Next generation Power Systems

High Power Systems for Next Generation Big Nanosatellites

Cal Poly Spring CubeSat Workshop  April 18-20 2012
Julien Hennequin, Stefano Speretta
Where are we now?

• Most flying Cubesats are currently 1U (1kg)
• Increasing number of 2U-3U in orbit (2 – 3 kg)
• 6U, 12U are mainly under development (6 – 20 kg)
• Bigger satellites have completely different power systems (30 – 60 kg)
Where are we now?

- Most flying Cubesats are currently 1U (1kg)
  - 10 W power class EPS
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)
Where are we now?

- Most flying Cubesats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
  - 20W – 30W power class EPS
  - Deployable becoming common
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)
Where are we now?

• Most flying Cubesats are currently 1U (1kg)
• Increasing number of 2U-3U in orbit (2 – 3 kg)
• 6U, 12U are mainly under development (6 – 20 kg)
  • Complexe Deployable panels
  • 40W – 80 W peak power needed
• Bigger satellites have completely different power systems (30 – 60 kg)
Where are we now?

- Most flying Cubesats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)
  - 80 – 100 W power class EPS
Where will we be in 3 years?

- 1U Cubesats used for simpler/compact missions
- 2U and 3U the new standard for CubeSat Science missions
- 6U, 12U and up will become key
Where will we be in 3 years?

- 1U Cubesats used for simpler/compact missions
  - First hands on experience
  - Small technological demonstrators
  - Highly miniaturized payloads
- 2U and 3U the new standard for CubeSat Science missions
- 6U, 12U and up will become key
Where will we be in 3 years?

• 1U Cubesats used for simpler missions
• 2U and 3U the new standard for CubeSat Science missions
  • Small size payloads
  • Commercial applications possible
• 6U, 12U and up will become key
Where will we be in 3 years?

• 1U Cubesats used for simpler missions
• 2U and 3U the new standard for CubeSat Science missions
• 6U, 12U and up will become key
  • High-end miniaturized scientific instruments
  • Many commercial / defense applications
  • Bridging the gap with small micro satellites
  • Cubesats going up in weight / size, microSats going down!
Perceived bottlenecks

• Available power
  • Breaking the 30W barrier

• Redundancy
  • One string is not always enough

• Scalability
  • Modularity
Breaking the 30W barrier

- Satisfy needs of high-end payloads
  - 30W peak power are not enough
  - Target: 60W
- Support a higher number of solar cells strings
  - Deployable panels are becoming common
- How to transfer 60W to the payload?
  - CSKB connector not suited
  - Useless to route high power to the whole satellite
  - Dedicated power bus to the payload
  - Customizable high voltage bus (up to ~28V)
One string is not always enough

- Most of the Cubesats are single string designed
  - Simple system
  - Low cost
  - Risk has to be tolerated
- Risk is not always tolerable
  - Need of High-reliability EPS
  - Power is one of the most critical systems
- Why not using 2 power systems?
  - Divide the risk
  - Graceful performance degradation
Modularity

• One solution to fit a wide range of missions
  • Reuse the Core design
  • Scalability is critical

• Scalability on power generation
  • Modular MPPT units to accommodate multiple deployables
  • Modular BCR to accommodate different needs

• Scale the number of power buses available
  • Advanced power control on-board
iEPS: a possible solution

- ISIS and SystematIC Design are cooperating in the development of a Power System
- Develop an EPS targeted for
  - High-end nanosatellites
  - Satisfy needs from 2U to 24U
  - Focus on a scalable and robust design
Introduction to the ISIS iEPS

• High output power
  • Up to 60W in a single subsystem
  • Targeted for multiple deployable panels
  • Scalable energy storage

• Next generation EPS
  • Fully redundant solution possible
  • Graceful performance degradation
Introduction to the ISIS iEPS

- 4 MPPT controllers (4 – 8 TJ solar cells)
  - Stackable MPPT controllers for supporting deployable / body mounted cells
- Stackable battery boards
- Multiple power busses available
  - Standard 3V3, 5V
  - High voltage bus (up to ~ 28V)
  - Customizable output voltages
  - Redundant power switch units
Unique features

- **EPS features**
  - Backdoor access: Achieve EPS control even with main bus stuck

- **Ground support equipment**
  - Fast development & test of single systems
  - Use the board without an OBC

- **“Conventional Space Industry” PA/QA**
  - Elaborate documentation
  - Professional customer support
  - Extensive Test reports