

Space Ops 101

An Introduction to Spacecraft Control

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German Space Operations Center

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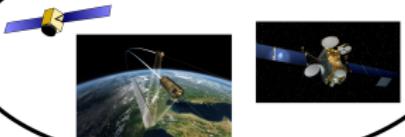
35c3

What we will not talk about ...



... but instead

Space Segment



Transfer Segment



Ground Segment



... but instead

Space Segment



Transfer Segment



Ground Segment



Outline

1 Basics of Spaceflight

- Orbits
- Communications
- Phases of Mission Operations

2 Procedures

- TC, TTC, Telemetry and Procedures

3 Subsystems

4 Contingencies

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- TV?

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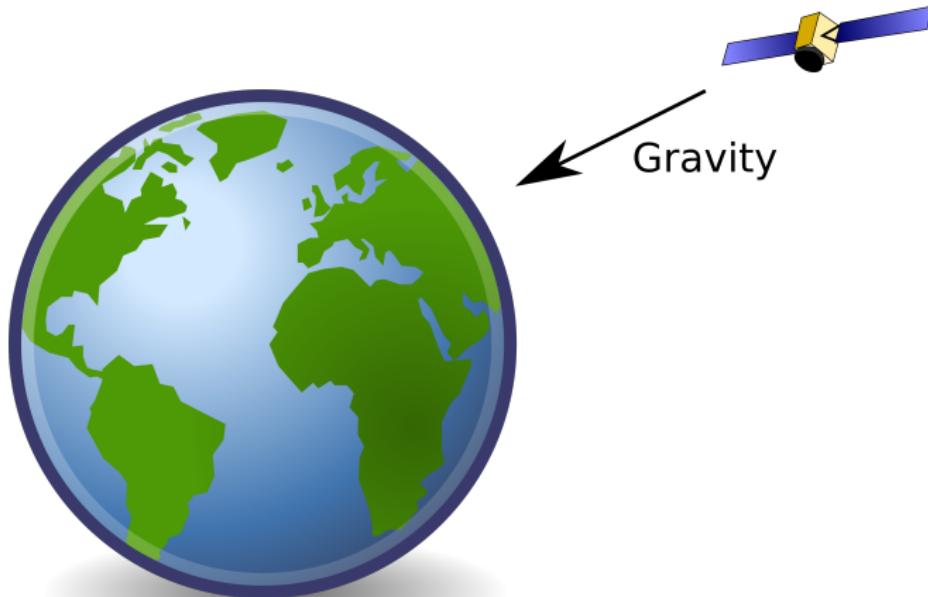
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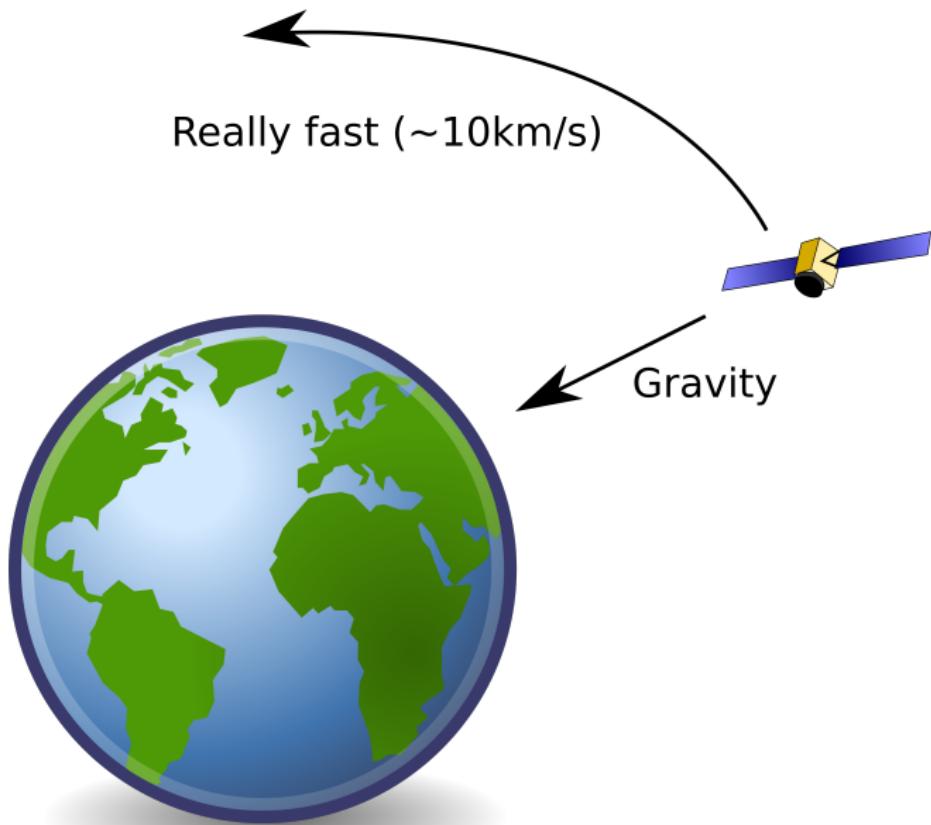
Basics of Spaceflight

Why does a space craft not fall down?

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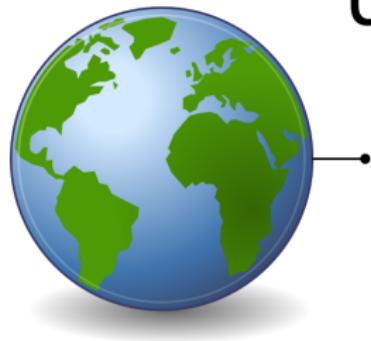
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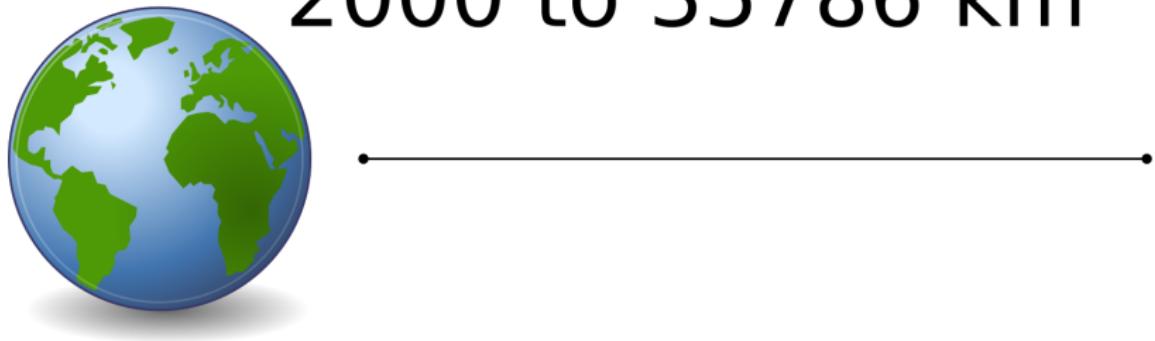
LEO, MEO and GEO



Low Earth Orbit
up to ~2000km



Medium Earth Orbit
2000 to 35786 km

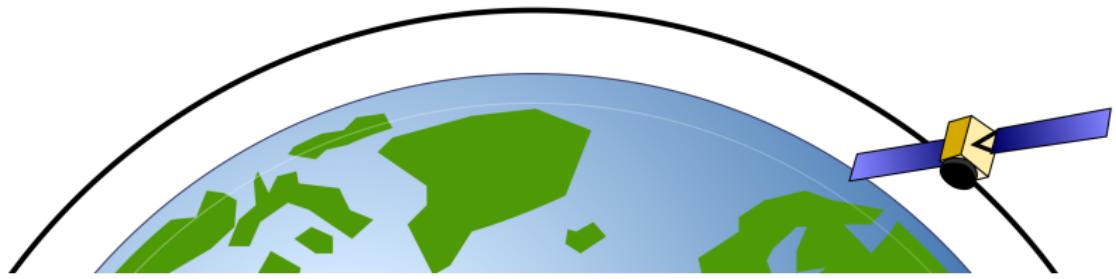


Geostationary Orbit
~35786km

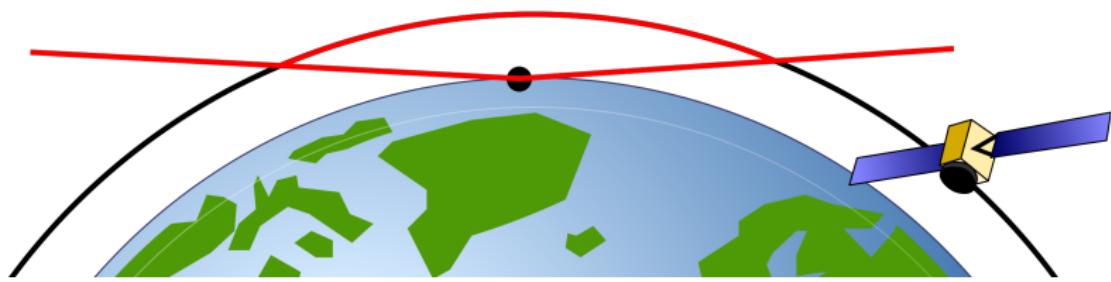


Contacts and Passes

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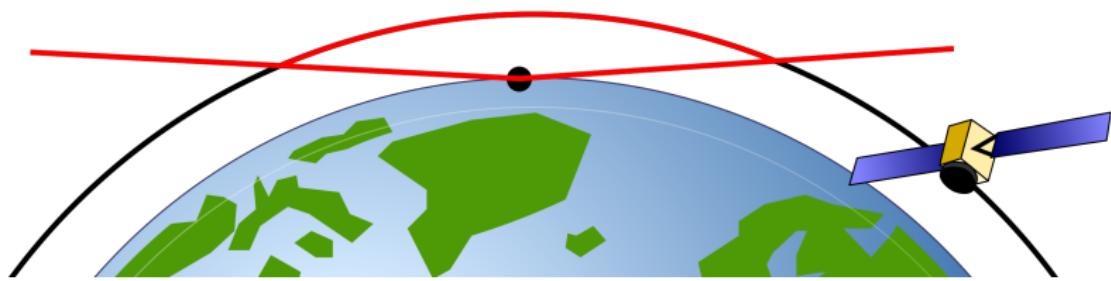


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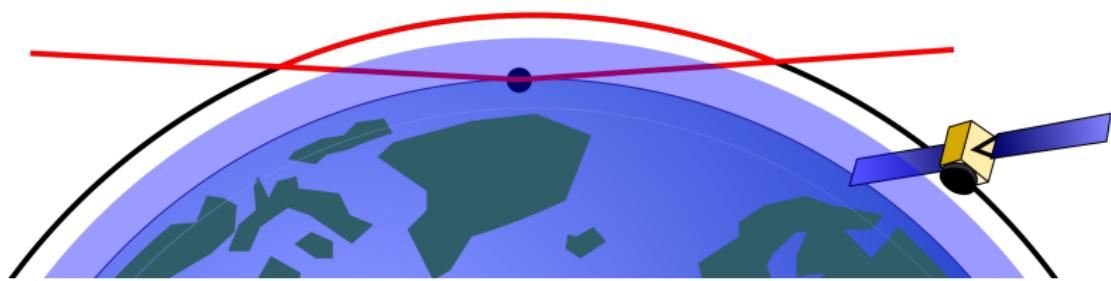


Contacts and Passes

600km altitude, 90min period, 5° elevation, ~11min contacts

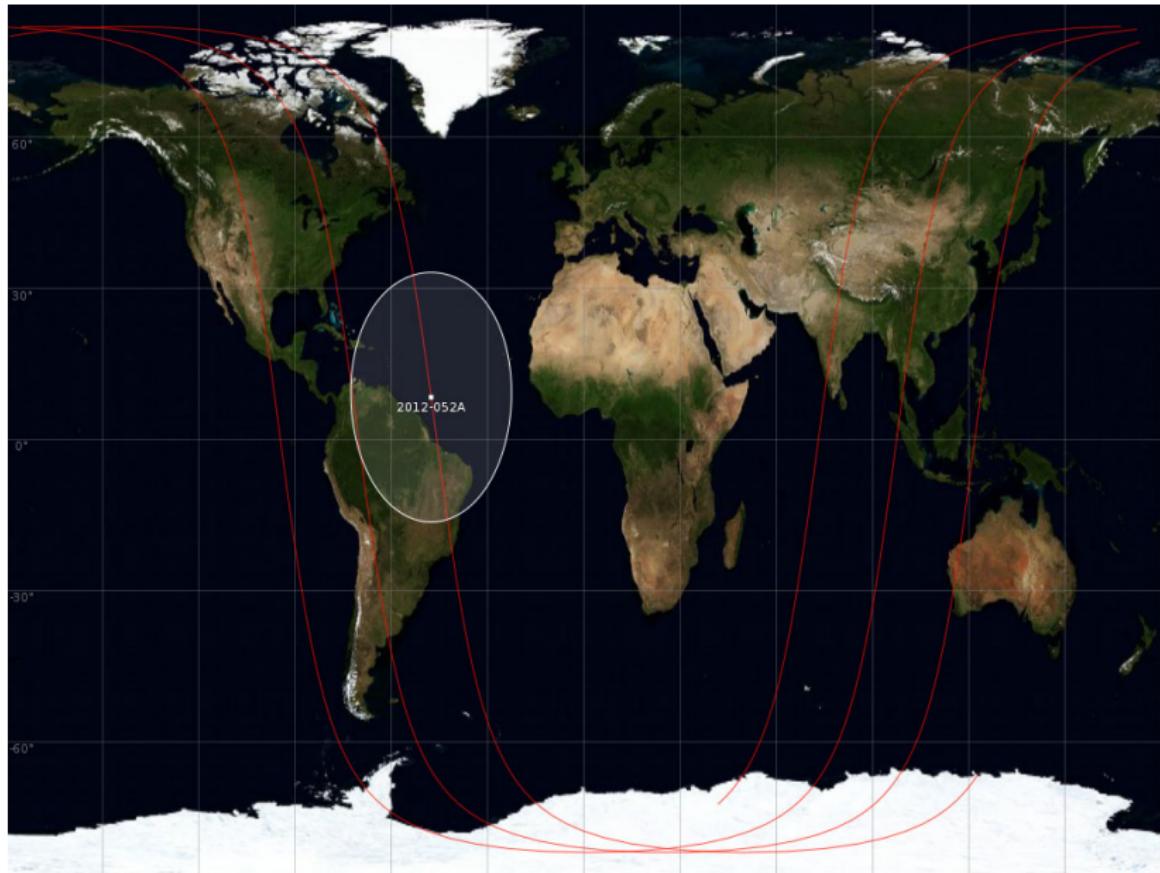


Contacts and Passes



Ground Tracks

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Frequency Range

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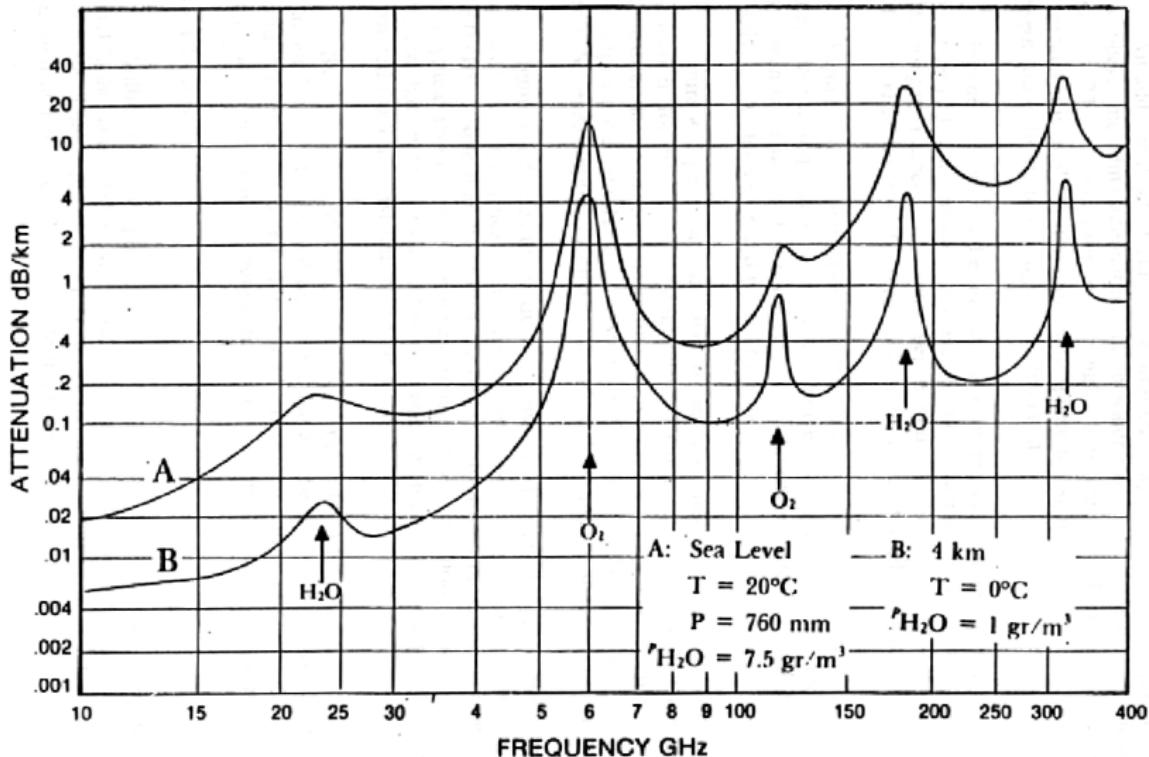


Figure 4: Average Atmospheric Absorption of Millimeter Waves.

Frequency Range

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- Ka-Band: 26-40 GHz (?)

Up- and Downlink

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A satellite connection is used for

- downloading satellite telemetry ("house keeping data")

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- uploading new software

Up- and Downlink

A satellite connection is used for

- downloading satellite telemetry ("house keeping data")
- downloading payload data
- uploading commands
- uploading new software
- receiving and sending signals (as a relay)

Phases of Mission Operations

LEOP

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Launch and Early Orbit Phase

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- Starts right after separation from transfer vehicle

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 - Unfolding of solar panels
 - Transfer Maneuvers to reach final orbit
 - First switch-on of star trackers, reaction wheels etc.

Commissioning or IOT

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In Orbit Testing

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- Follows LEOP

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 - Verification of payload

Commissioning or IOT

In Orbit Testing

- Follows LEOP
- Takes 1 to 6 months
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 - Turn-on of payload
 - Verification of payload
 - Test of routine operations

Routine

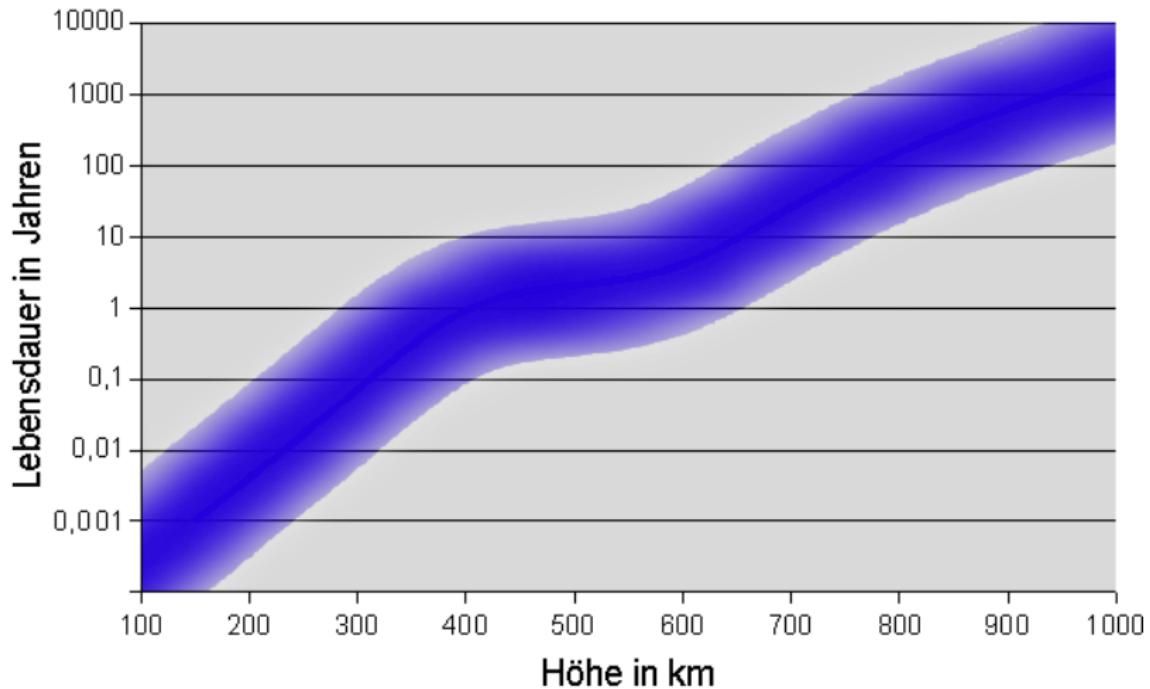
Routine



TODO explain purpose of Routine (mention monitoring + machine learning)

End of Life

End of Life



TCs and TTCs

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TODO explain TCs and TTCs

Examples for TTCs during a maneuver

Examples for TTCs during a maneuver

TODO example TTC

Telemetry

Telemetry

TODO example TTC

Flight Procedures

Flight Procedures

TODO explain purpose of flight procedures

Ground Procedures

Ground Procedures

TODO picture of a ground procedure

Control Room

Control Room



FDS and AOCS

FDS and AOCS

TODO explain purpose FDS and AOCS, mention Fortran

Safe Modes

Safe Modes

TODO add picture for various modes

Data and TM/TC

Data and TM/TC

TODO explain purpose Data and TM/TC

SCOS

SCOS

TODO add picture SCOS

PTR

TODO explain PTR, show heat curve, mention MLI

MIPL

TODO explain purpose

SoE

TODO add picture sample SoE

Flight and Engineering Model

Flight and Engineering Model

TODO explain purpose of engineering model

Procedure in Case of Contingency

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TODO add picture contingency procedure

Example Contingency: TvSat-1

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TODO add picture and explanation TcSat-1

Questions?

Thank you and enjoy the rest of the congress!