



A satellite with homespun electronics

April 2017

INDEX

Problem
Solution
Project Philosophy
Team
Achievements
Tools
Roadmap
Current I+D process



Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

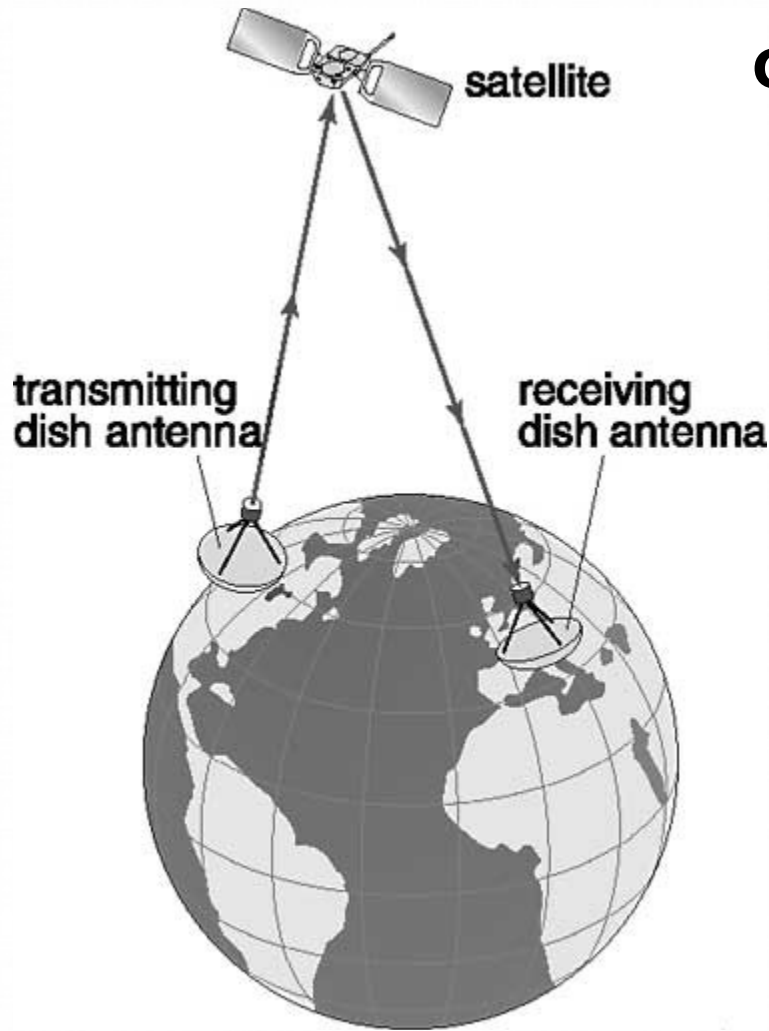
Current I+D process



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

PROBLEM



Classic Satellite Communications usual problems

High costs
Unaccessible
Private owners
Low bandwidth
Maintenance



INDEX

Problem

Solution

Project Philosophy

Team

Achievements

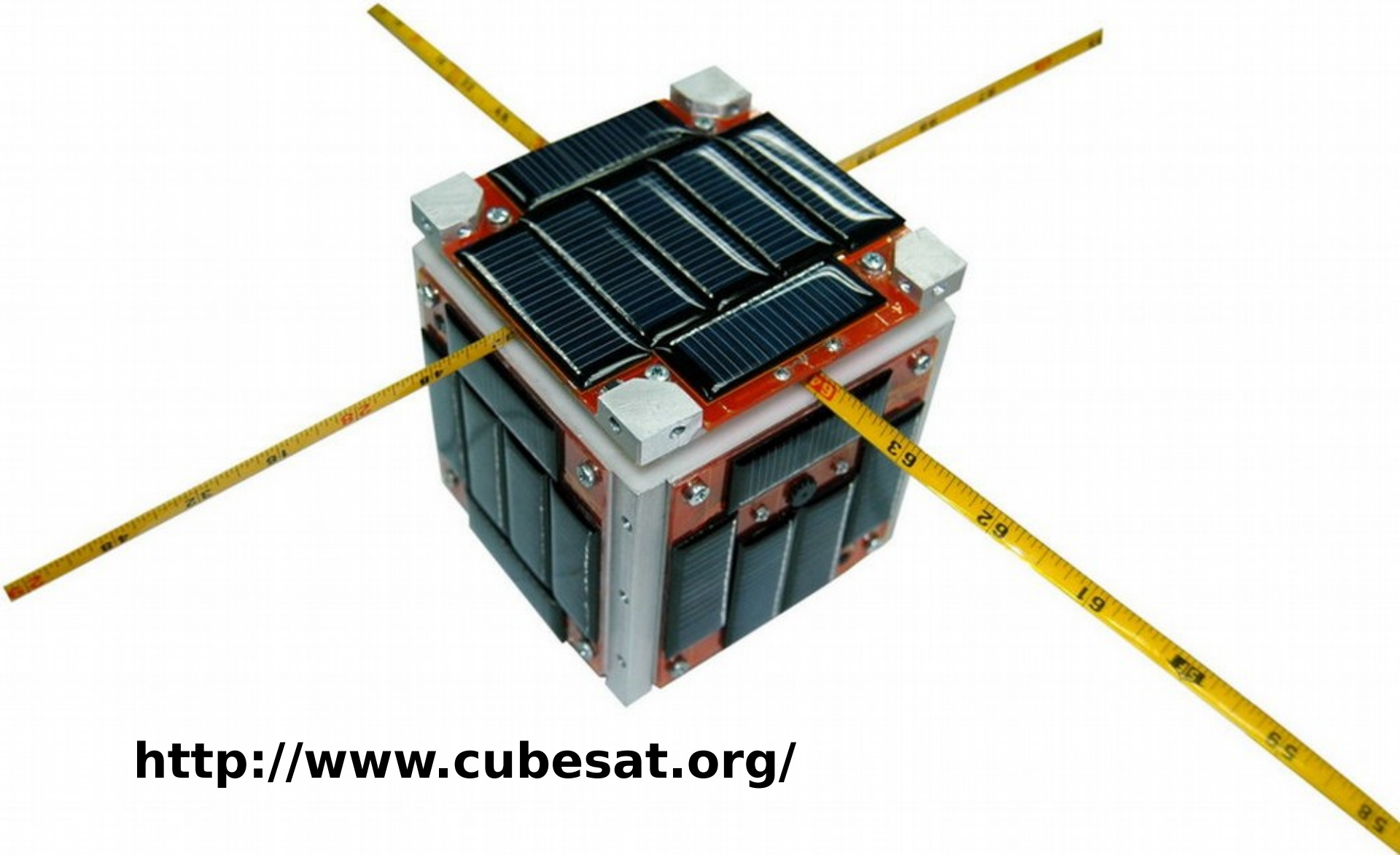
Tools

Roadmap

Current I+D process



SOLUTION



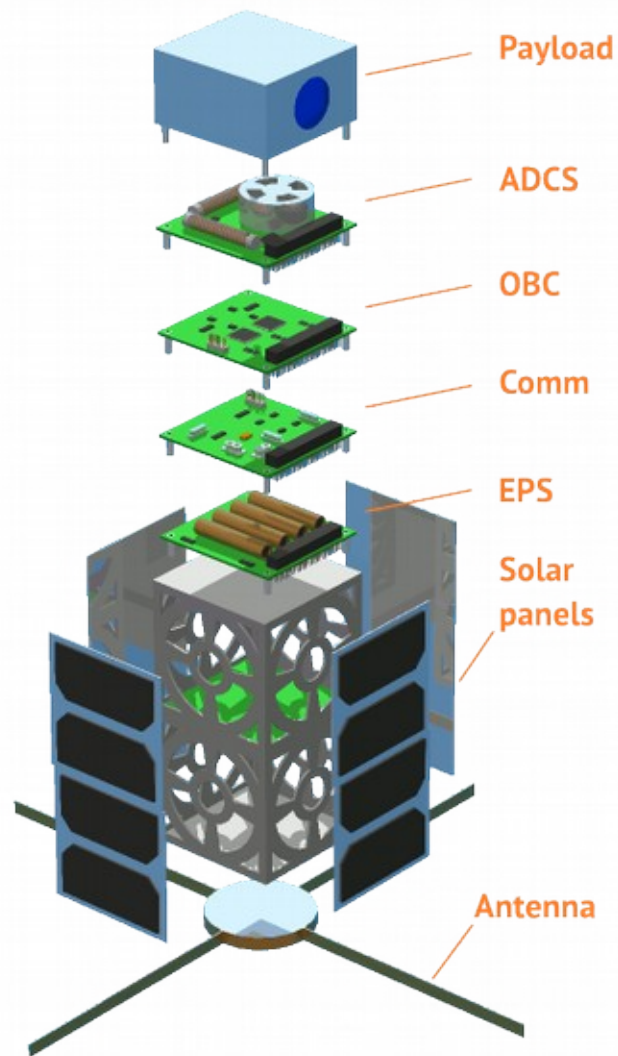
<http://www.cubesat.org/>



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SOLUTION



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SOLUTION

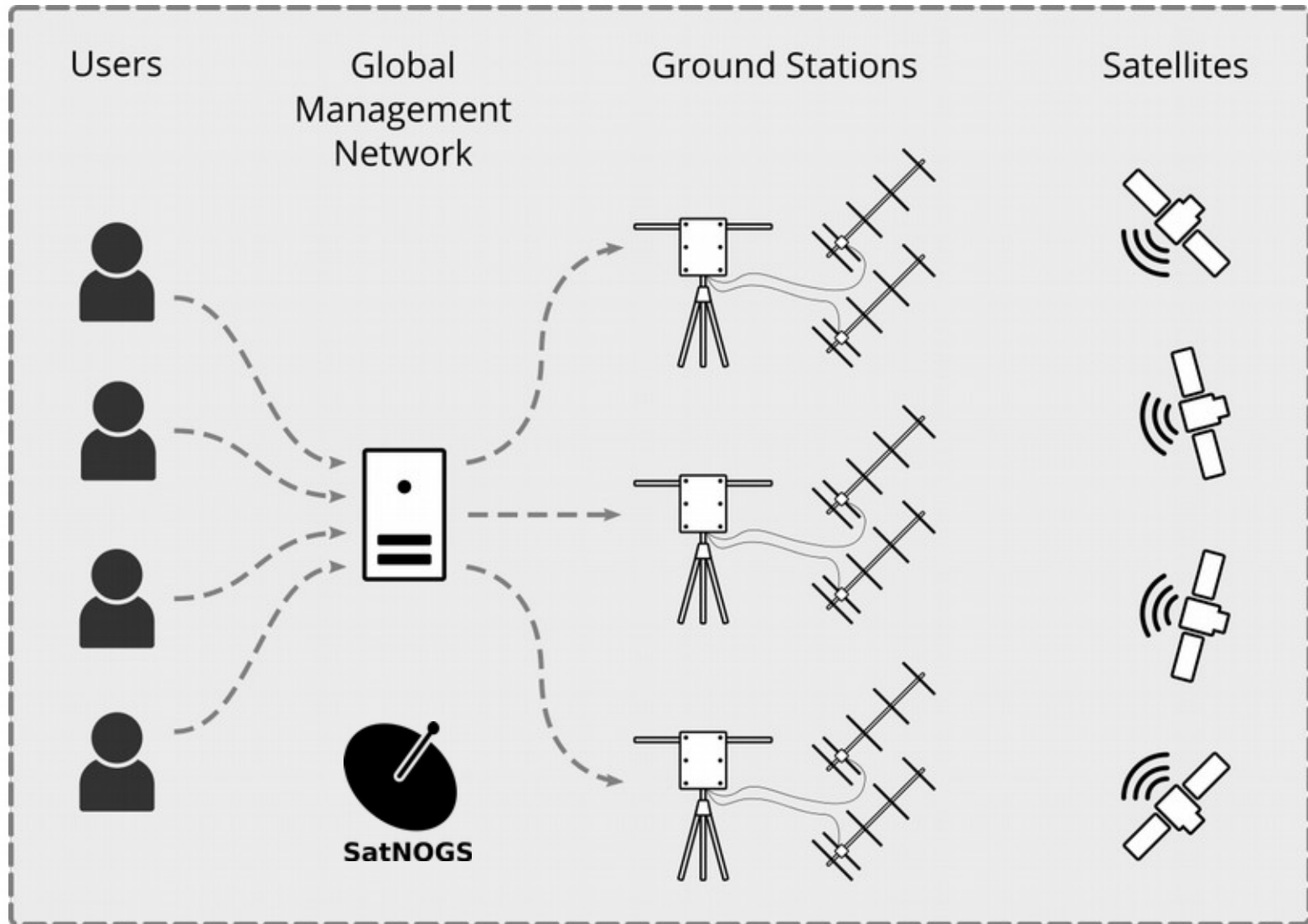
<https://satnogs.org/>



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SOLUTION



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

Problem
Solution

Project Philosophy

Team
Achievements
Tools
Roadmap
Current I+D process



PROJECT PHILOSOPHY



open source



open hardware



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

INDEX

Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

Current I+D process



TEAM



**Eduardo González
Hernández**



Héctor Melián Plasencia



Luis Herrera Medranda



**Ernesto Padrón
Velázquez**



**Goyo Regalado
Pacheco**



Dailos Díaz Lara



salesianos

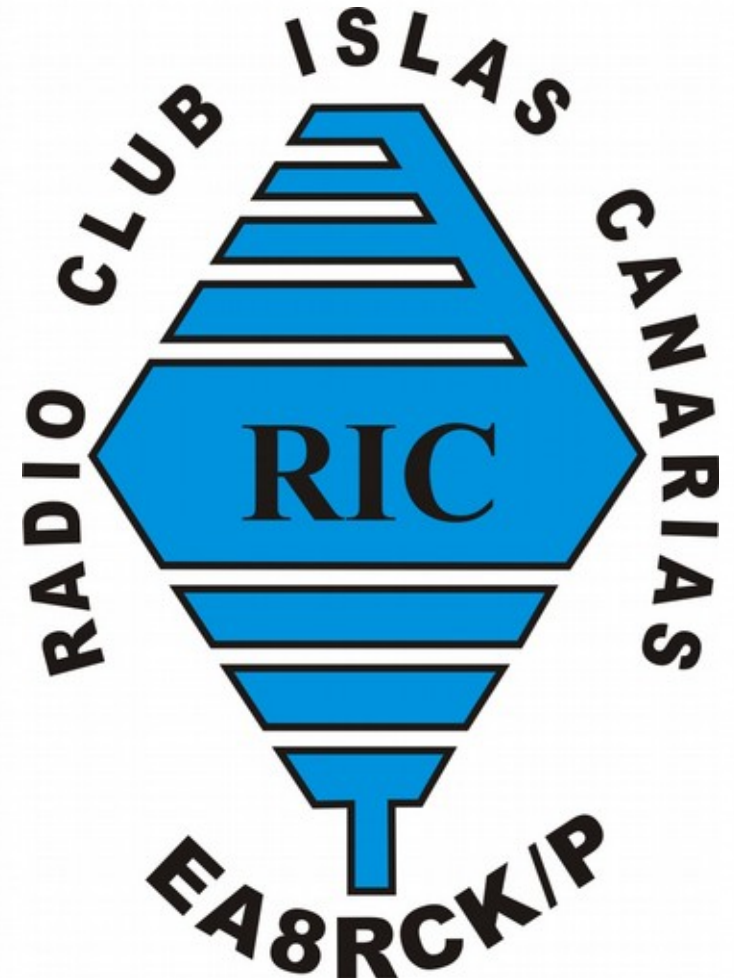
COLEGIO SAN JUAN BOSCO LA CUESTA

TEAM



salesianos

LA CUESTA



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

INDEX

Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

Current I+D process

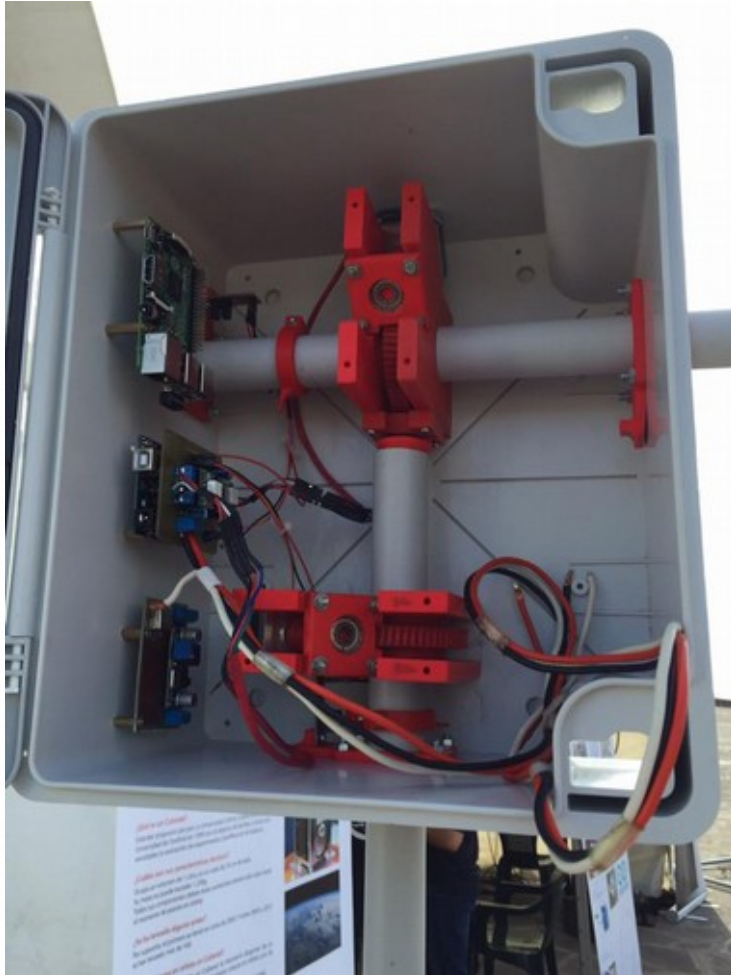


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

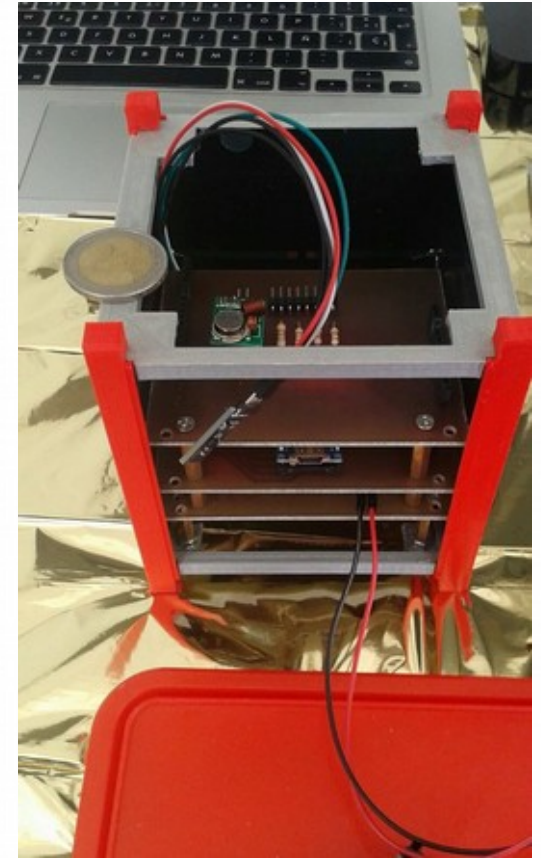
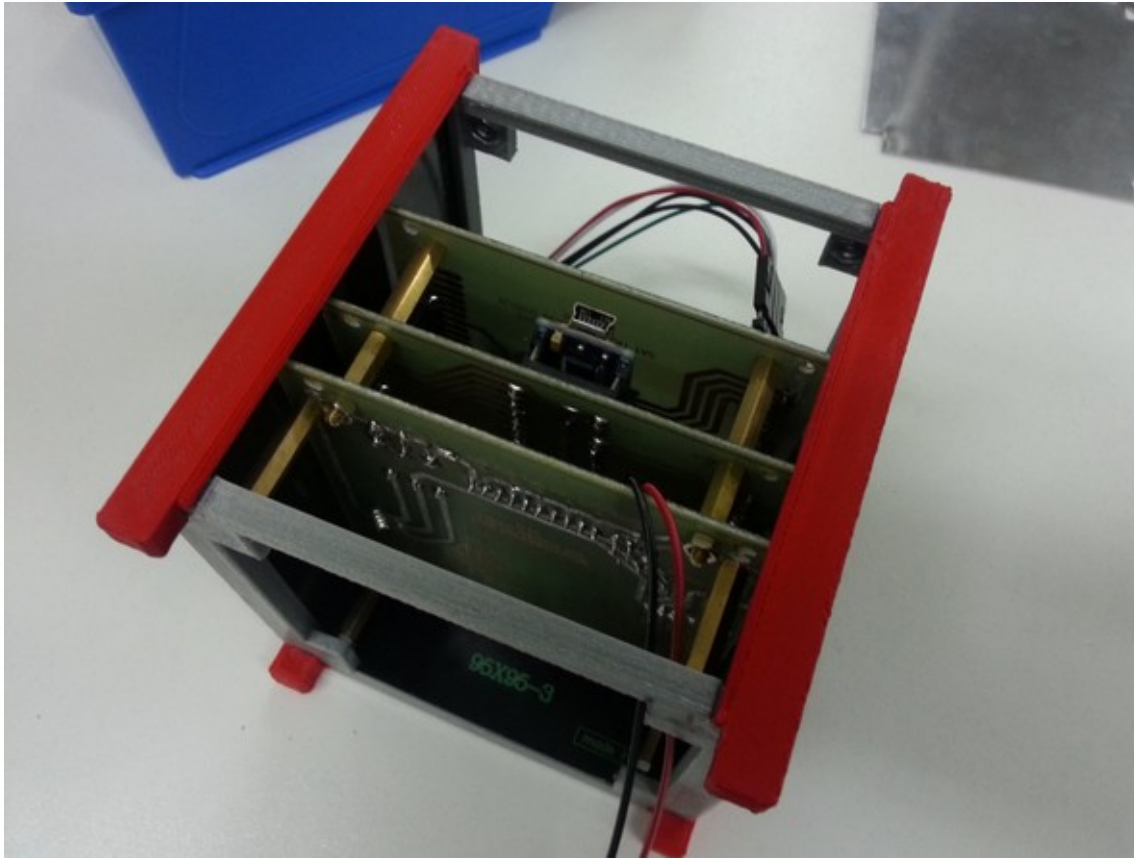
ACHIEVEMENTS

RADIO STATION (SATELLITE TRACKER)



ACHIEVEMENTS

SATELLITE

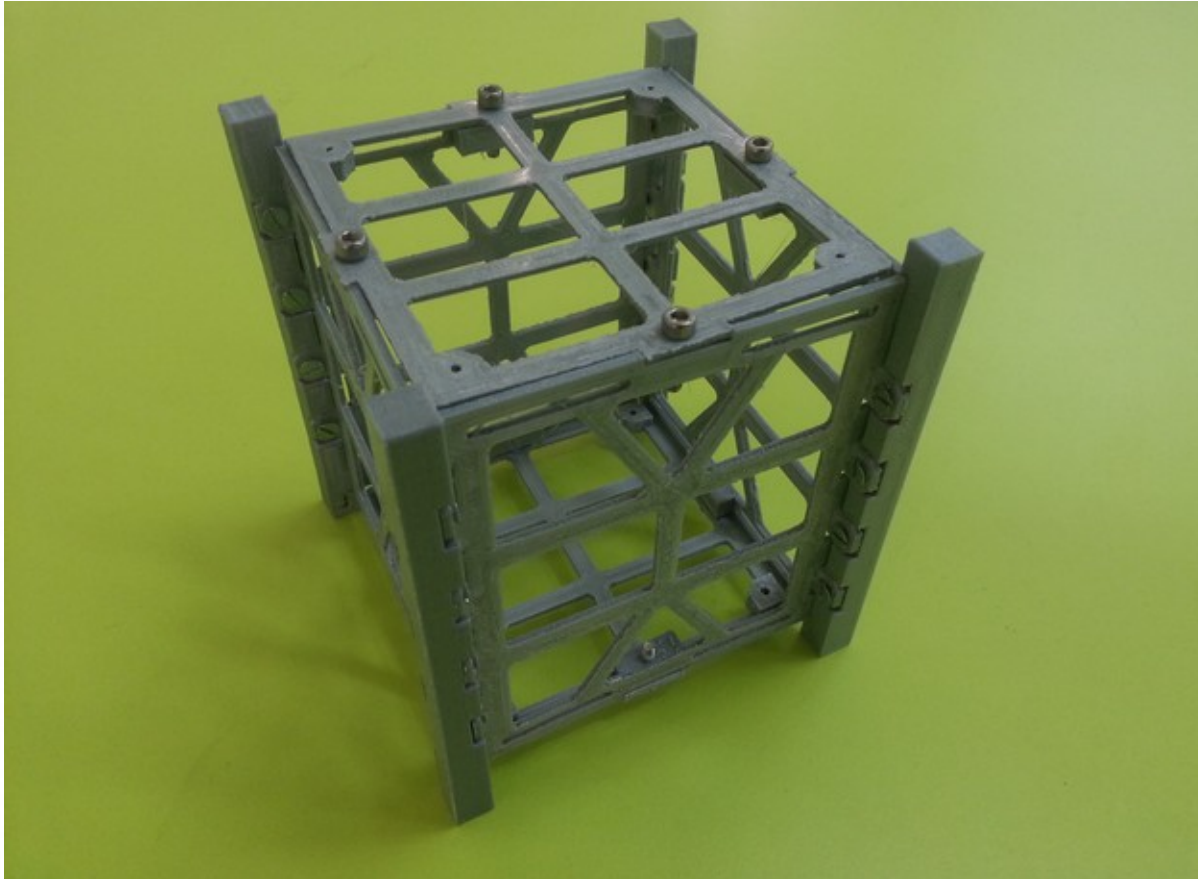


MARK I - ALPHA 1



ACHIEVEMENTS

SATELLITE

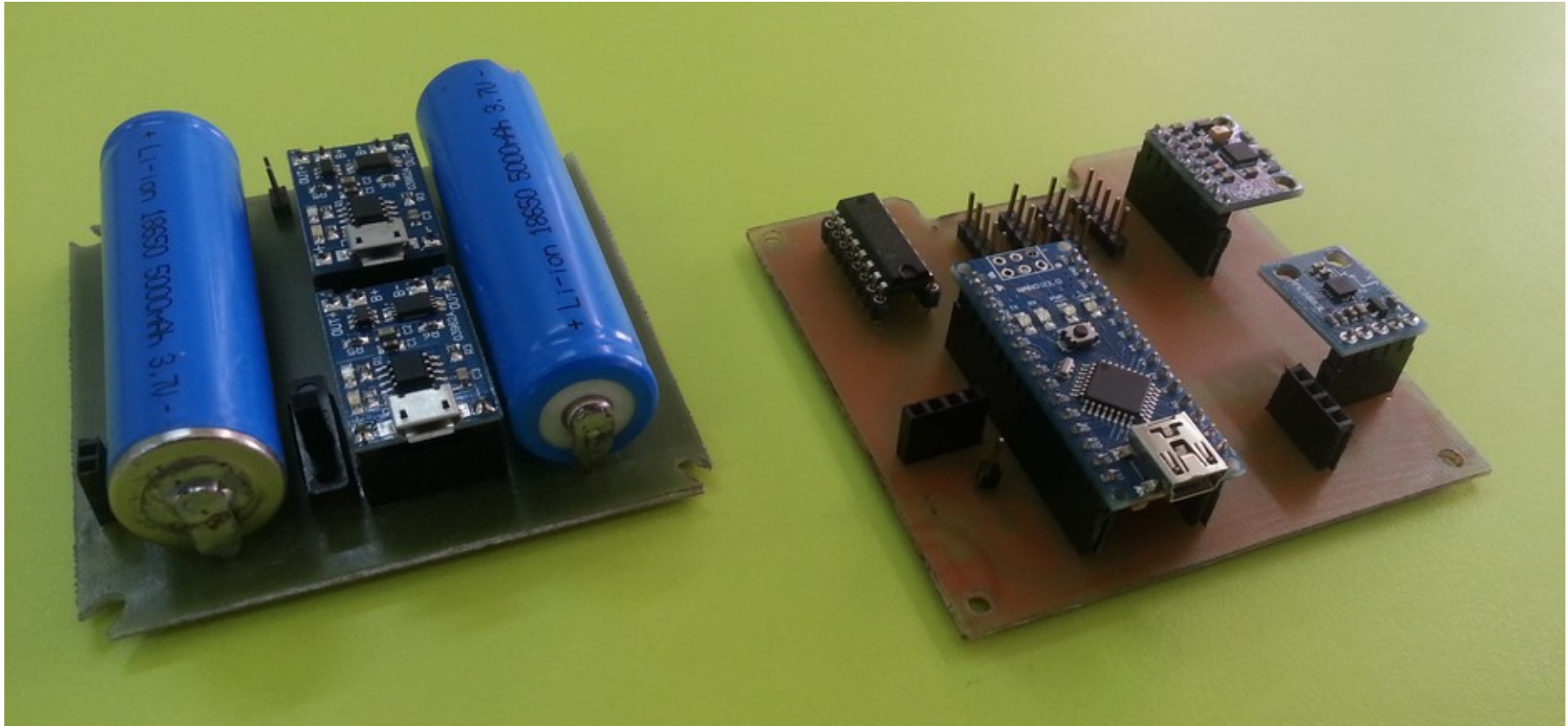


MARK I - ALPHA 2



ACHIEVEMENTS

SATELLITE



MARK I - ALPHA 2

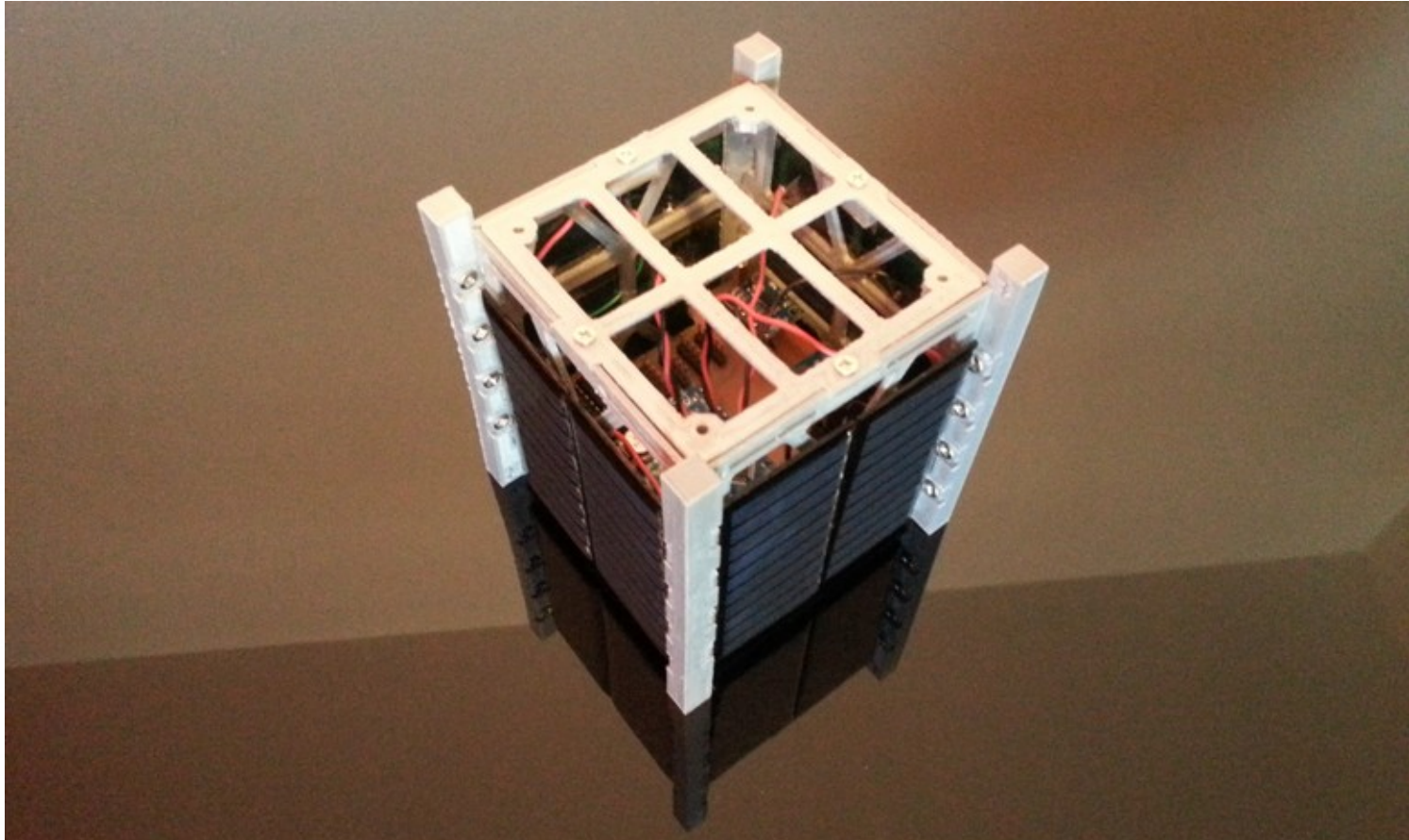


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ACHIEVEMENTS

SATELLITE




MARK I - ALPHA 2






salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA


ACHIEVEMENTS

DOCUMENTATION (GitHub Repository)






[Pull requests](#) [Issues](#) [Gist](#)



Boscovery SAT
boscoverysat

 Tenerife, España
 boscoverysat@gmail.com
 Joined on 27 Aug 2015

2


Followers


0


Starred


0

Following






 Contributions

 Repositories


 Public activity

 Edit profile

Popular repositories

 bsat.sat.transmision_400mhz	0 ★
Análisis, pruebas y documentación del sistema de transmisión en 400MHz empleado en el proyecto.	
 bsat.doc.documentacion_de_...	0 ★
Este repositorio contendrá los documentos de referencia que iremos empleando a lo largo del proyecto.	
 bsat.doc.git_y_github	0 ★
En este repositorio se recogerá toda la documentación relativa a la instalación, configuración, operaciones y dem...	
 bsat.doc.presentaciones	0 ★
Repositorio donde se recogerán las presentaciones preparadas para el proyecto.	
 bsat.gst.control_de_rotor	0 ★
Este repositorio contiene el código fuente y la electrónica de control para el rotor de antena.	

Contributions



Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov



salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

INDEX

Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

Current I+D process



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

TOOLS

COMMUNICATION



Gmail



Whatsapp

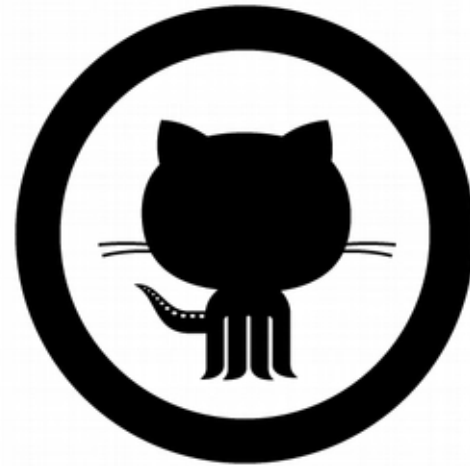


TOOLS

TEAMWORK



Google Drive



GitHub



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

TOOLS

MANAGEMENT



Google
Calendar



Trello



TOOLS

DEVELOPMENT (SW & HW)

Editors and IDEs



Prog. Languages



Version Control



Operative Systems



Satellite & Tracker



INDEX

Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

Current I+D process

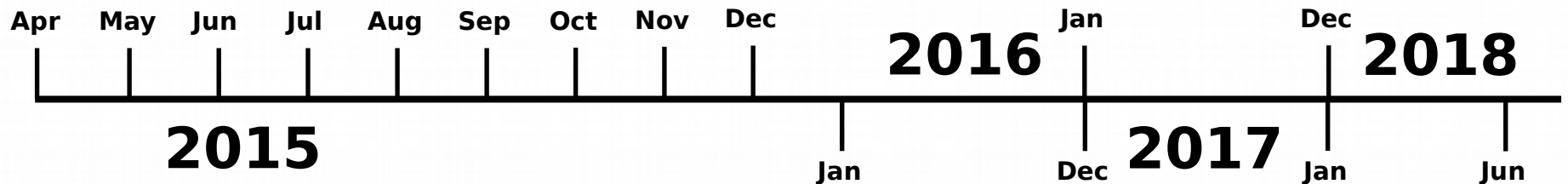


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP

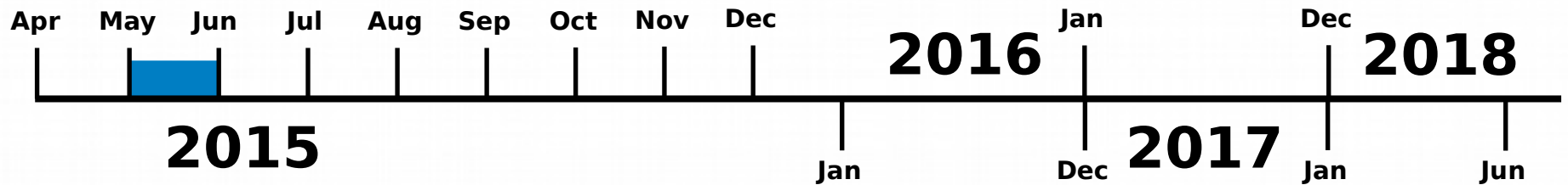
It is a long time project



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



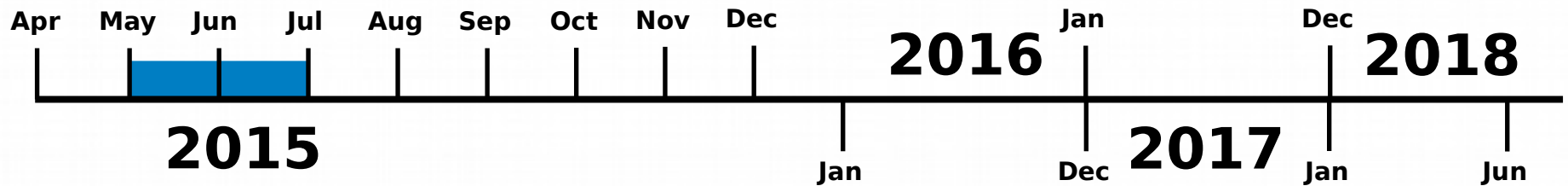
salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



**San Juan Bosco
La Cuesta School**
*Projects Week 2015
Satellite Tracker*



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

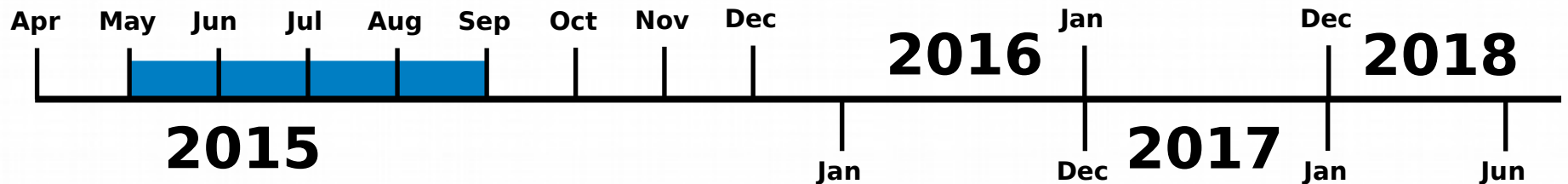
ROADMAP



**San Juan Bosco
La Cuesta School**
*Projects Week 2015
Satellite Tracker*



Satellite Tracker
First systems development



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



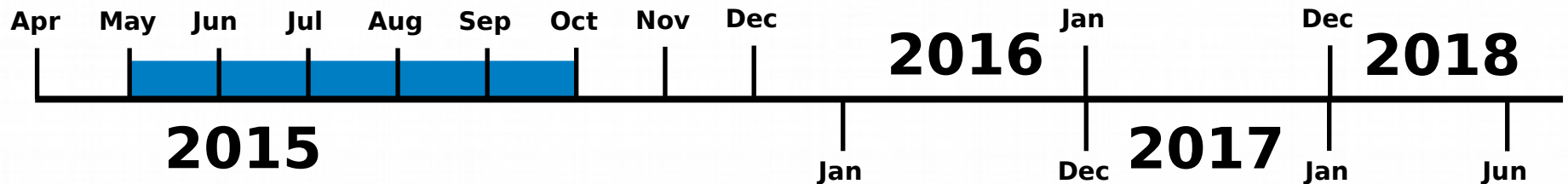
**San Juan Bosco
La Cuesta School**
*Projects Week 2015
Satellite Tracker*



Satellite Tracker
First systems development



Satellite
Orbital sensors testing



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



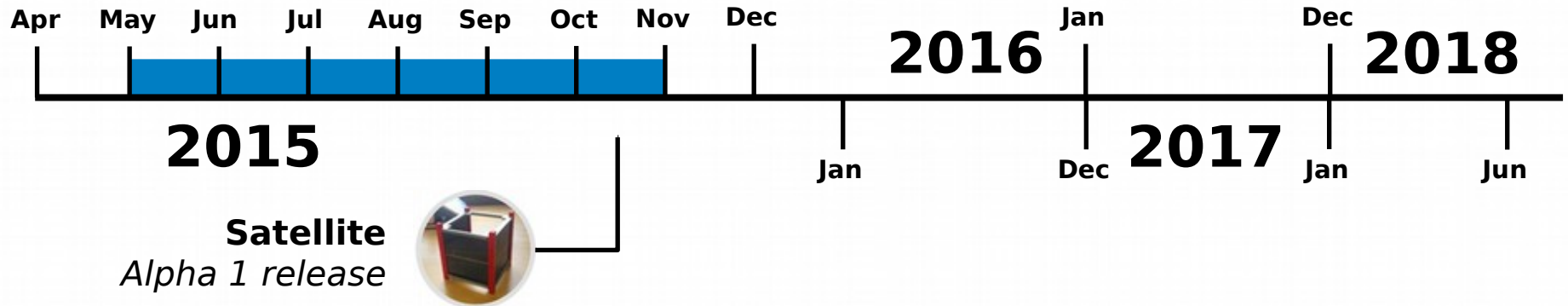
**San Juan Bosco
La Cuesta School**
*Projects Week 2015
Satellite Tracker*



Satellite Tracker
First systems development

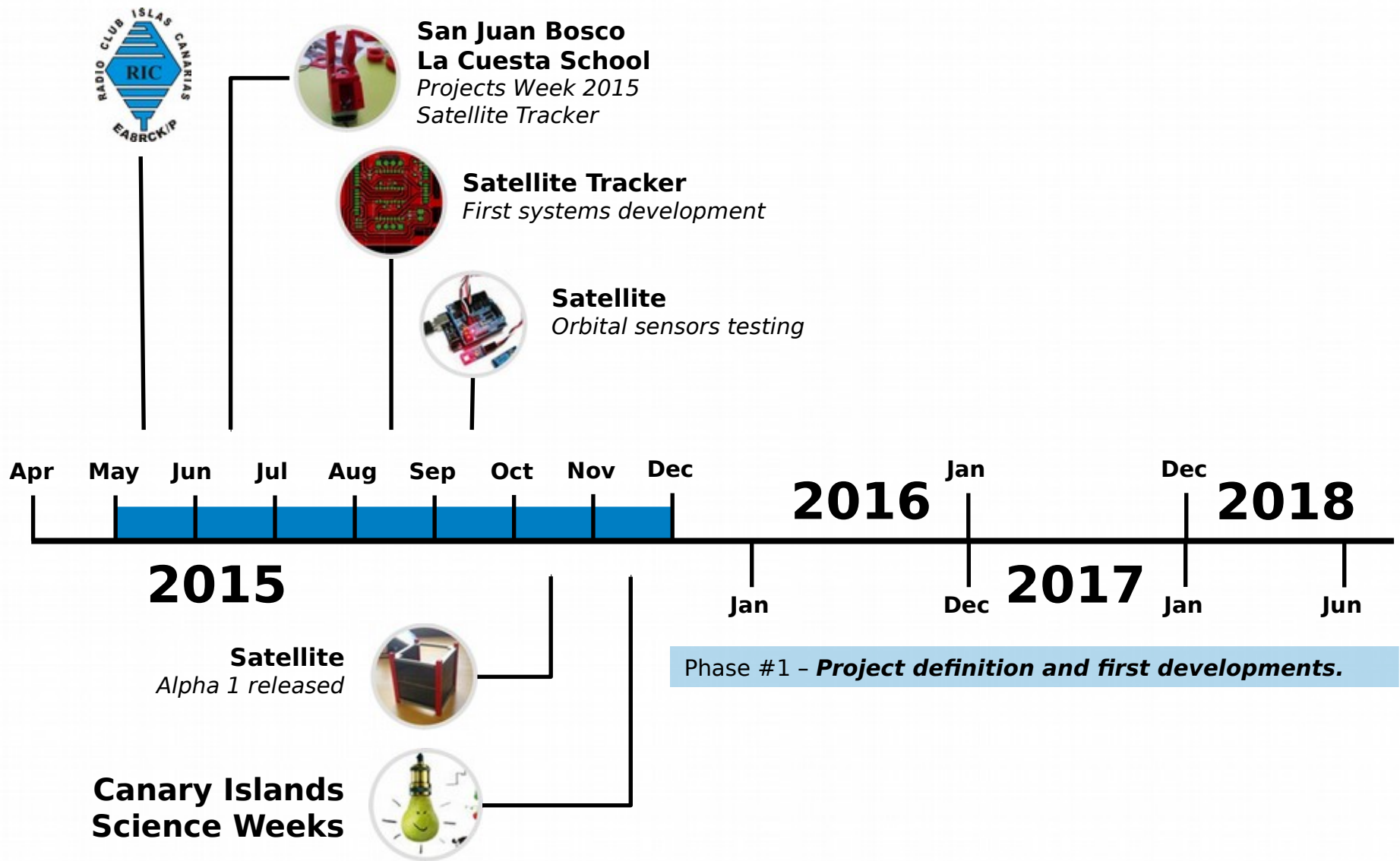


Satellite
Orbital sensors testing



salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

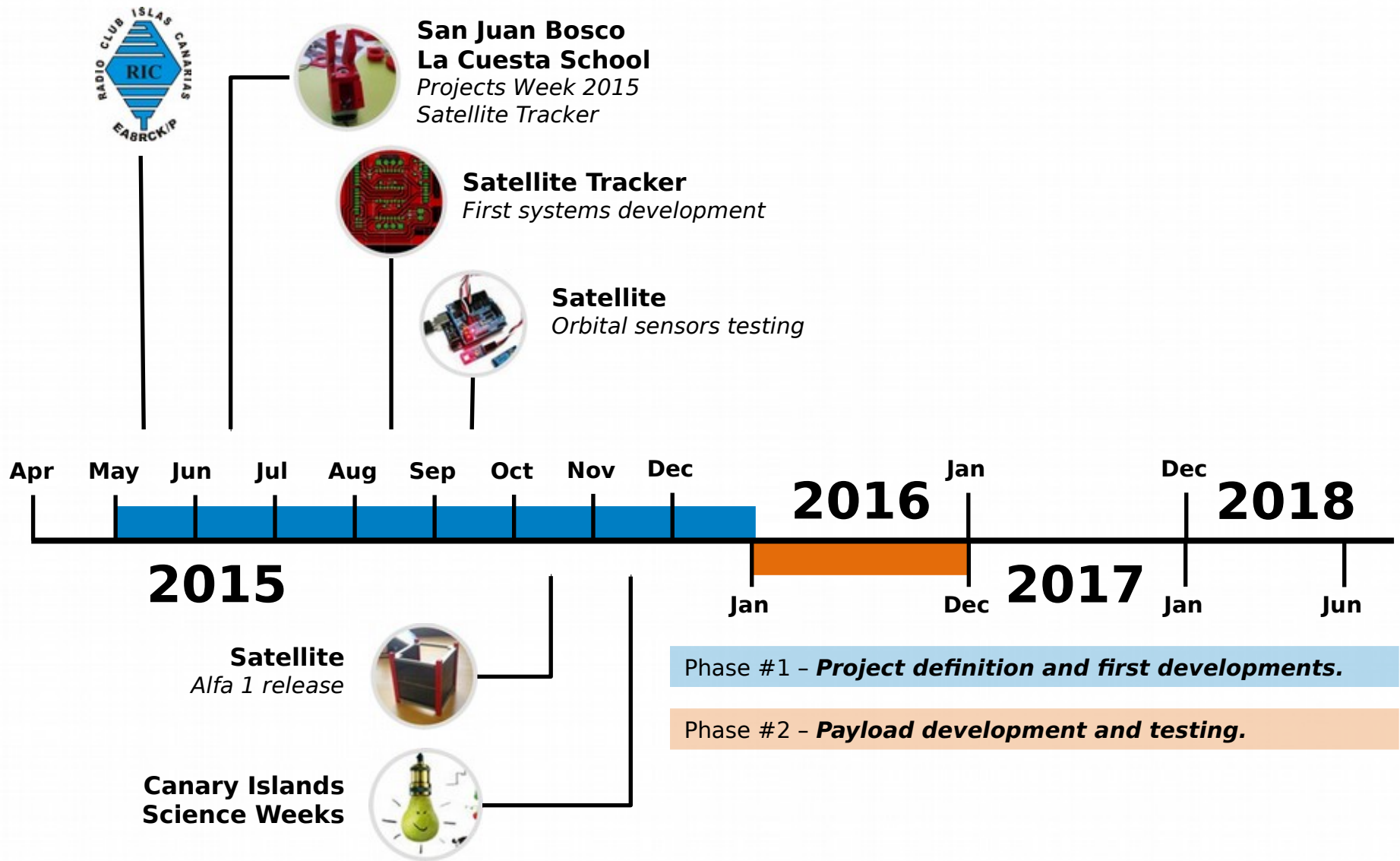
ROADMAP



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP

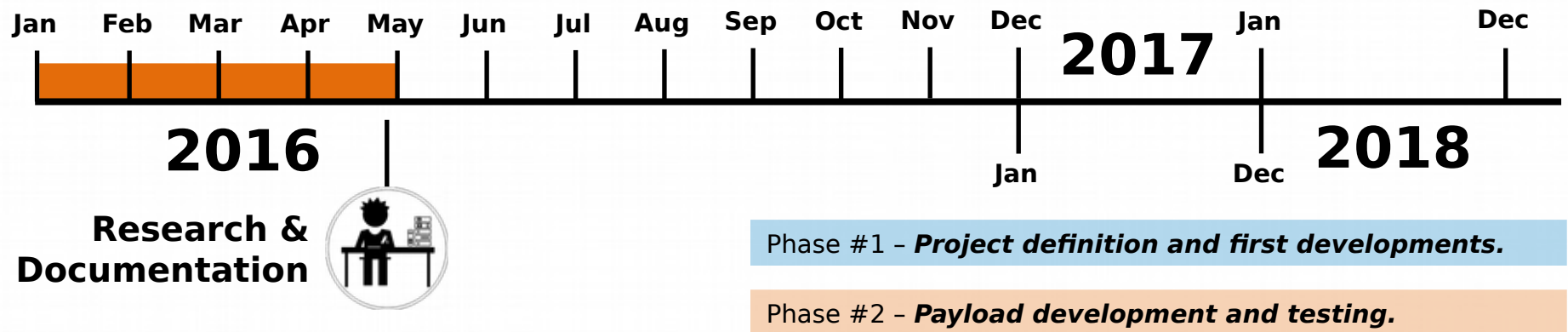


salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

2016



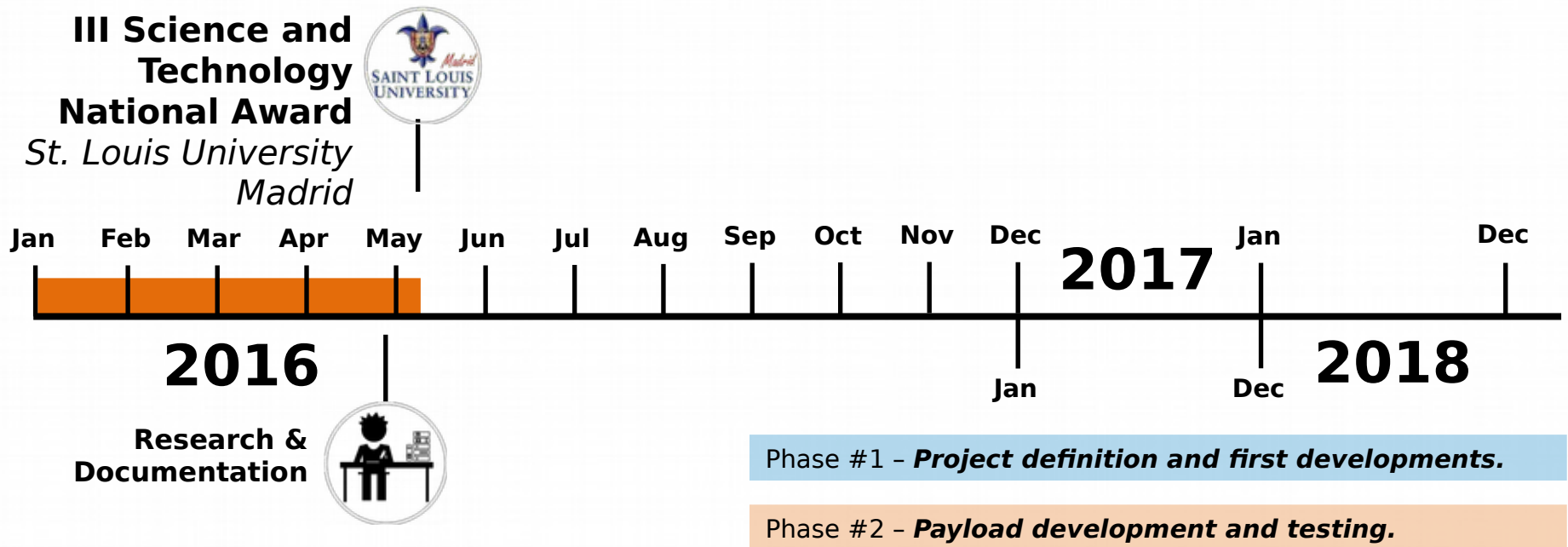
ROADMAP



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP

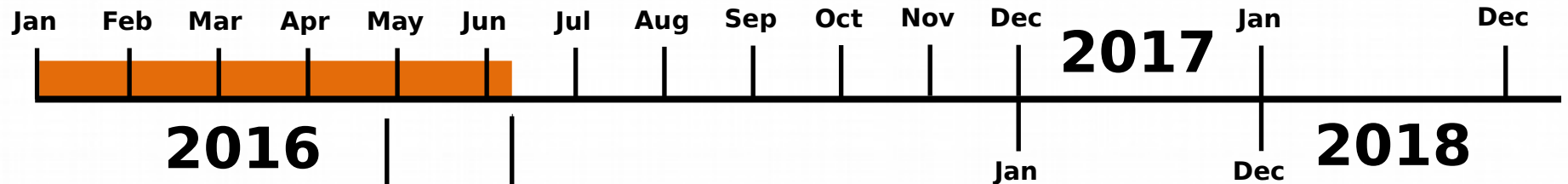


salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP

**III Science and
Technology
National Award**

St. Louis University Madrid



**Research &
Documentation**



Phase #1 - ***Project definition and first developments.***

Phase #2 - ***Payload development and testing.***

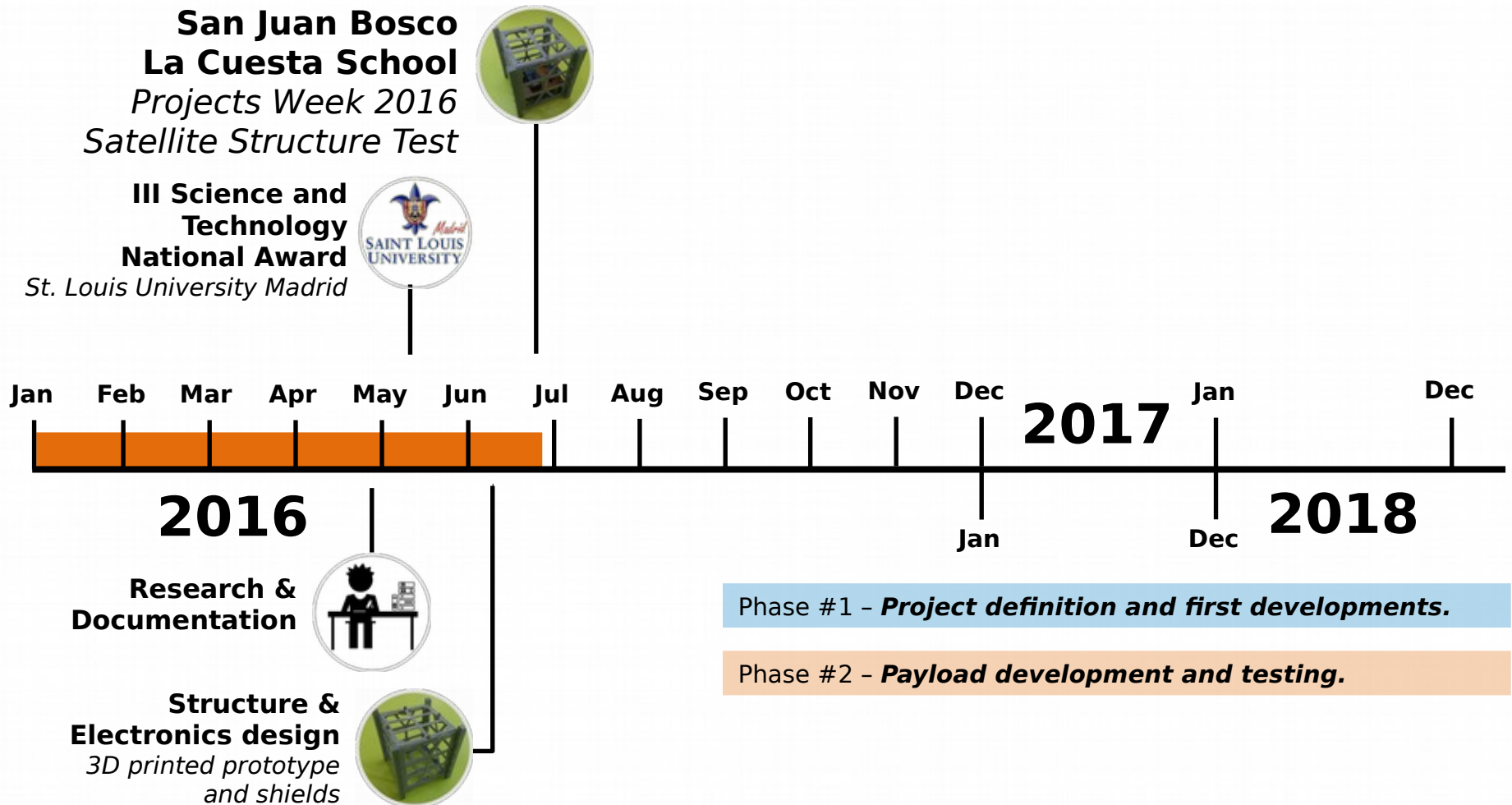
**Structure &
Electronics design**
*3D printed prototype
and shields*



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

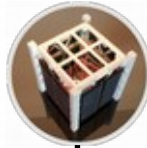
ROADMAP



salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP

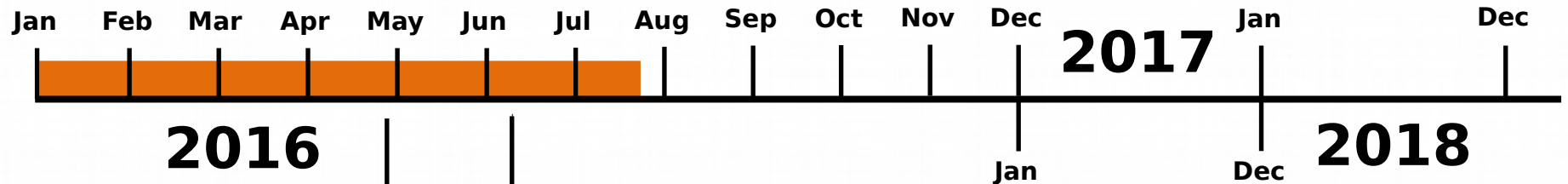
Satellite
Alpha 2 released



**San Juan Bosco
La Cuesta School**
*Projects Week 2016
Satellite Structure Test*



**III Science and
Technology
National Award**
St. Louis University Madrid



**Research &
Documentation**



**Structure &
Electronics design**
*3D printed prototype
and shields*



Phase #1 - **Project definition and first developments.**

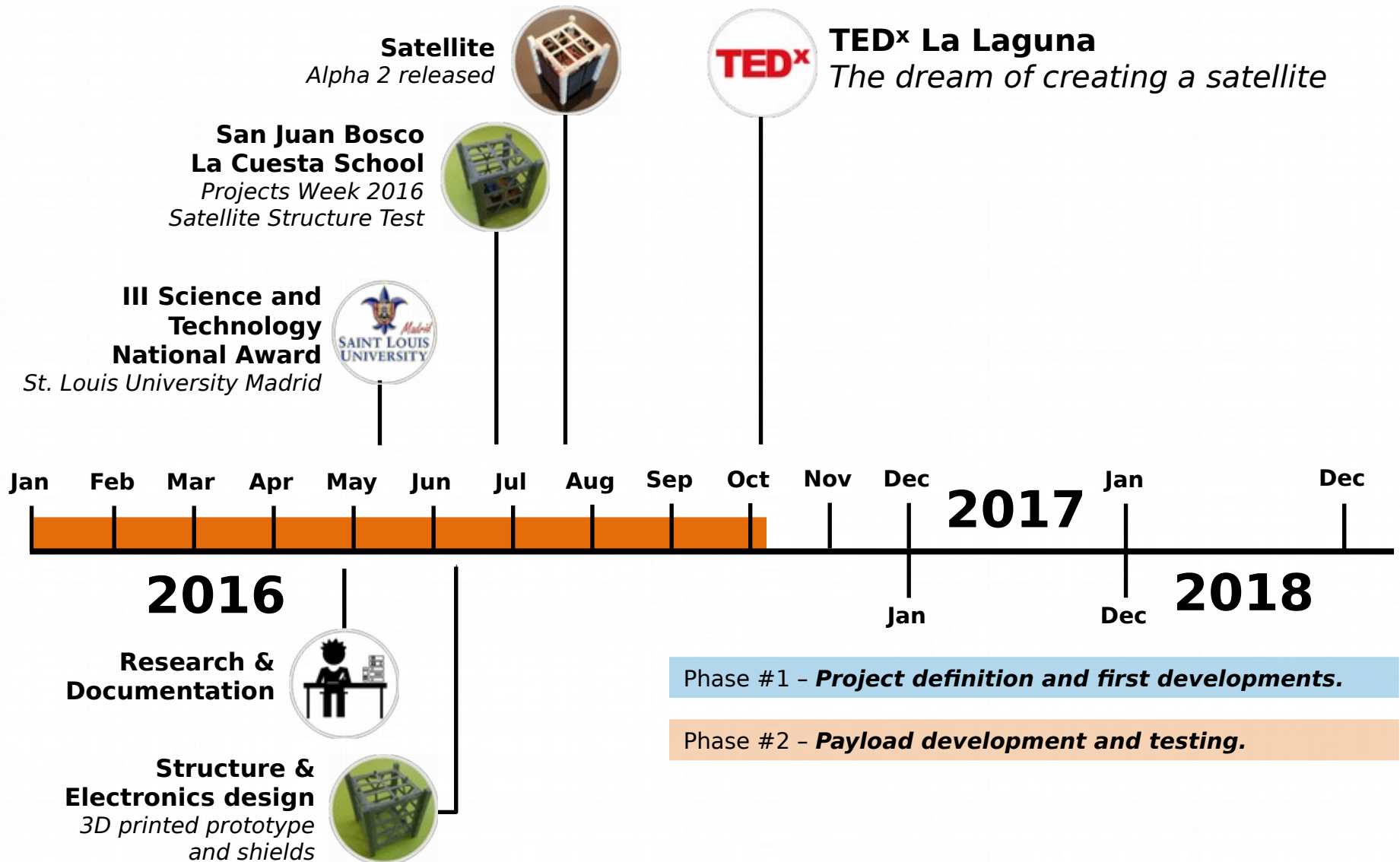
Phase #2 - **Payload development and testing.**



salesianos

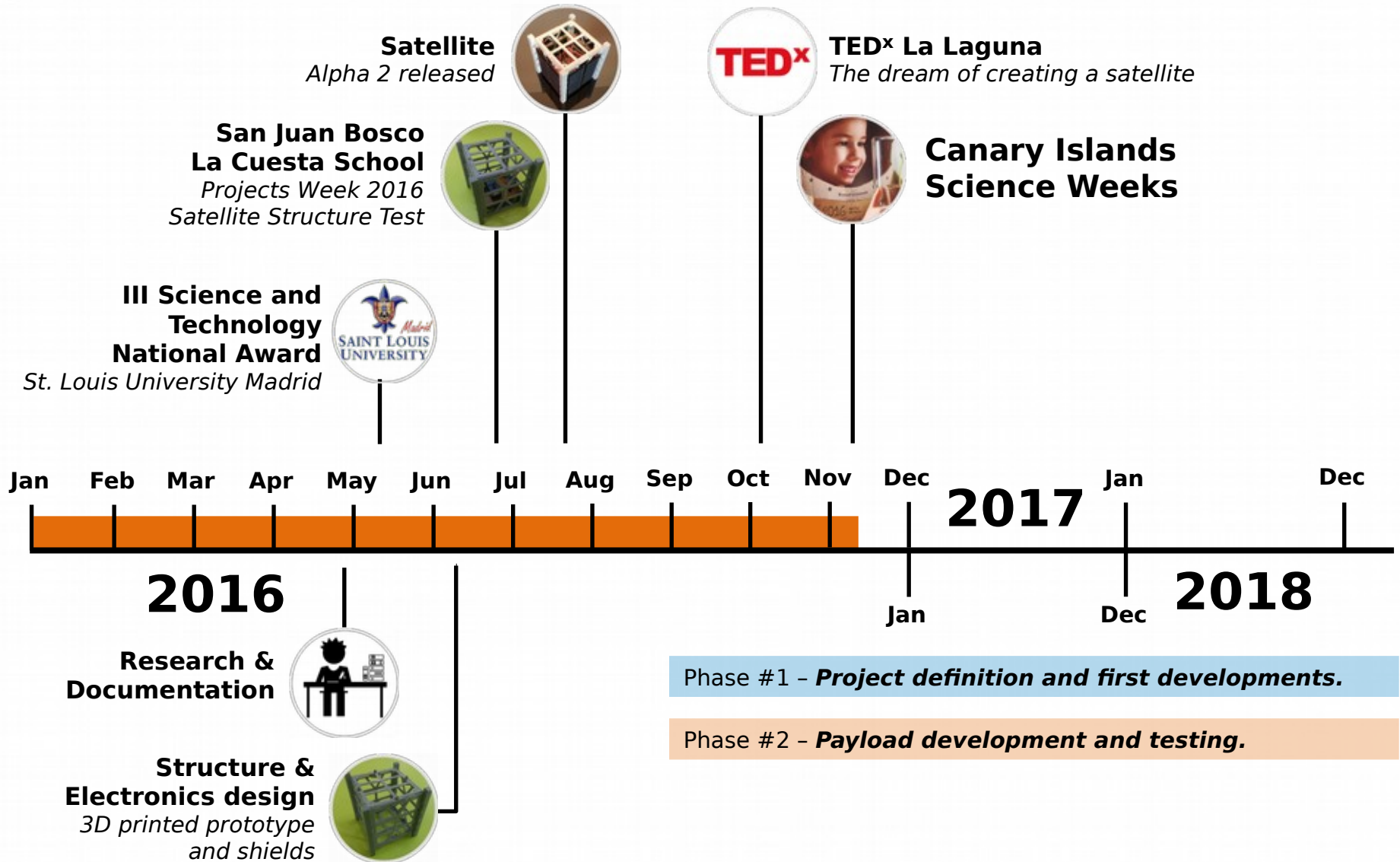
COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

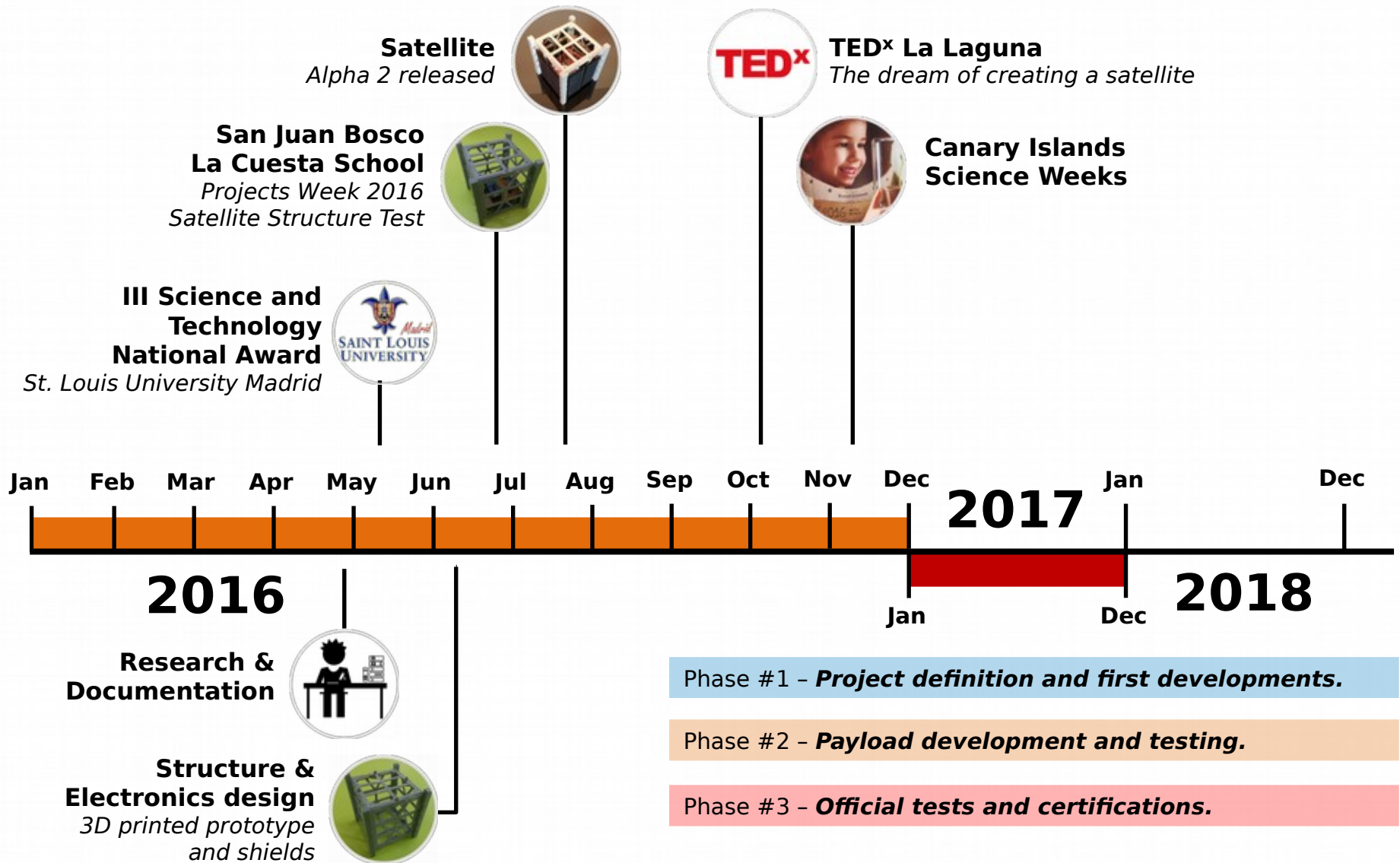
ROADMAP



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



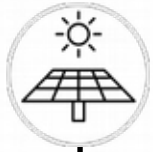
salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

2017

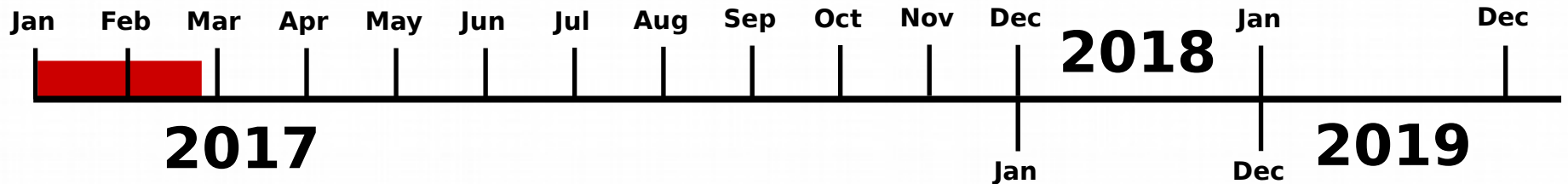


ROADMAP



Research

*Solar power &
battery recharging systems*



Phase #1 - ***Project definition and first developments.***

Phase #2 - ***Payload development and testing.***

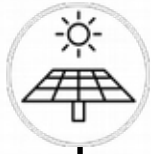
Phase #3 - ***Official tests and certifications.***



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



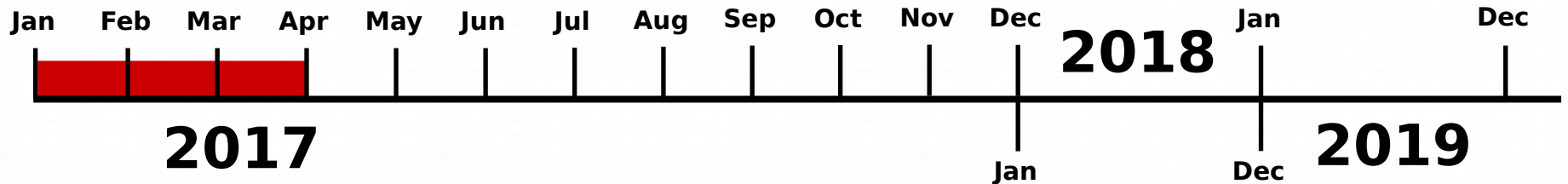
Research

*Solar power &
battery recharging systems*



New development tools

*CAD Software,
CNC machines, etc.*



Phase #1 - ***Project definition and first developments.***

Phase #2 - ***Payload development and testing.***

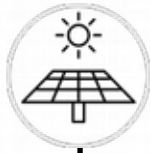
Phase #3 - ***Official tests and certifications.***



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



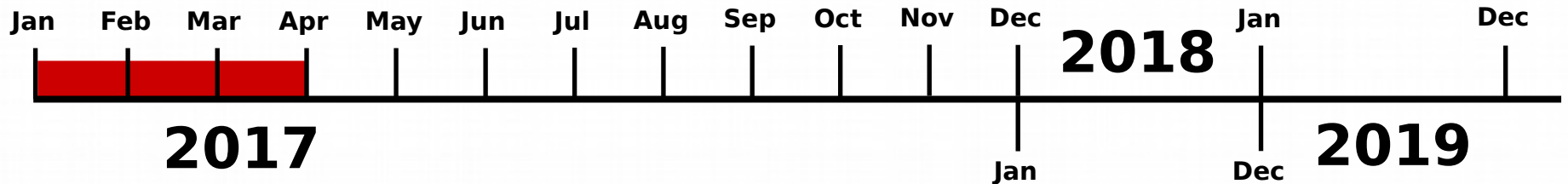
Research

Solar power & battery recharging systems



New development tools

CAD Software, CNC machines, etc.



Phase #1 - **Project definition and first developments.**

Phase #2 - **Payload development and testing.**

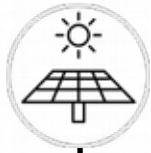
Phase #3 - **Official tests and certifications.**



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

ROADMAP



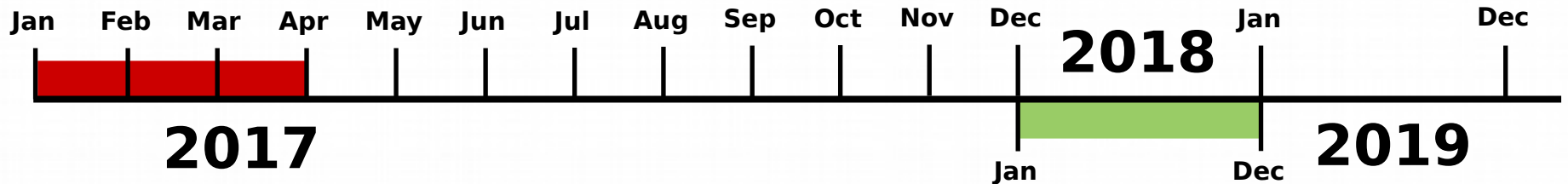
Research

Solar power & battery recharging systems



New development tools

CAD Software, CNC machines, etc.



Phase #1 - **Project definition and first developments.**

Phase #2 - **Payload development and testing.**

Phase #3 - **Official tests and certifications.**

Phase #4 - **Satellite launching.**



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

INDEX

Problem

Solution

Project Philosophy

Team

Achievements

Tools

Roadmap

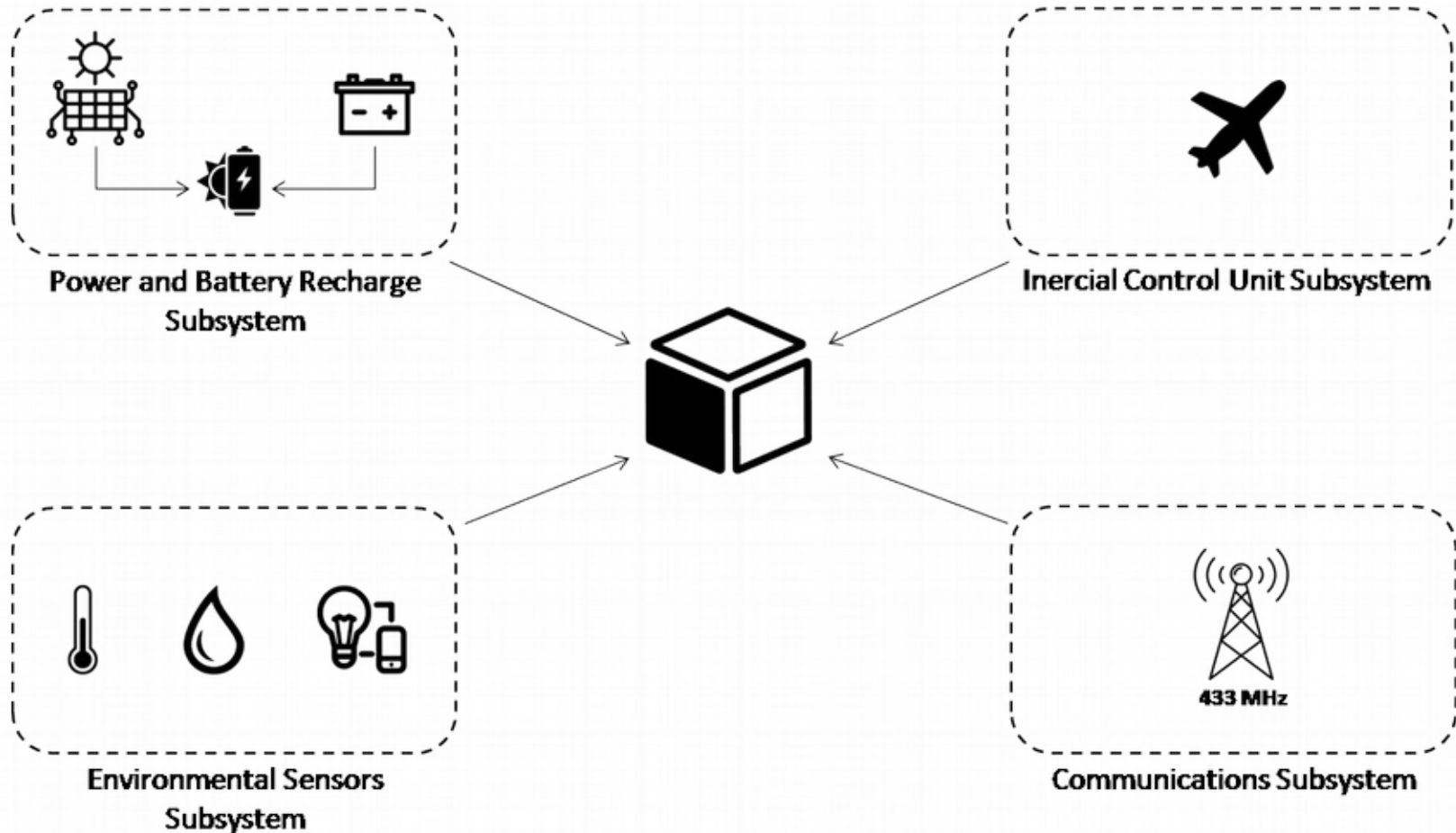
Current I+D process



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

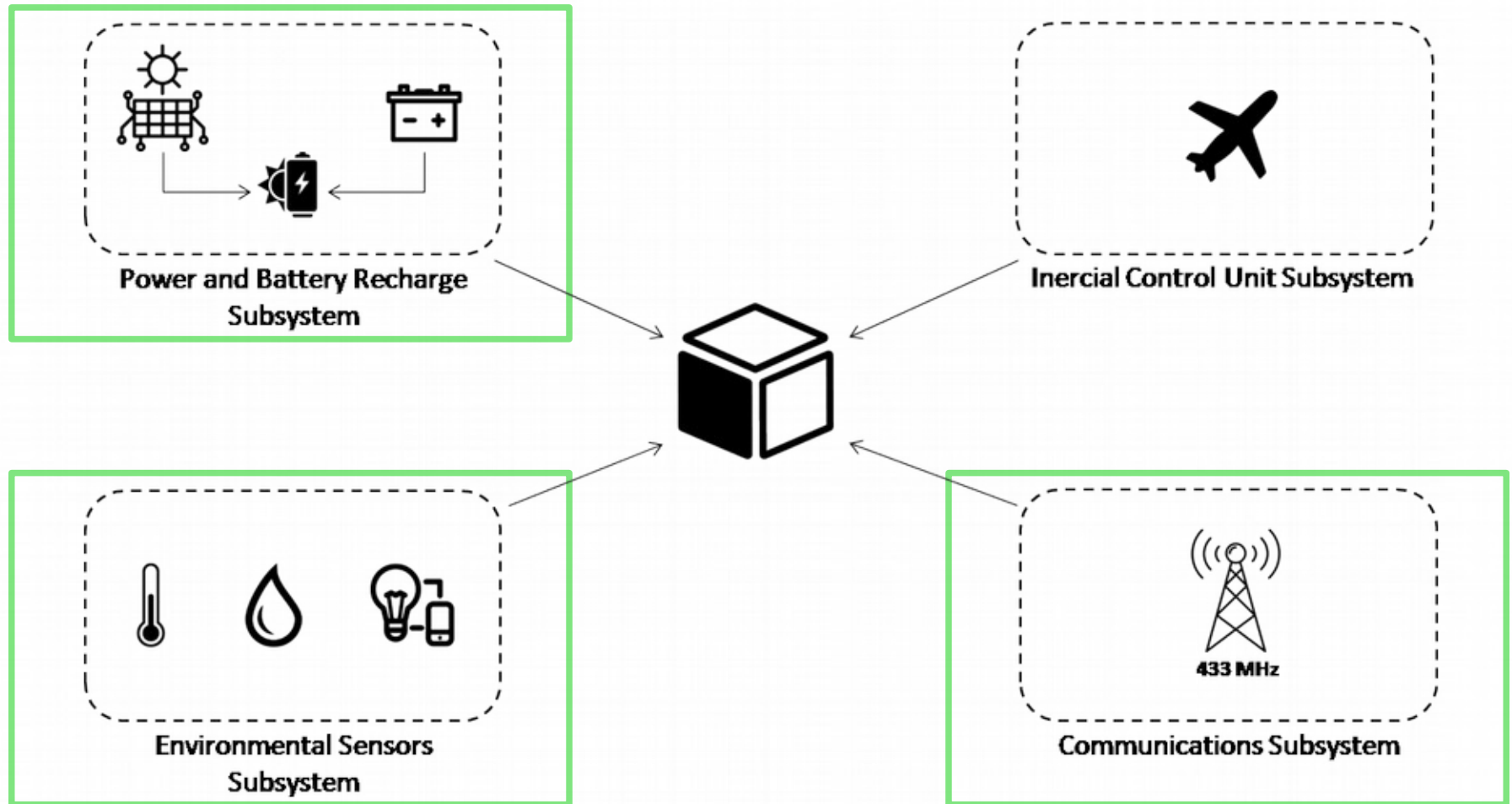
CURRENT I+D PROCESS



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

CURRENT I+D PROCESS



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA



boscoverysat@gmail.com



@boscoverysat



boscoverysat



boscoverysat.github.com



BoscoverySAT



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA



A satellite with homespun electronics

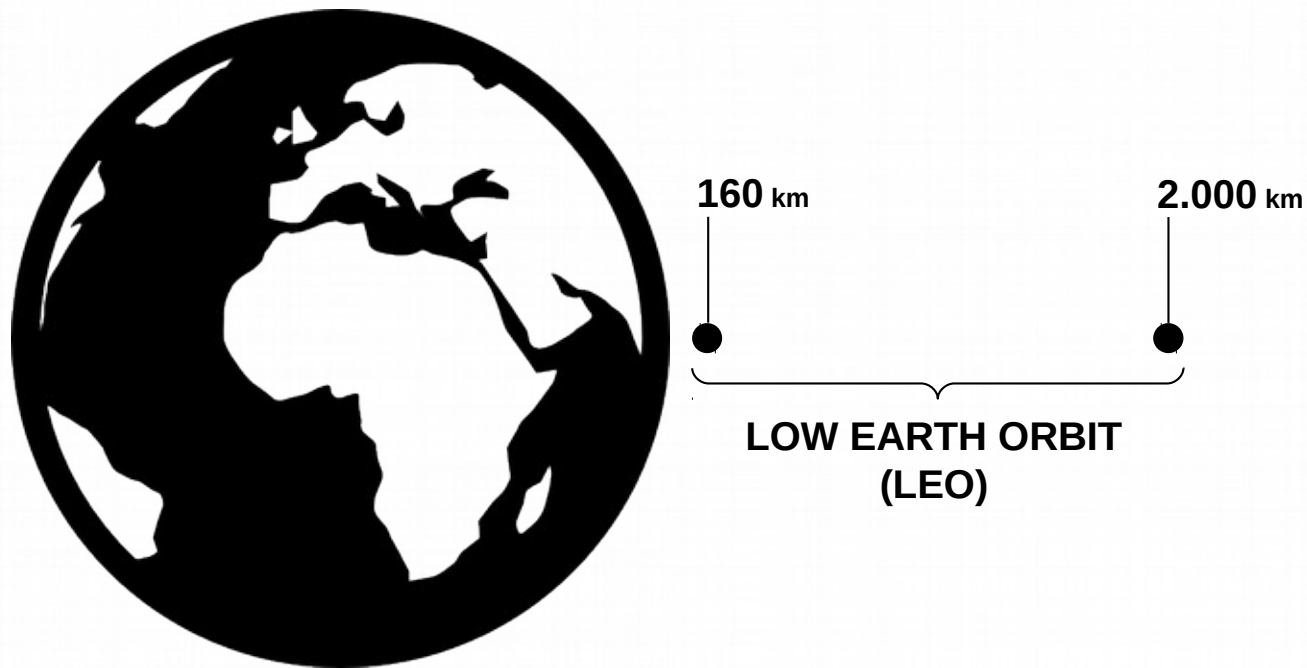
April 2017

Satellites' Orbits and Positioning



SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

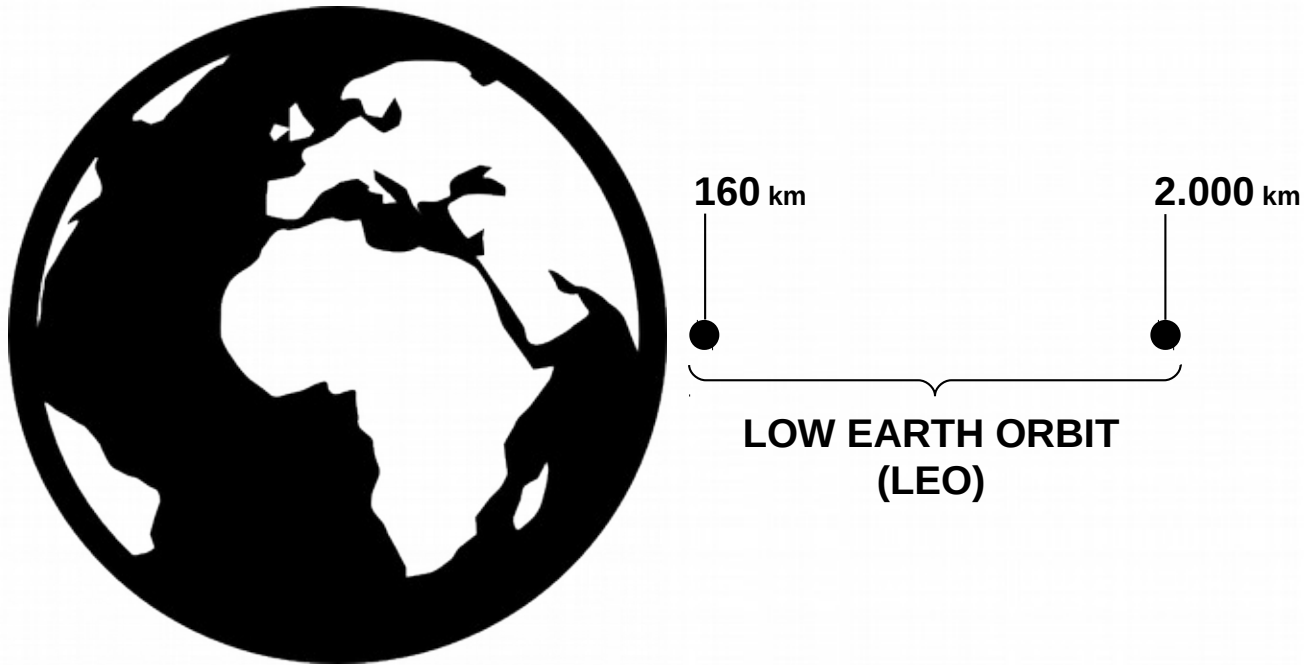


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs



LOW EARTH ORBIT DATA:

Average speed:	7,8km/s (28.080km/h)
Average orbit time:	99 minutes
Usual deployments:	Scientific missions



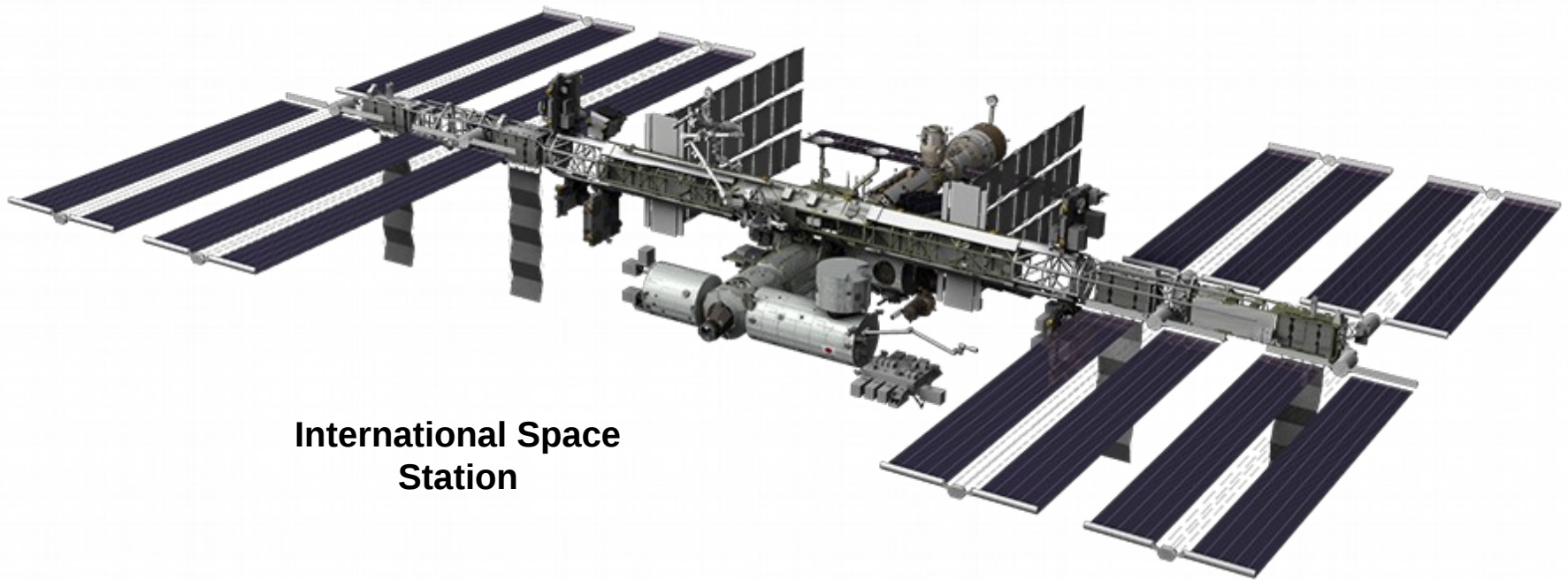
salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

Missions deployed at LEO orbit



International Space
Station

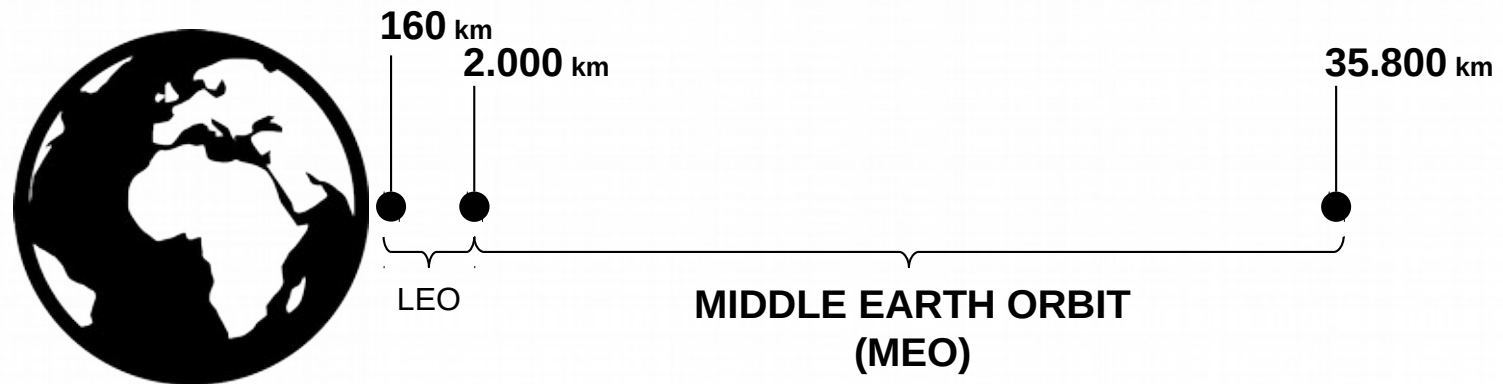


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

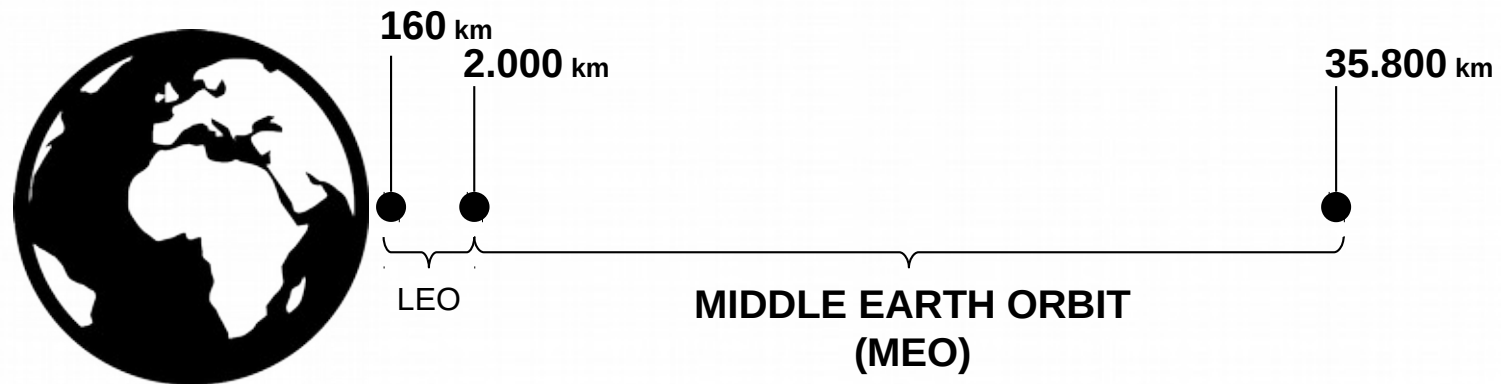


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs



MIDDLE EARTH ORBIT DATA:

Average speed: **3,9km/s (14.040km/h)**

Average orbit time: **12 - 24 hours**

Usual deployments: **GPS (20.200km) and special use for regions tracking**



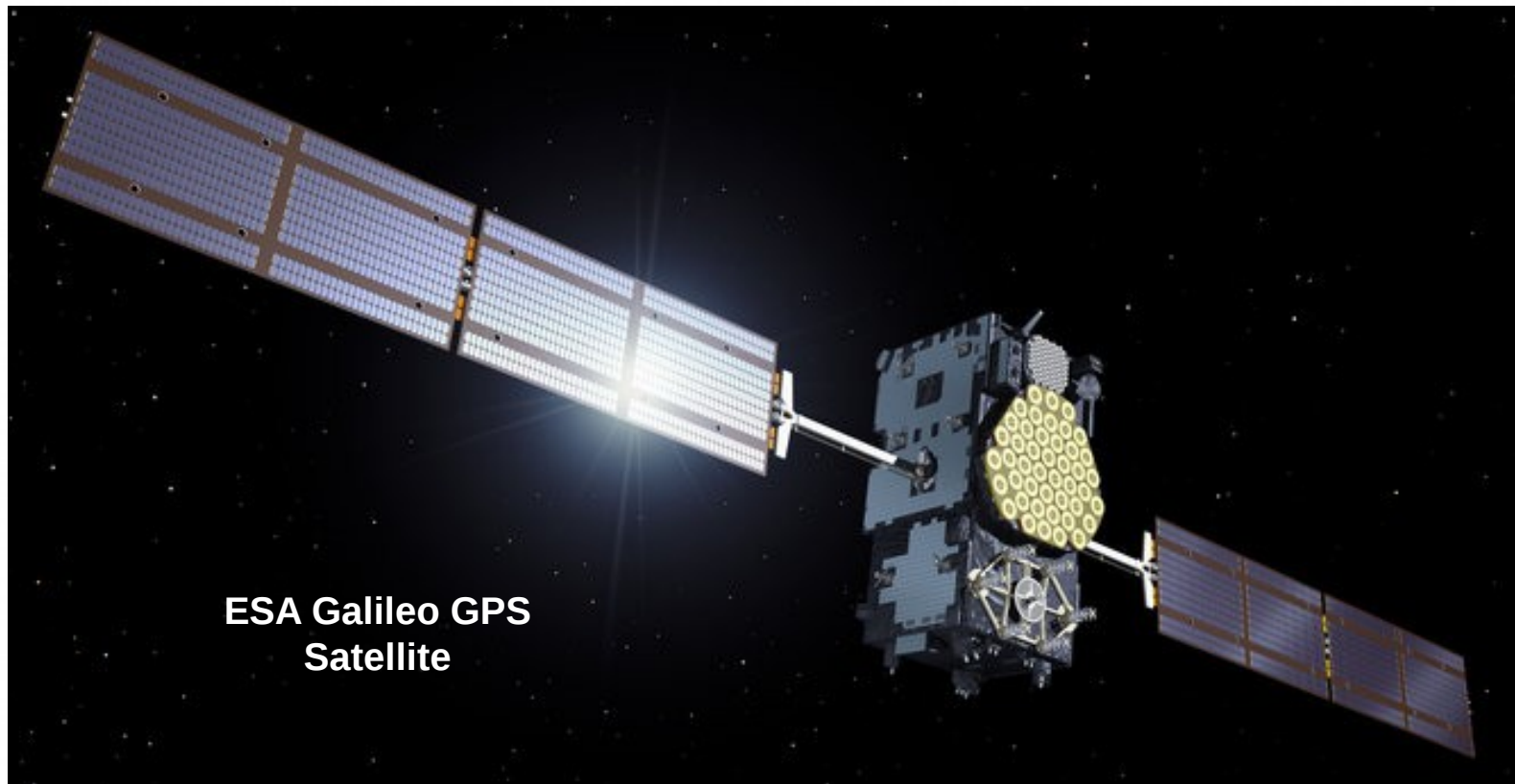
salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

Missions deployed at MEO orbit



ESA Galileo GPS
Satellite

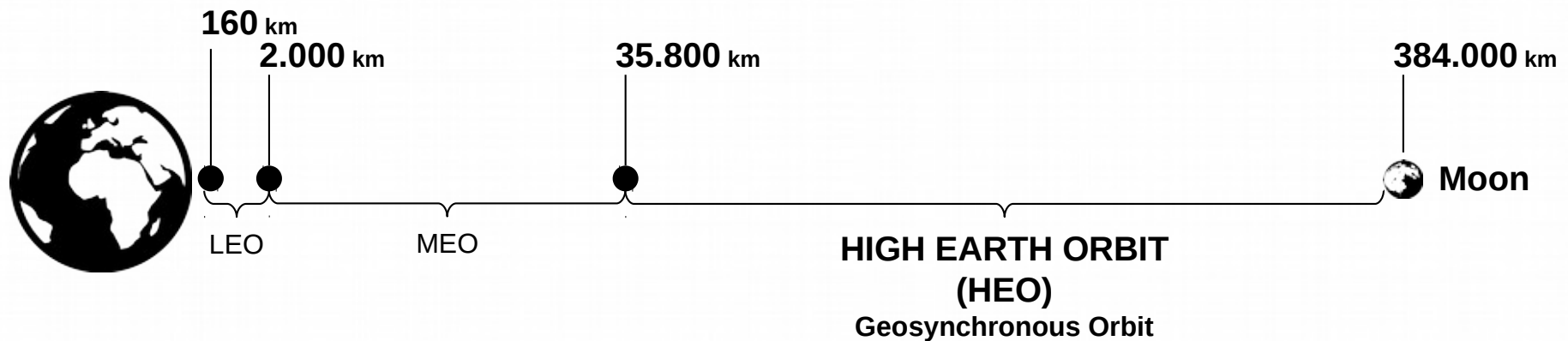


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

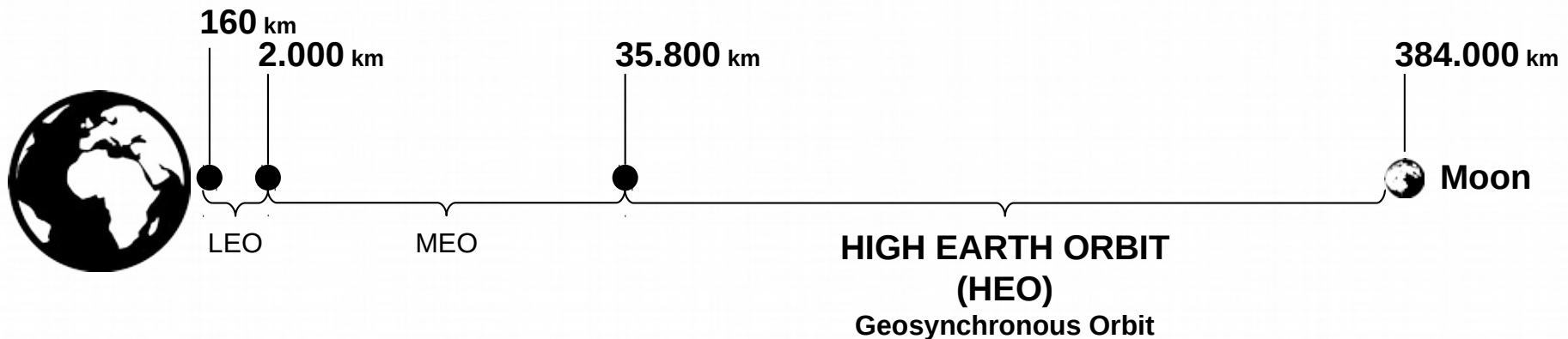


salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs



MIDDLE EARTH ORBIT DATA:

Average speed:	3,08km/s (11.088km/h) = Earth's rotation speed
Average orbit time:	Years (geostationary orbit)
Usual deployments:	Communications and weather stellites

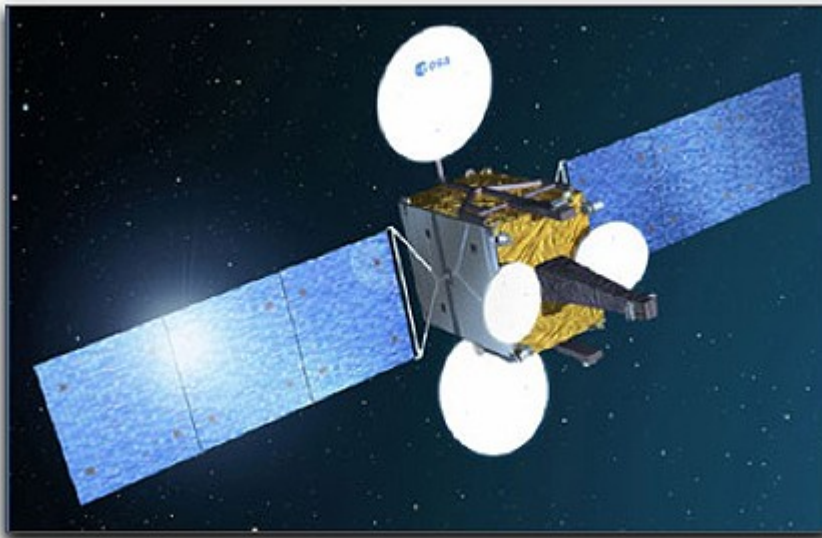


salesianos
COLEGIO SAN JUAN BOSCO LA CUESTA

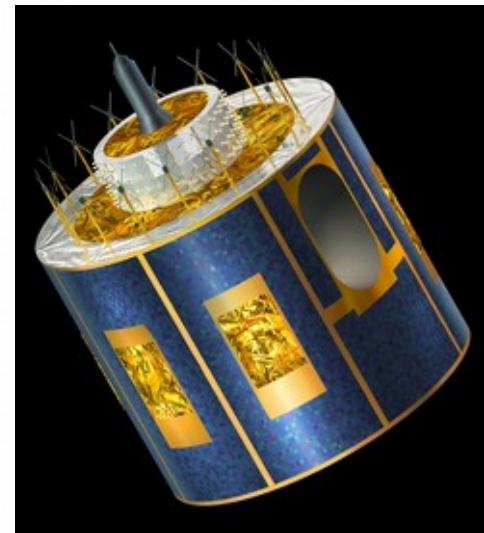
SATELLITES' ORBITS AND POSITIONING

Based on HEIGHTs

Missions deployed at HEO orbit



Hispasat AG1



Meteosat

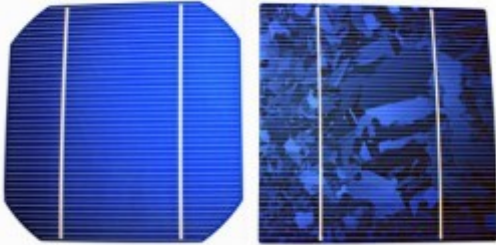


Power and Battery Recharge Subsystem



POWER AND BATTERY RECHARGE SUBSYSTEM

Facts



9,5 – 11 VDC/Side
50 – 60mA/Side

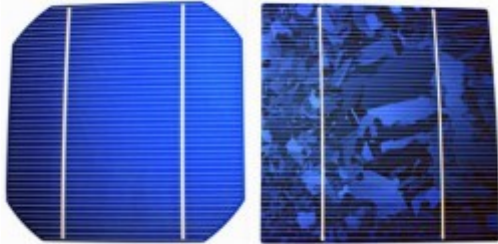


2 x 18650 Batt type
3,7V @ 5000mAh



POWER AND BATTERY RECHARGE SUBSYSTEM

Facts

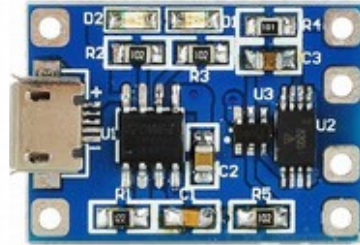


9,5 – 11 VDC/Side
50 – 60mA/Side



2 x 18650 Batt type
3,7V @ 5000mAh

Fails

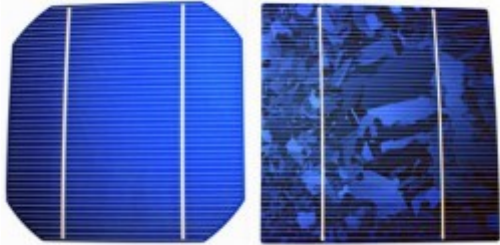


2 x TP4056
4,1V @ 1A
Battery Charger



POWER AND BATTERY RECHARGE SUBSYSTEM

Facts

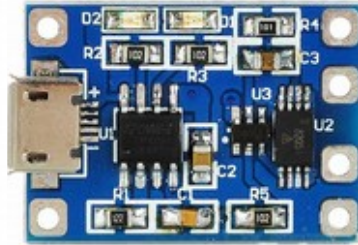


9,5 – 11 VDC/Side
50 – 60mA/Side



2 x 18650 Batt type
3,7V @ 5000mAh

Fails



2 x TP4056
4,1V @ 1A
Battery Charger

Researching



MAX1873REEE
Up to 4 Li+ Batts
-40°C to +85°C



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

Environmental Sensors Subsystem



ENVIRONMENTAL SENSORS SUBSYSTEM

Facts



HTU21D
Temperature

Battery, Cockpit, Side 1 – 6,
Control Unit



BH1750L
Light Intensity

Side 1 – 6



ENVIRONMENTAL SENSORS SUBSYSTEM

Facts



HTU21D
Temperature

Battery, Cockpit, Side 1 – 6,
Control Unit



BH1750L
Light Intensity

Side 1 – 6

Issues

Multiple I2C devices with the same
address.



ENVIRONMENTAL SENSORS SUBSYSTEM

Facts



HTU21D
Temperature

Battery, Cockpit, Side 1 – 6,
Control Unit



BH1750L
Light Intensity

Side 1 – 6

Issues

Multiple I2C devices with the same address.

Researching

Multiplexing SDA wire.



Dual CMOS 4-channel analog
multiplexer, demultiplexer.



Communications Subsystem



COMMUNICATIONS SUBSYSTEM

Facts



**Telemetry &
Configuration**

UHF 430 – 440 MHz



**Radio
Communication**

VHF 144 – 148 MHz



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

COMMUNICATIONS SUBSYSTEM

Facts



**Telemetry &
Configuration**

UHF 430 – 440 MHz



**Radio
Communication**

VHF 144 – 148 MHz

Issues

Buffer overflow on packages
transmission for telemetry and
configuration.



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

COMMUNICATIONS SUBSYSTEM

Facts



**Telemetry &
Configuration**

UHF 430 – 440 MHz



**Radio
Communication**

VHF 144 – 148 MHz

Issues

Buffer overflow on packages transmission for telemetry and configuration.

Researching

Error control by parity bits.

Antenna deployment system.



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

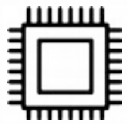
Budget



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

TOTAL RESOURCES INVESTED UP TODAY



Electronics

190,00 €



3D Printing

75,00 €



Mechanical components

25,00 €



Other materials

30,00 €

TOTAL AMOUNT

320,00 €



Total spent time (aprox.)

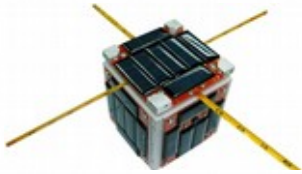
1.790 h



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

DEPLOYMENT BUDGET



500,00 €



10.000,00 €



60.000,00 €

Unexpected expenses

2.500,00 €

TOTAL AMOUNT

73.000,00 €



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

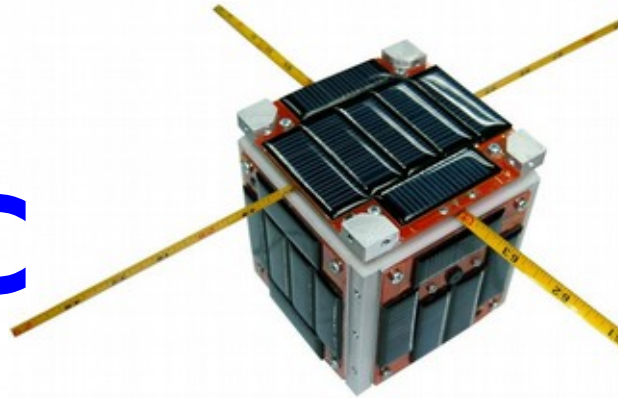
Deployment environmental conditions



DEPLOYMENT ENVIRONMENTAL CONDITIONS

temperature

-157°C



120°C



<https://science.nasa.gov>



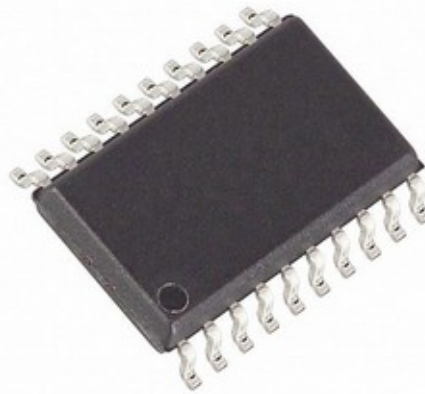
salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

DEPLOYMENT ENVIRONMENTAL CONDITIONS

Temperature electronics components

-40°C
(-157°C)



85°C
(120°C)

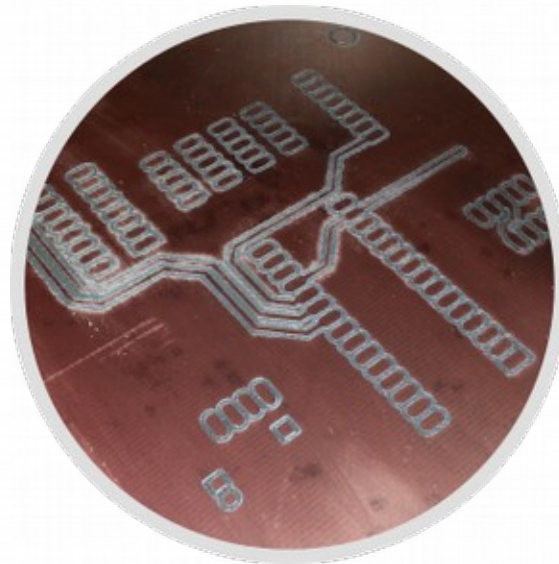


DEPLOYMENT ENVIRONMENTAL CONDITIONS

Temperature

printed circuits boards

-50°C
(-157°C)



140°C
(120°C)

FR-4 – Glass reinforced epoxy composite
1 oz copper thickness



DEPLOYMENT ENVIRONMENTAL CONDITIONS

Temperature soldering materials

-190°C
(-157°C)



183°C
(120°C)

Sn60Pb40



Real deployed CubSat based projects on



REAL DEPLOYED CUBSAT BASED PROJECTS ON



Maybe...

But we are not alone.



REAL DEPLOYED CUBSAT BASED PROJECTS ON

50\$ Sat



Built by three
amateur radio
operators.



7 months in orbit.



Dniepper russian
rocket.



www.50dollarsat.info



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

REAL DEPLOYED CUBSAT BASED PROJECTS ON

PicoDragon



Built by VNSC

(Vietnam National Satellite Center)



In orbit during 4 months.



ISS



<https://vnsc.org.vn/en/projects/profile-of-the-picodragon-satellite/>



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA

REAL DEPLOYED CUBSAT BASED PROJECTS ON

PhoneSat Series



Built by NASA.



Actually in orbit.



It's payload is an android phone.



Falcon 9.



phonesat.org



salesianos

COLEGIO SAN JUAN BOSCO LA CUESTA



A satellite with homespun electronics

April 2017