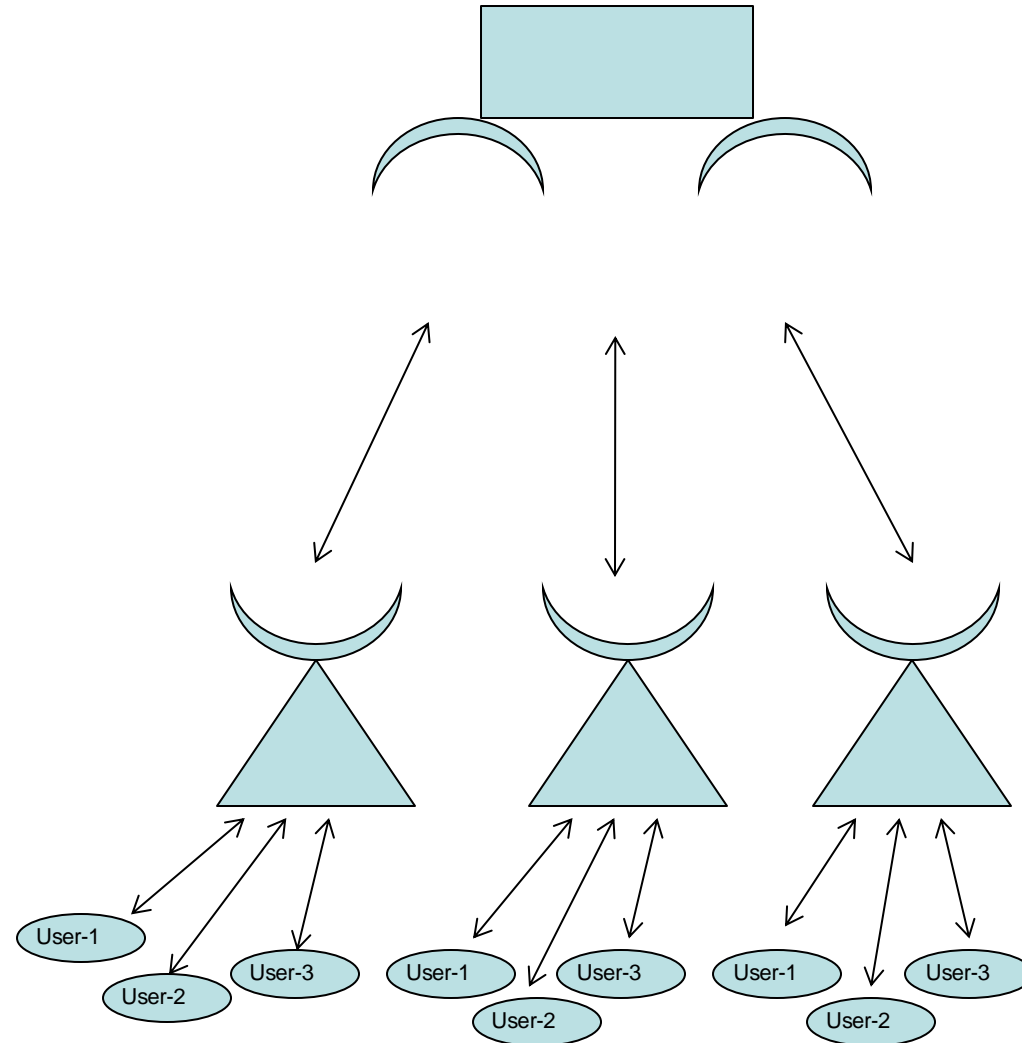
# Signal propagation

- What frequencies? Why?
- What polarization? Why?
- Atmospheric absorption?
- Rain attenuation?
- ITU-recommendations
- Explain, motivate choices, describe consequences

# Link budget



Power budget



# Link budget

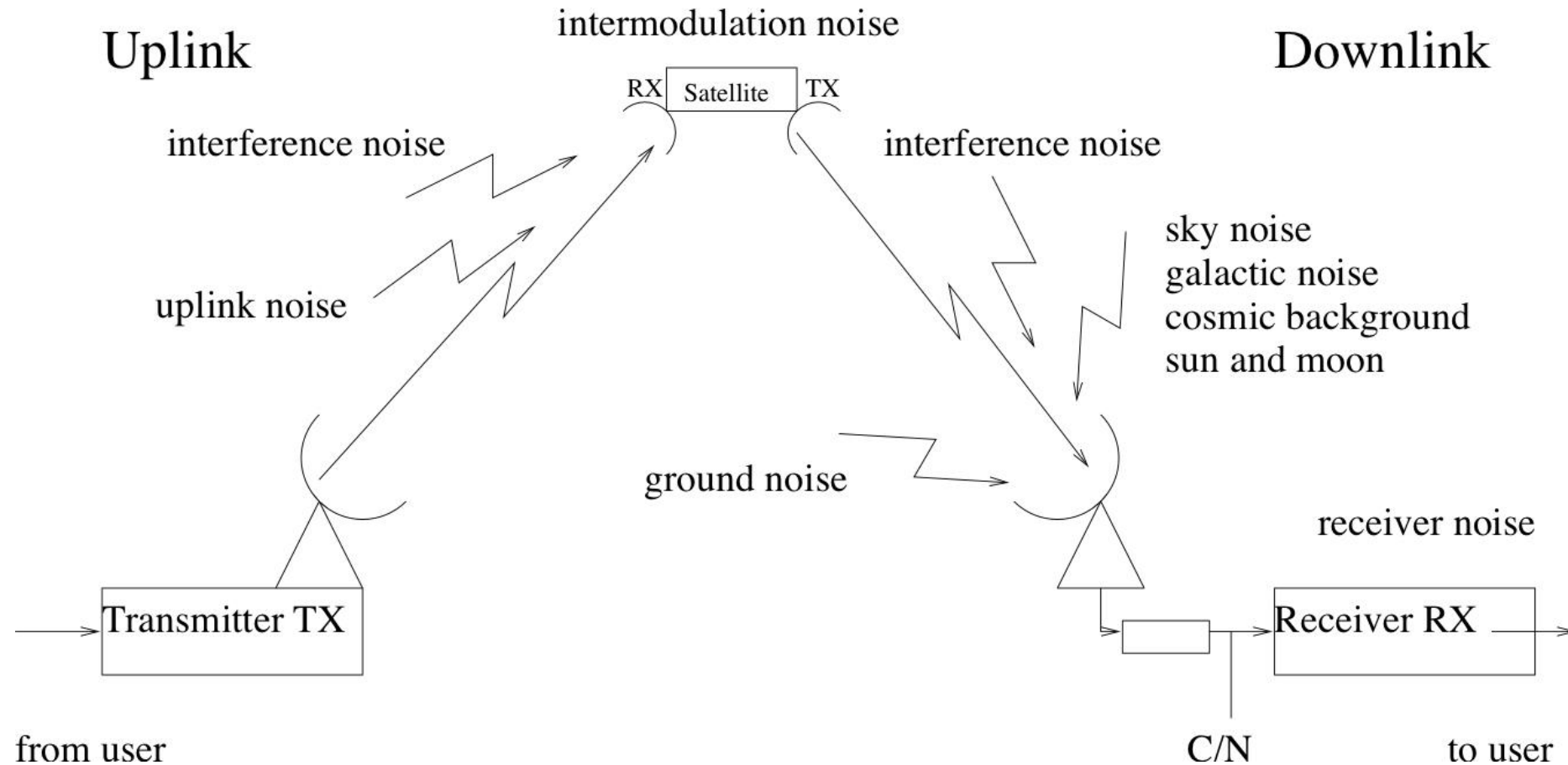
- Amount and type of data?
- Number of users?
- Multiplex, Modulation, Multiple access?
- Link margins?
- Overall C/N ratio? Overall BER?
- Quality? System availability? Robustness?

# Questions on digital communication aspects and e.g. multiple access

Maral, Gérard Michel, Bousquet Sun, Zhili. (2020). *Satellite Communications Systems - Systems, Techniques and Technology (6th Edition)*. John Wiley & Sons. Retrieved from <https://app.knovel.com/hotlink/toc/id:kpSCSSTT02/satellite-communications/satellite-communications>

Accessible via Chalmers library.

# Link budget





# Your examination report

- Scientific/technical report
- Write with your own words
- Explain, motivate, discuss
- Use correct referencing and citations
- Use also references for graphical material that you use
- Upload your report as a pdf-file to the course page on Canvas latest 17:00 on Friday, 2024-10-25

# What I will check...

- Evaluation  
e.g. criticize, evaluate, judge
- Synthesis  
e.g. make conclusions
- Analysis  
e.g. formulate and solve problems
- Application  
e.g. simulations, calculations
- Description  
e.g. relations between quantities
- Facts  
e.g. definitions

