The European Space Agency (ESA) is Europe's gateway to space

The ESTRACK (ESA TRACKing network) with 11 terminals on 5 nations manages the space-earth communication

The terminals are coordinates by ESOC (European Space Operations Centre) at Darmstadt in Germany

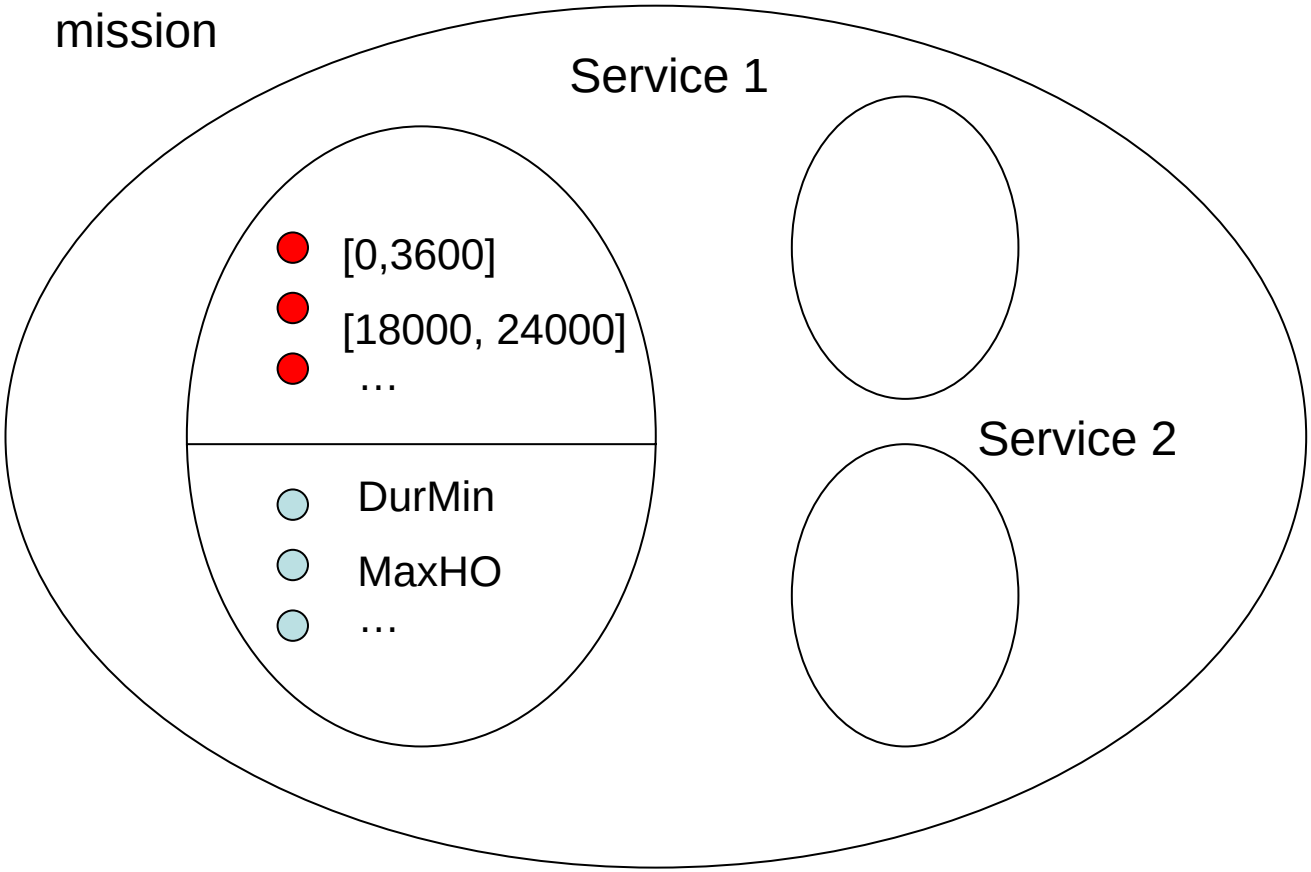
Each spatial mission can require
the implemetation of services to each ground station.

Each ground station can manage more than one
mission.

This leads to the EPS
(ESTRACK Planning System)

The EPS system

In order to build an allocation plan for the ground stations the EPS requires a description of the missions and of the available resources



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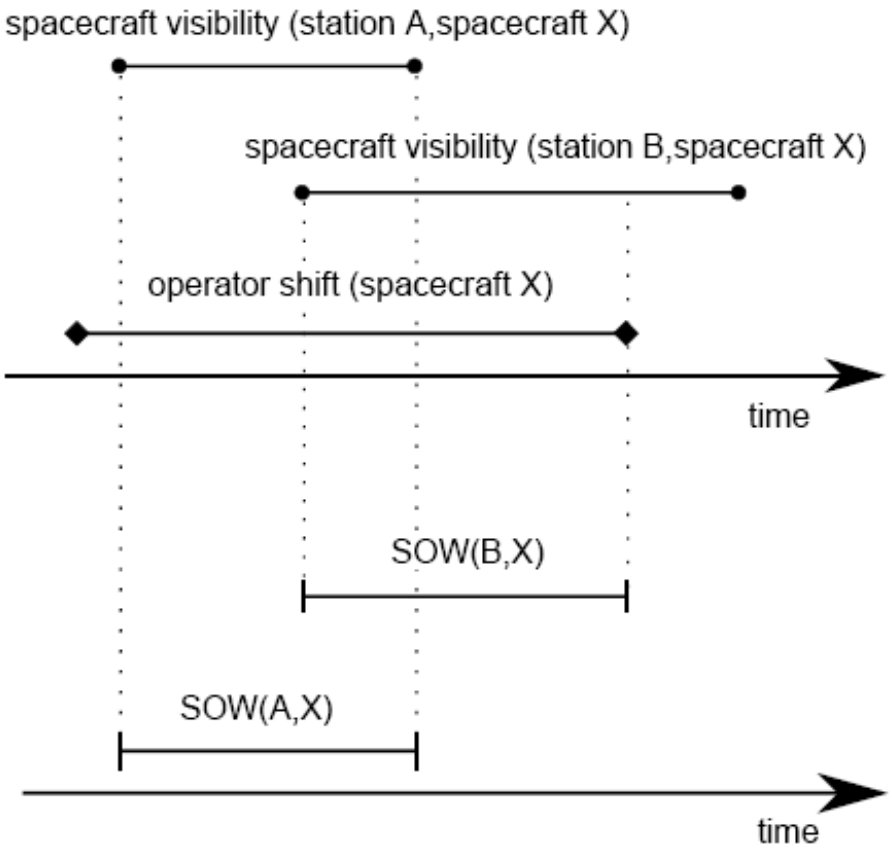


BSOP

Each *mission* in the *mission model* asks for the implementaion of one or more *User Services* on a given periodicity :
the Basic Standing Order Period

1 starting time
2 ending time
3 mission name
4 User Service name

Ex.

BSOP	startB	endB	missionB	serviceB
1	3632	9668	ma_env_1	envisat_orbit_com
2	9668	15704	ma_env_1	envisat_orbit_com
3	15704	21740	ma_env_1	envisat_orbit_com

...

SOW

The implemenation of a *User Service* can be done only by a visible *Ground Station*. The time windows during which a satellite and a *Ground Station* can exchange information are called Service Opportunity Windows.

1 starting time
2 ending time
3 mission name
4 User Service name
5 Ground Station name
6 Satellite name

Ex.

SOW	startS	endS	missionS	serviceS	gsS	satS
1	1062	1469	ma_env_1	envisat_orbit_com	Perth	ENV
2	3386	4102	ma_env_1	envisat_orbit_com	Kourou	ENV

…

OSS

For a resources better use a Service execution can be divided into time intervalls and managed by more than one Ground Station. Each time intervall is called an *Operational Service Session*.

1 starting time
2 ending time
3 mission name
4 User Service name
5 Ground Station name

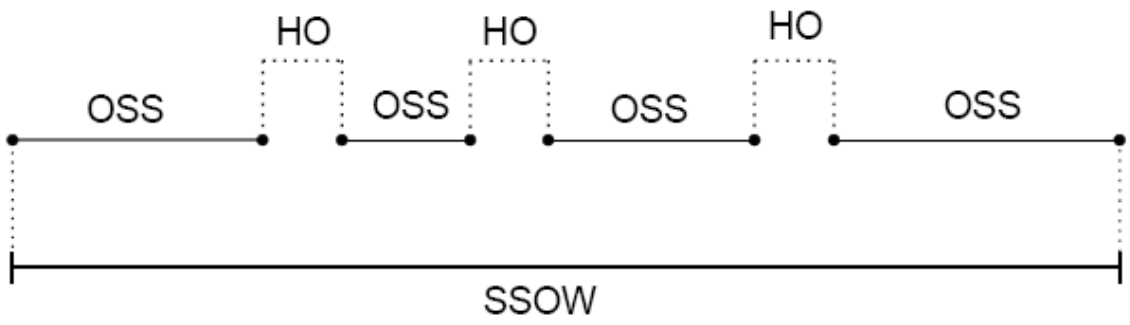
COSS

Starting and ending time of each transmission and the used Ground Station are variables and the OSS are called *Candidate Operational Service Session*

SSOW

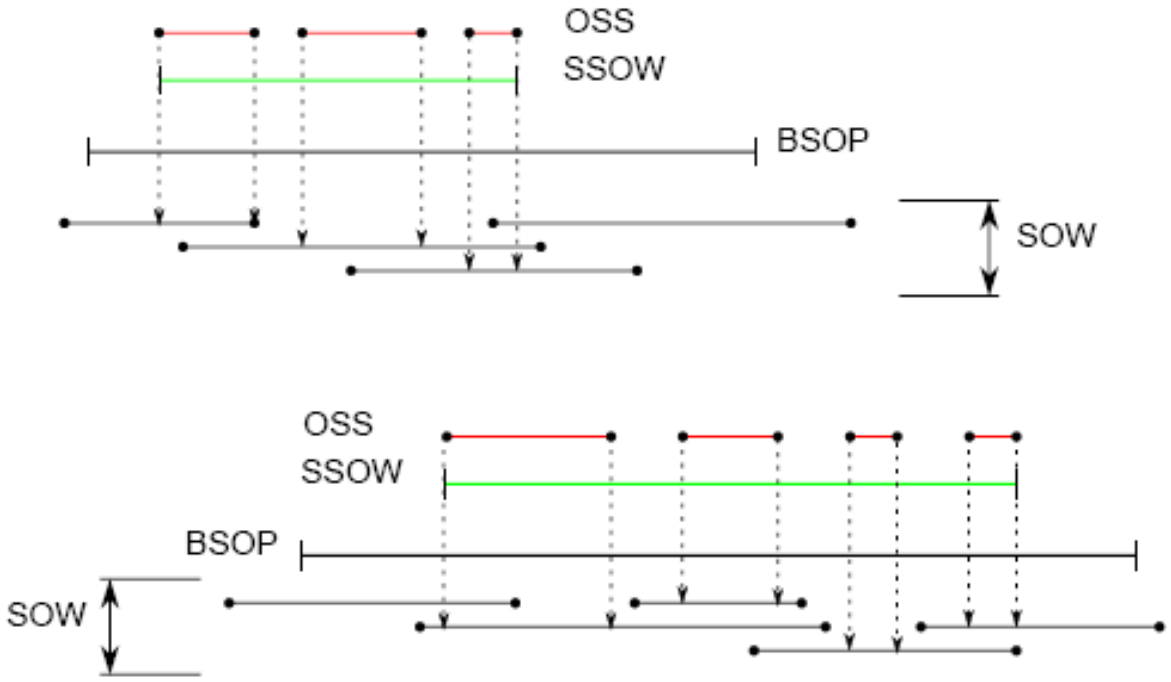
If a Service execution is divided into time intervalls and managed by more than one *Ground Station*, then between two transmission an *Handover* setup time must elapse in order to make the satellite ready for a new comunication.

The sequences of OSS and of Handover are called SSOW.



The objective

We want to associate to each BSOP a set of OSS implemented on the SOW available for the required service



Other requirements:

- a few as possible Ground Station exchange
- long transmission

"Real" data available

Steps:

- Modelling the problem as an Integer Linear Programming (ILP) model
- Solving the model with an ILP solver

Tools

- Modelling language AMPL
- Solver Cplex

Improvements

Applying decomposition techniques ?