6S Iniciative

Space Education and more

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NPC new production concept

SPACE MIND

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

Brief

- Why 6S?
- Project components
- Impact to global society
- Technical feasibility
- Technical risk analyses
- Project evolution

Some important questions

When did you decide to follow the aerospace career?

What was your inspiration?

Our Vision

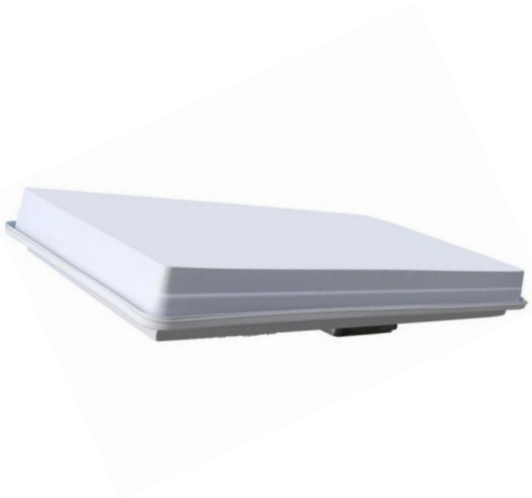
Engineers soon discover their vocations

Our proposal

- **Equipping schools and colleges with low cost ground stations at global level.**
- **Using the access to satellites as an educational tool in large scale.**
- **Creating a global network of space education.**

Project components

✓6S Transponder



✓6S ground station

App Store Google play

✓Pedagogical materials

Project portal in web

✓Documentation for users and developers

How can 6S help teachers and students?

✓ It can help learning:

- math,
- physics,
- geography,
- basic telecommunications

✓Introducing space technology in their daily lives.

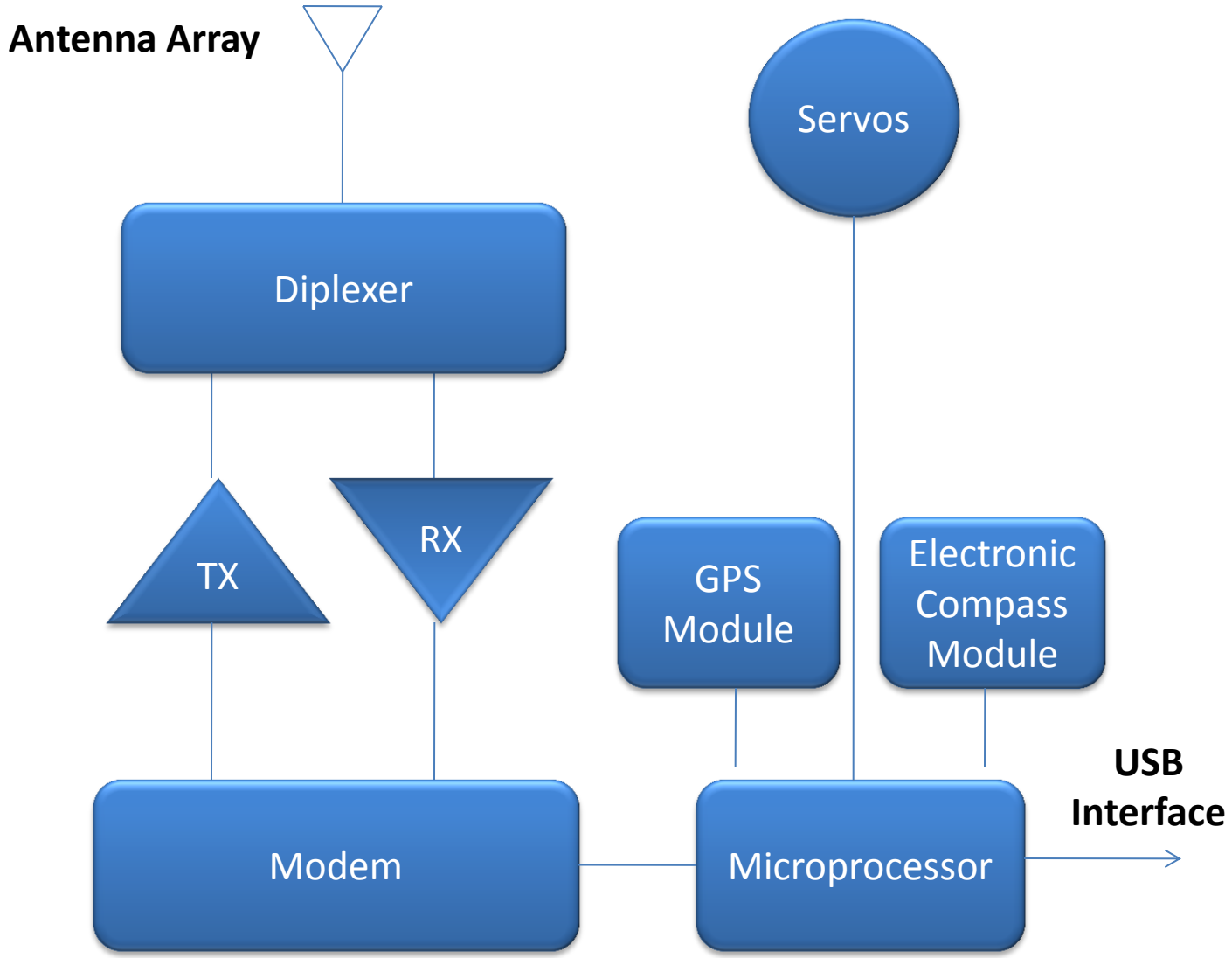
✓Being introduced to basic concepts of engineering

SGS - Simple ground station

- ✓Auto tracking capacity
- ✓No RF cables
- ✓USB interface
- ✓No special skills for installation
- ✓Plug and play philosophy
- ✓Remote operation for TCP/IP

Target: Costs below $ 800 (300 units escale)

SGS – Block Diagram (Servo version)



SGS - Connectivity

Sensor package (optional)

DC

USB

Computer

TCP-IP

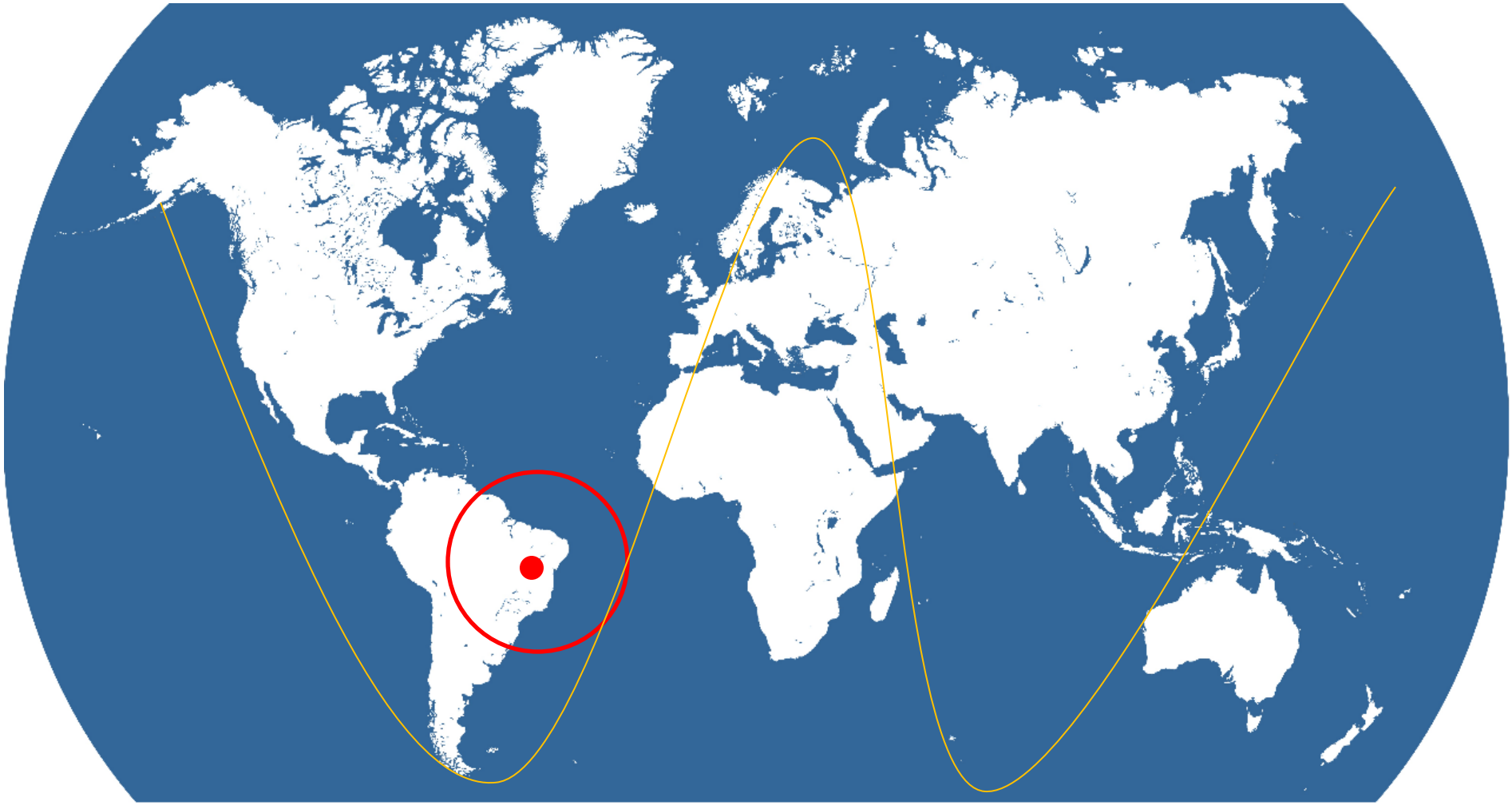
Internet

Power supply

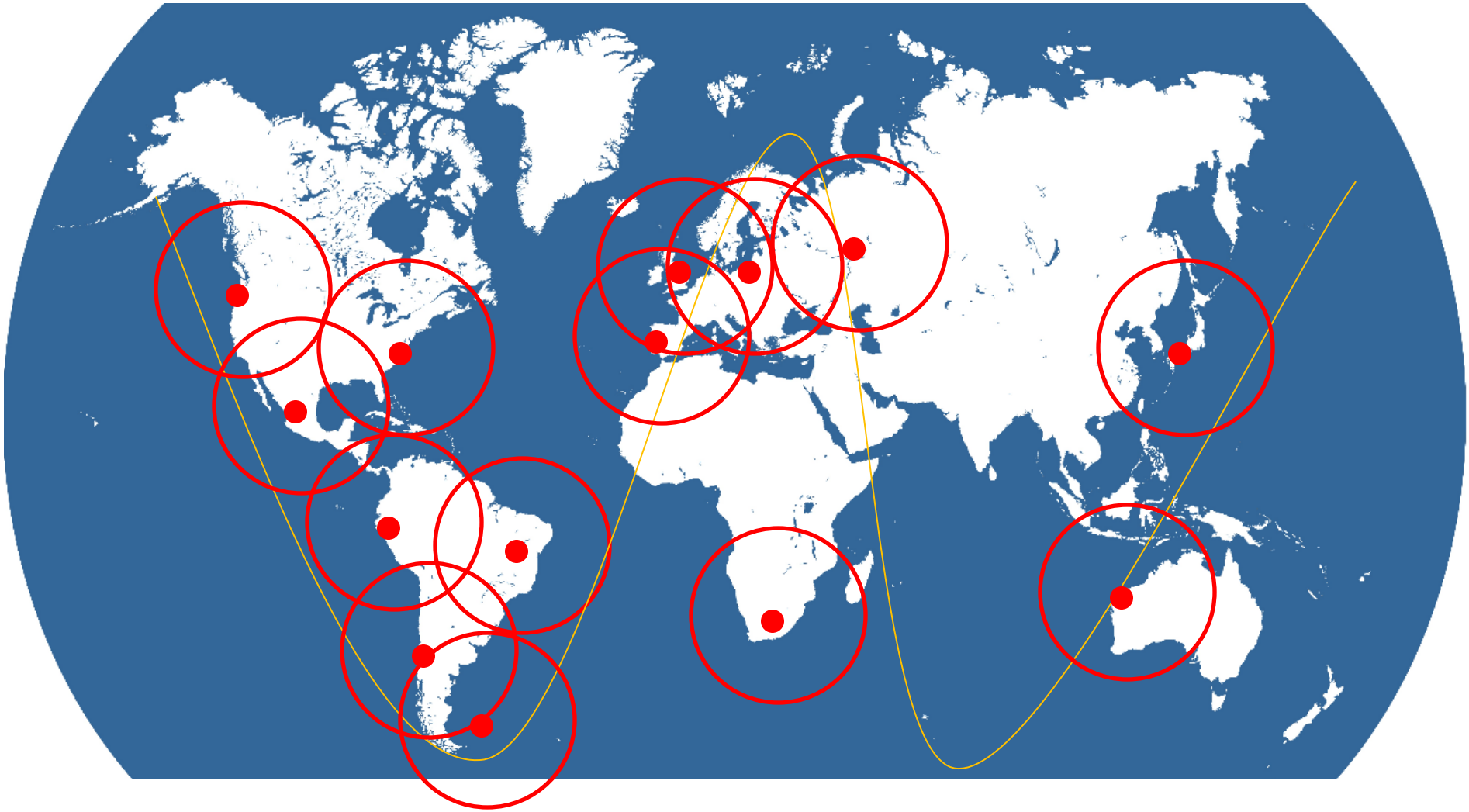
6S Network - A global coverage

Target: over 300 ground stations in five years

A global coverage



A global coverage



Near real time concept

6ST – 6 S Transponder

6ST

Modes:

- ✓ Beacon (Morse Code)
- ✓Transceiver
- ✓Time measurement and doppler shift
- ✓Store-drump
- ✓Telemetry (4 ADC channel)
- ✓Telecontrol (8 I/O)

Low mass: < 120g

Dimensions: <90mm x 90mm x 16mm

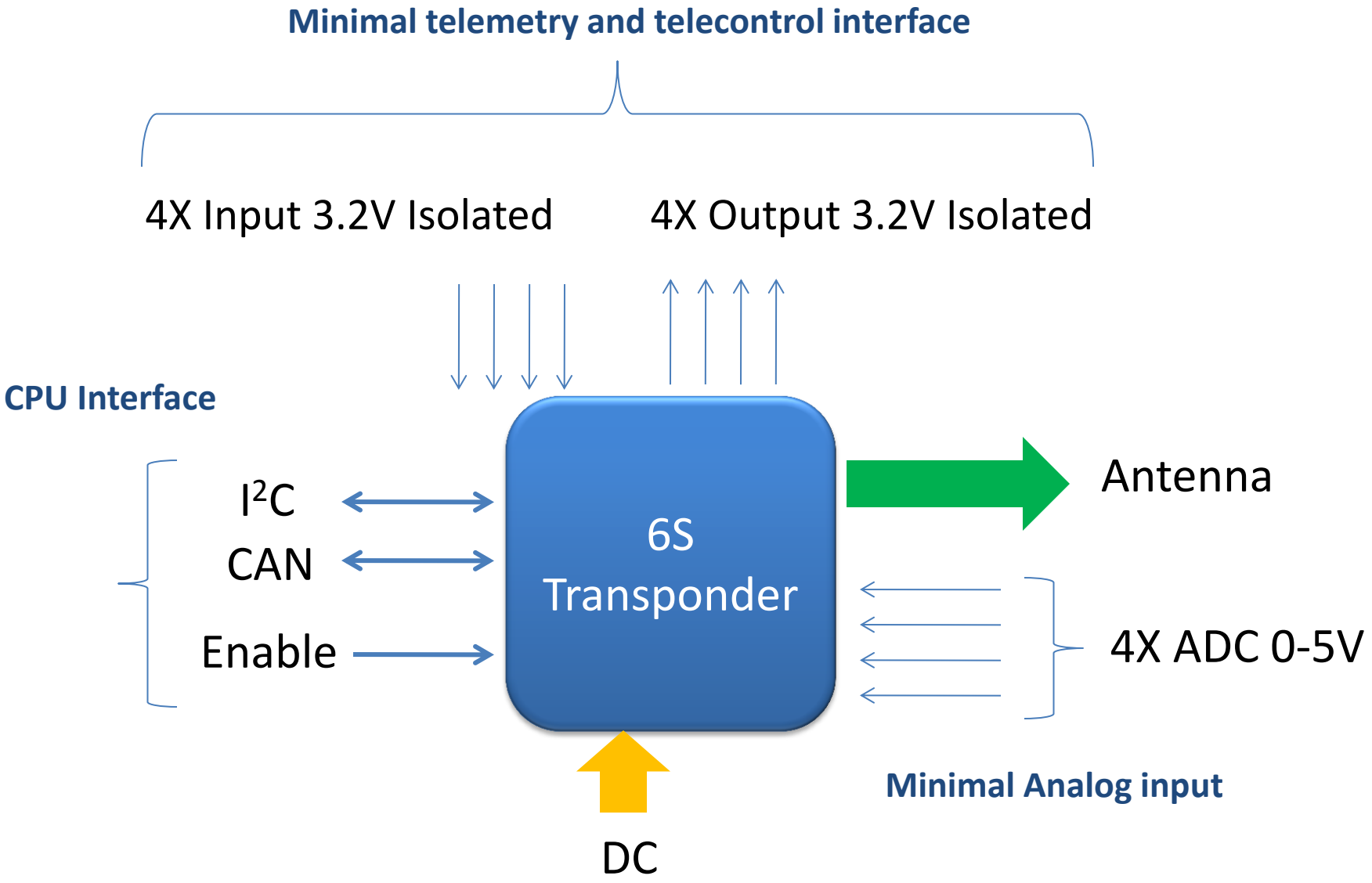
Frequency: TBD

Power: TBD

Sensibility: TBD

Target: Up to 10 transponders on satellites partners in a decade

6ST - Connectivity



Impact to global society

Students

- ✓Introduction on space technology.
- ✓Stimulus for careers in engineering and sciences.
- ✓Stimulus for new and creative experiences.

Teachers and professors

- ✓New pedagogical tools
- ✓Practical experiments in mathematics, physics and geography.
- ✓Practical proof of theory

Impact to global society

Cube Sat designers and builders

- ✓A turn key ground segment.
- ✓Global tracking network.
- ✓Standardization in telecom subsystems.
- ✓Near real time tracking, telemetry and telecontrol.

Governamental and private satellites programs

- ✓Near real time, limited telemetry and telecontrol.
- ✓ Same redundancy for serious failures events.
- ✓ Policy approach in some cases (for educational uses)

Impact to global society

For all society

- Widespread diffusion of the culture of small satellites.
- New Vocations for aerospace science and engineering.
- A global network of ground stations for small satellites.
- Cost reduction for Cube sat programs according a ground segment cheap and available.

Developing the mission - Project phases

1st STEP

2nd STEP

3rd STEP

Developing the mission - Project phases

1st STEP

2nd STEP

3rd STEP

Simplify the mission:

1) Write down the Primary Requirements and connected risks

2) Write down the “Nice to have”

3) Meet the Primary Requirements in the design

This is the actual phase in which the project is

Developing the mission - Project phases

1st STEP

2nd STEP

3rd STEP

Make the basis

1) Build the prototype of the system

2) Test the system

3) Is it enough for a first mission?

Developing the mission - Project phases

1st STEP

2nd STEP

3rd STEP

"Nice to have"

1) Meet the "Nice to have" requirements

1) Build the final system

2) Distributions

Simplify the mission

1st STEP

The mission is based on basic input (space segment) and output (ground segment) capabilities of the system.

All that is not a primary requirement turns in to a “nice to have” requirement (uplink, servo antenna)

Simplify the mission

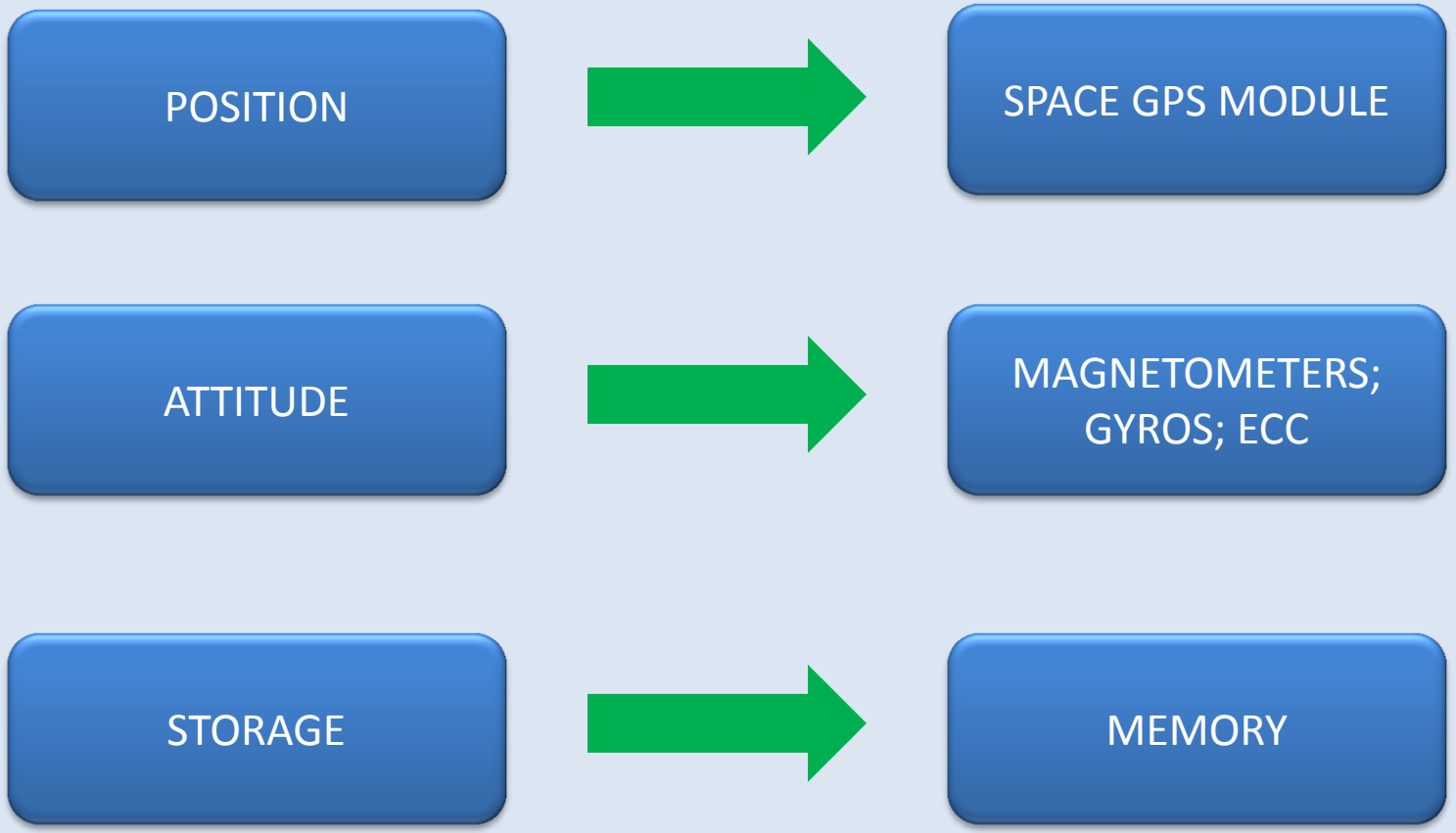
1st STEP

GROUND SEGMENT / SPACE SEGMENT Primary Requirements:

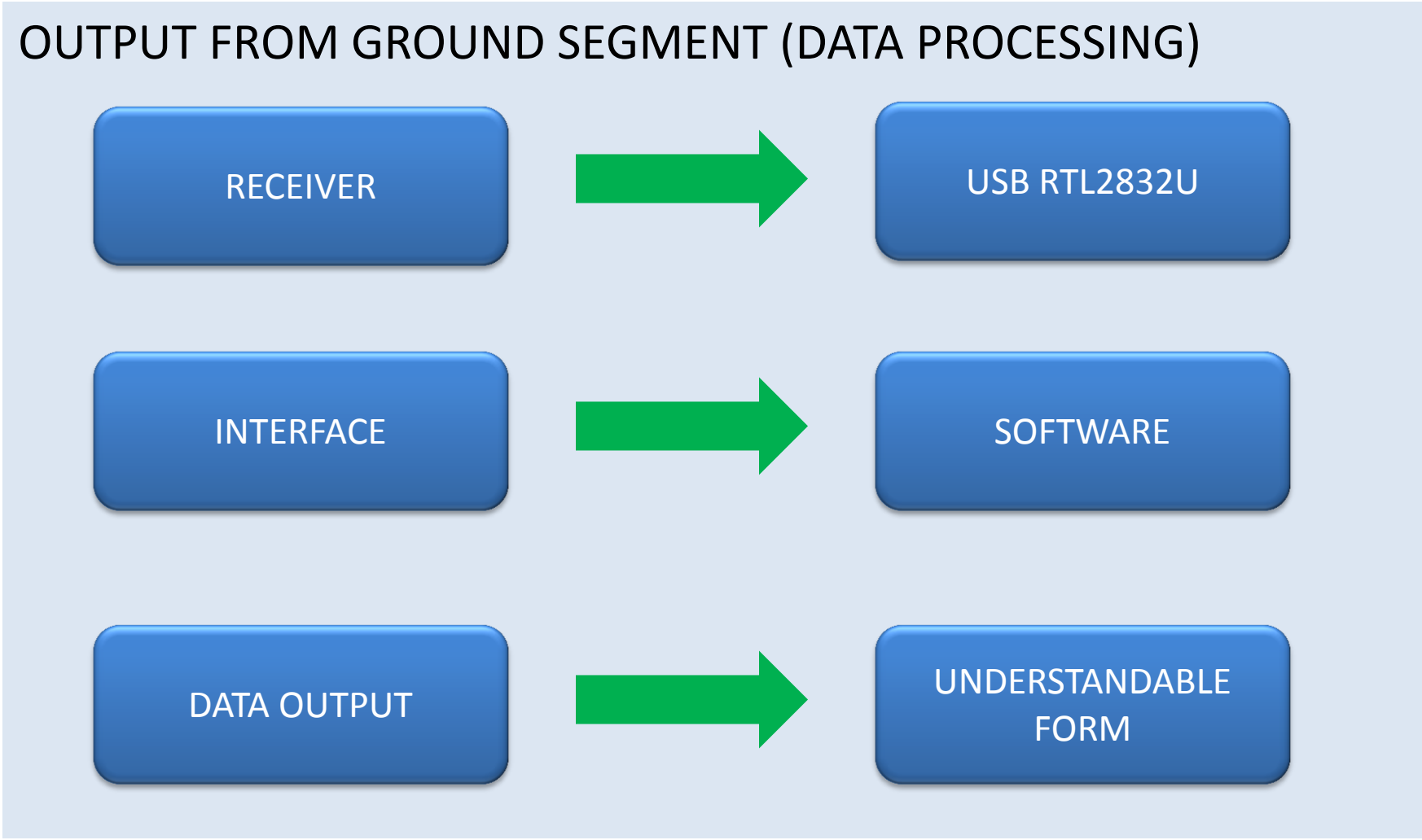
- Collect data from space (Position and attitude)
- Low cost system
- “Off-the-shelf” components
- Plug and play / Stand alone solution
- Light system
- Simple interface
- Reconfigurable system (Ground Segment)

How to do: general

INPUT TO SPACE SEGMENT (DATA COLLECTION)



How to do: general



Space Segment: risks and issues 1/2

Because of the particular issues related to the Space Segment it must be considered from the beginning as a normal payload to the host satellite (Very strict timeline, enter in satellite project)

ISSUES	RISKS	POSSIBLE SOLUTION
To be stand-alone / Plug and play	Battery is not sufficent to guarantee an adequate lifetime	- Consider a power plug from the host satellite - Solar panel (?)
Radio Transmission	It can jam the host satellite communication (ITU rules)	Consider to transmit the data through the satellite
Integration	It must be sure that it will not affect the design of the satellite. Maybe it is not possible to have a standard shape	Maybe it will be necessary to design the “shape” for each satellite. Moreover the system should resists to different vibration profiles.

Space Segment: risks and issues 2/2

Another big topic of discussion is how to keep low the price of the space segment

ISSUES	RISKS	POSSIBLE SOLUTION
Low cost	It is very simple to overdrive the budget (ex.: Space GPS)	Try to find always the best cost/effective solution (for example the solar panel is not cost effective)
Low cost	The choice of cheap subsystems without qualification or flight heritage	These problems might simply not appear
Off-the-shelf components	Electronics components failure. It is not possible to know before the design of the system and the orbit of the host satellite	Use of space qualified materials. However this can affect the costs. MIL spec. maybe have to be considered

Space Segment: considerations 1/2

A good compromise can be to consider only Cubesat missions.

PRO:
-LEO or VLEO orbits could allow to use less shielded electronics material
-Short mission duration could be in part another asset for the electronics protection
-A lot of Cubesats don’t have a payload and are looking for that

CONTRA:
-Short duration of the mission and not constant coverage between launches
- Less possibility to fit in to the satellite

Space Segment: considerations 2/2

A “CRAZY” solution could be to build a CUBESAT or a POCKETQUBE:

PockeQube standard is a cube of 5x5x5 cm and it is enough big for a “IMU”, a GPS and a transmitter.

The complication to develop this “6S space segment” is similar to the complication related to developing this kind of satellites.

This satellite could be built from kit in the schools (providing all the elements and software + eventually school payload) improving the level of the educational part

Launch could be provided by the government

Ground Segment: risks and issues

For the ground segment the risks and issues are minor as the system could be assembled using cheaper parts and does not need to be integrated with another system.

ISSUES	RISKS	POSSIBLE SOLUTION
To be stand alone / Plug and play	Difficult to connect with the computer	Use of an USB RTL receiver
Simple interface	Difficulties to interface to the system	Create ad hoc software with a very simple graphic interface
Reconfigurable capability	It can be impossible to catch every possible frequency (we don't know the final host satellite)	Make it possible to change the antenna with a standard plug

Ground Segment: considerations

The ground station should be more simple to realize. Anyway we need to keep in mind that the operation capability of the ground station will depend from its software

The ground station should be able also to catch the meteo satellite data to offer another field in the educational aspect.

The ground station should be also in grade to catch the frequencies of other satellites (wide range of receiving) in order to visualize the attitude and position data directly from the satellite and not from our transponder

Nice to have (the future)

An Uplink system to transmit a message from ground station to another ground station: storage and forward

Auto adjustable servo antenna in order to improve the view time

Sonification of collected data (processed on ground) and diffusion by internet and dedicated app.

…….

Future of the project

1) Complete the 1st STEP (Different scenario)

2) Talk with possible partners (Government, Cubesats missions ecc)

1) Complete the 2nd STEP

2) Look for international agreements

3) First distribution

4) “Nice to have” phases (3rd STEP)

5) Second distribution

Collaborative effort

Exchanging of experience and knowledge.

User gains experience in mission design and satellite issues and developer gains experience in telecommunications field.

Increasing of network and future collaboration.

Cultural exchange.

THANK YOU FOR YOUR ATTENTION

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