Femto-satellite based on Commercial-Of-The-Shelf:

Payload integration in the Design Cycle

Joshua Tristancho

Escola d'Enginyeria de Telecomunicació i Aeroespacial de Castelldefels

UPC Barcelona Tech - SPAIN

(Team FREDNET)

tristancho@gmail.com

December 20, 2011

Index

Introduction

- Femto-Satellite definition: Less than 100 grams !!!

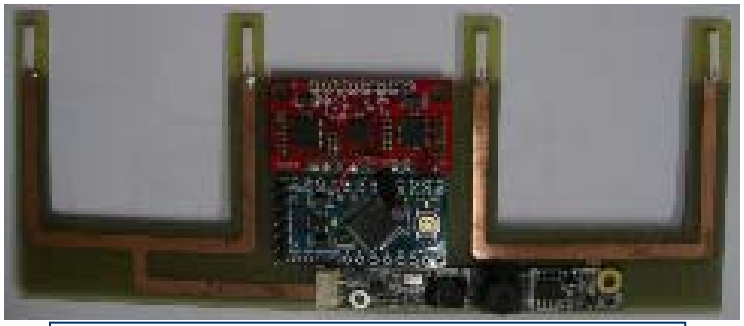
- Motivation. The N-Prize
  - <20 grams satellite
  - <$2,000 launcher cost
  - Before September 19th, 2012

- This satellite was a probe of concept

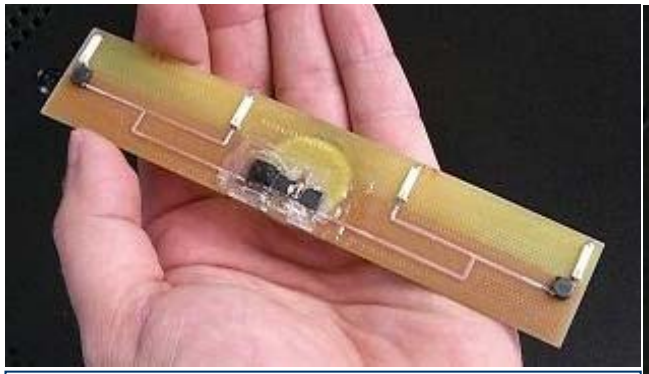
Introduction

- More complex femto-satellites were developed from then

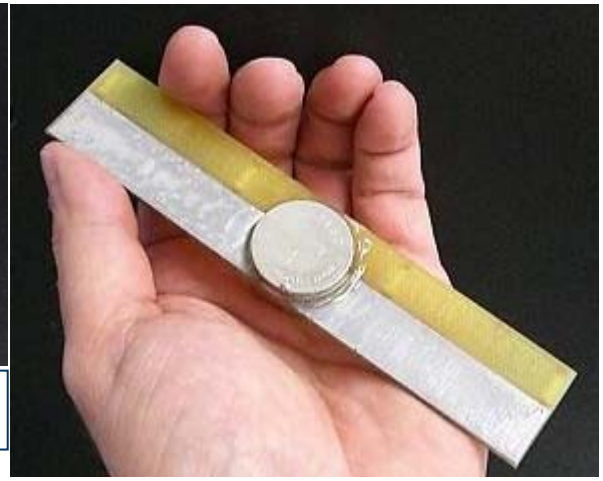
WikiSat v1. 11 grams



WikiSat v2. 27 grams



WikiSat v3. 19.9 grams



Introduction

- Mission characteristics
  - A very short time of development (less than one year)
  - A very low launch cost (less than 10,000 Euros)
  - A very easy and automatic operation
  - Ground operation based on amateur people
  - No human action required in flight (Autonomous)
  - A very short mission time and operation cost (Few weeks)

Introduction

- How a mission looks like? www.youtube.com/watch?v=LQ10gl6D7b0

Introduction

- How a mission looks like?
  - A very simple way to design a mission based on interesting points
  - Possible to update the list of interesting points once every day by the First Responders or by the Decision Makers
  - No huge communication networks are required
  - For emergency applications, real time recording is delivered directly to the First Responder in the field
  - A mission that provides a basic flight in real space conditions for SMD (Surface Mounted Devices) components validation

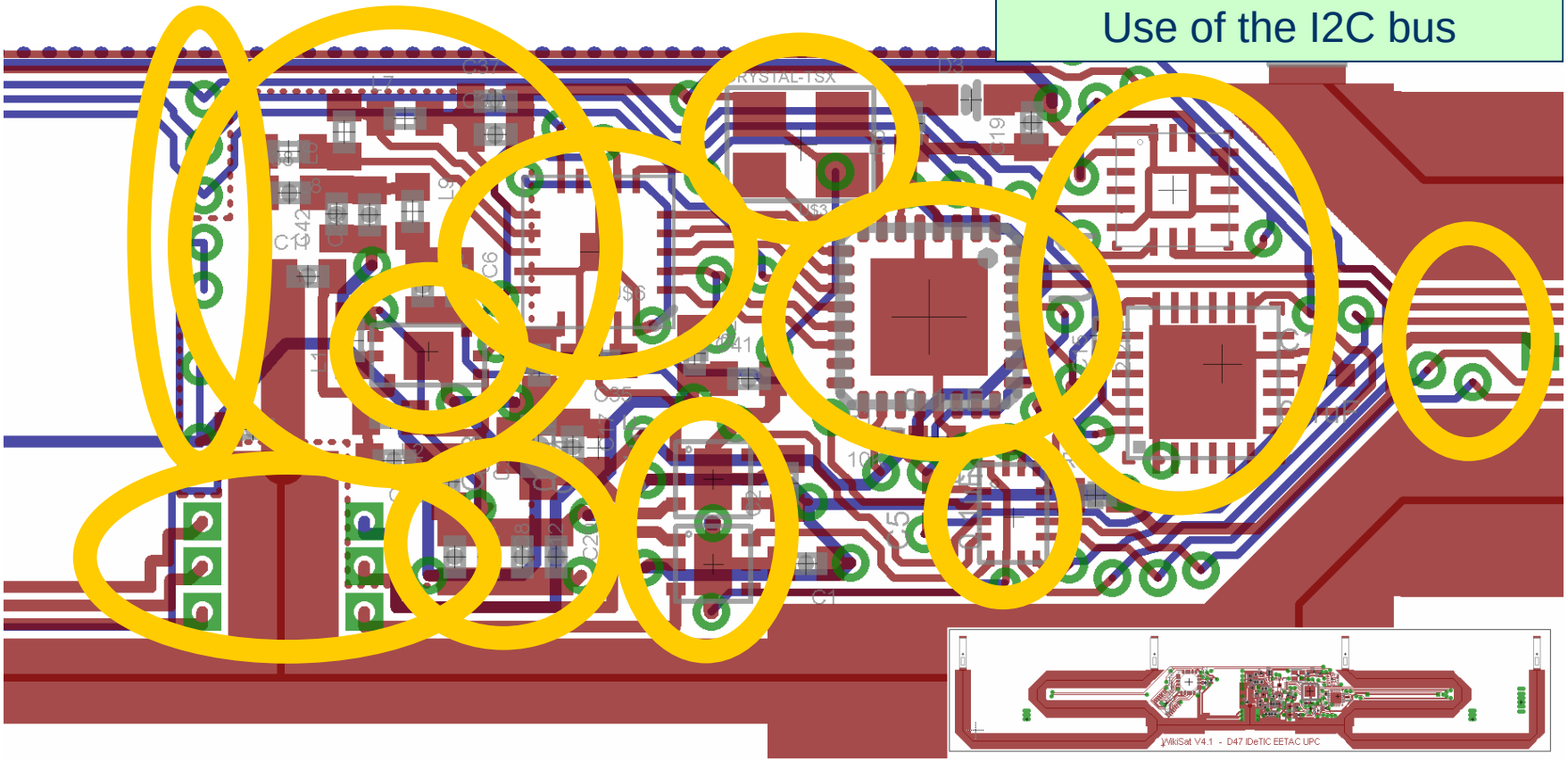
Femto-satellite description

- Main components
  - Synthetic Aperture Antenna
  - Onboard computer
  - Sensor / Camera
  - Magnetorquers
  - LiPoly battery
  - Solar cells?

Femto-satellite description

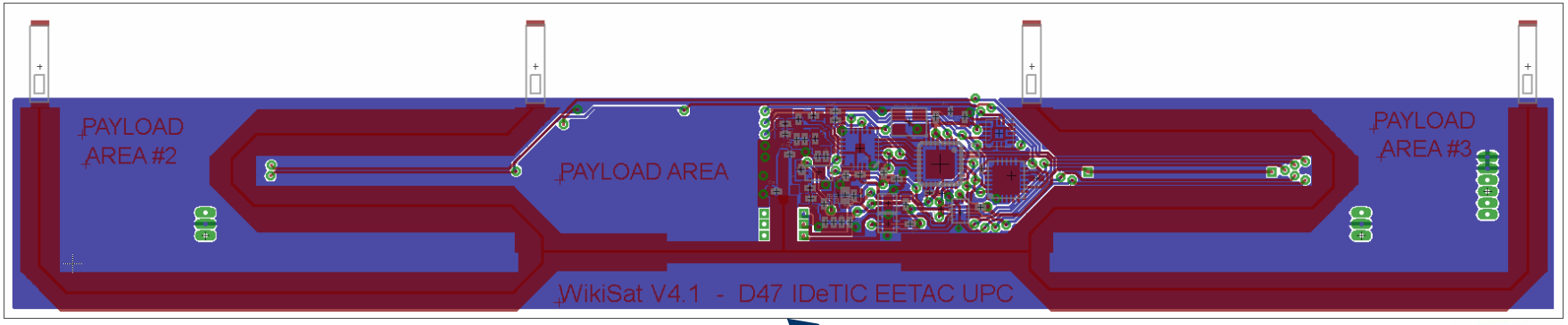
- Onboard computer

Control bus
SPI bus
Launcher control
Payload area #3 control
1.5 V Payload
Use of the I2C bus



Design rules

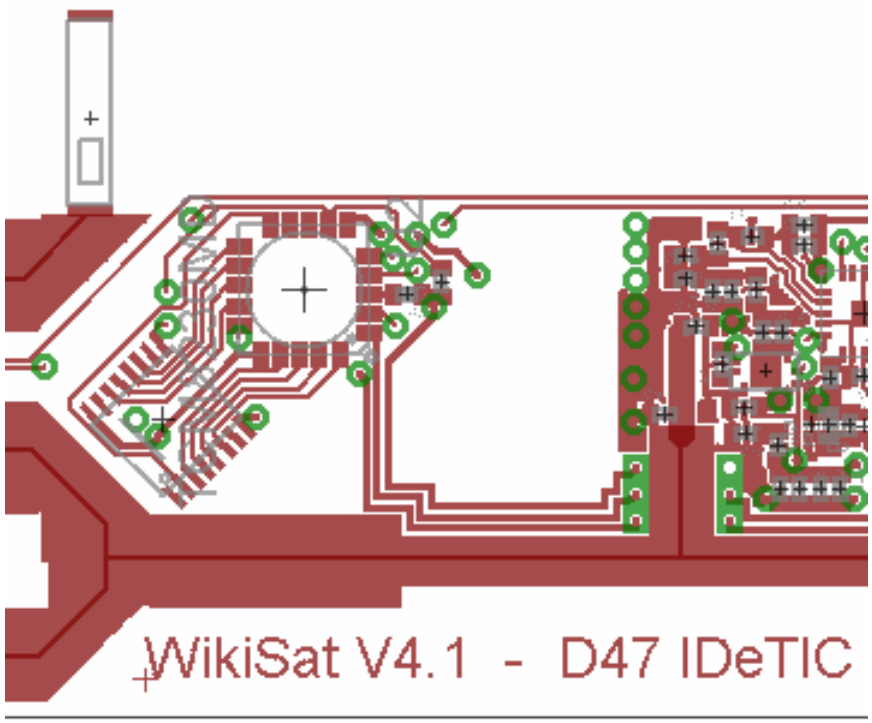
- PAYLOAD AREA (#1)
  - Shielded by the LiPoly battery
  - Easy connections. I2C bus
- PAYLOAD AREA #2
  - Unshielded. Smaller area than #1
  - Far connections
- PAYLOAD AREA #3
  - Unshielded- Smaller area then #2
  - SPI bus



Forbidden area. weak point

Example of payload integration

- HD Camera Toshiba TCM8240MD
- 8 bits serializer Texas Instruments SN74HC165



Example of payload integration

- HD Camera TCM8240MD
  - Mass: 1.0 grams
  - Max. power: 150 mA
  - Idle power: 50 mA
  - Resolution @ 1.3 Mpix: 1,280 x 1,024
  - Frame rate: 15 fps
  - Spatial resolution: 100 m per pixel
  - Scan area: 140 x 100 km
  - Temperature range: -20 to 60 ºC

Conclusions

- The inclusion of the client in the design process simplifies the satellite design and manufacturing
- It has a more efficient integration over a traditional implementation based on boxes
- In the current market, clients are more interested in SMD components validation but they are forced to validate a box
- The use of Freeware tools like Eagle or Moon2.0 make easy to be popular and become a future standard (Arduino like)

¿Qué puede aportar el IDeTIC?

Cada uno tiene su *Expertise*:

- El IDeTIC puede encargarse de la parte de comunicaciones: El transceiver, el amplificador de potencia, el filtrado y adaptación de la señal. La antena de apertura sintética, ayudar en la red de estaciones GENSO, la compatibilidad electromagnética con el resto de componentes sensibles, etc.
- La UPC se puede encargar de la parte aeronáutica: La computadora de abordo, los sensores, la alimentación eléctrica, el sistema inercial, el control de actitud, la lógica de vuelo y gestión de misión, el lanzamiento, etc.

Thanks for your attention!

tristancho@gmail.com

UNIVERSITAT POLITÈCNICA
DE CATALUNYA