A Big Change in Small Things in Space

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CubeSat Workshop
Logan, Utah

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Morehead State University
Morehead, KY
I am now at Morehead State University, why?

• Retired from Stanford, 2006. They needed a new perspective there after my 12 years.

• Stanford had Jamie Cutler and now Andrew Kalman. Done super job.

• Moved to Idaho for family reasons and to fish.

• Got bored soon when fish didn’t bite and have Space now in my blood, mainly due to Gil Moore getting me started.

• Blame Gil Moore.
Why Morehead Kentucky?
Met Kris Kimel from Lexington, Ky in ~ January 2006 at NASA Ames. He is the president of Kentucky Science and Technology Corporation.

Explained to him what we though was the educational value of CubeSats.

By March, 2006, Kris had raised $500,000 for a first CubeSat program in Kentucky.

As a fisherman, I knew I had hooked a big one there.

Kentucky universities have built KySat that is now manifested by NASA for launch. Soon????
What does Morehead State have for a space program?

- 21 Meter Ku band Tracking antenna
- New $16M Space Science Center
What could I say when I saw this?
I want to play too.

Please!
Please!
Please!
Now, it is commute time.
What programs are we now associated with or discussing?

POPACS – Gil Moore
QB50 – Von Karman Institute, Brussels
Interorbital launch vehicle test and orbit launches

More
Kentucky is committed to Space education and Space for economic development in Kentucky.

Who is here from Kentucky?
How did we get to small satellites?
Remember we stared with small satellites.
We built a satellite called Vanguard.

We had a big rocket.

We tried to launch it.

We had failures.
Now this satellite called Vanguard.

It ended up on the ground going beep, beep, beep.
America’s Sputnik dies bleeping on the ground

OH, WHAT A FLOPNIK!

Satellite blows up before take-off

By GILBERT CARTER

A MERICA’S much-hyped bid to launch a satellite to join Russia’s two Sputniks in space ended yesterday in a huge bellow of orange flame—on the ground.

For the tiny 96-minute rocket will go down in history as the Fugue before bursting in flames at its three-stage rocket blew up on the launching pad.

Belsky’s Cartoon

TEN SECONDS TO DISASTER

A MONSTER CLOUD OF FLAME: All that remains of America’s bid to launch a satellite.

Warship races to banana colony

A ROYAL NAVY warship raced to British Honduras last night with troop reinforcements. And as the frigate Ulster landed men of the Worcestershire Regiment at Belize, capital of the “banana colony,” it was announced that they had been sent at the Governor’s request.
The Future?

Further Miniaturization?
Comments - present satellites

• Present CubeSat too Big?

• Cost too much to launch!

• Everyone needs new challenges.
<table>
<thead>
<tr>
<th>Group name</th>
<th>Wet Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large satellite</td>
<td>&gt;1000kg</td>
</tr>
<tr>
<td><strong>Medium sized</strong> satellite</td>
<td>500-1000kg</td>
</tr>
<tr>
<td>Mini satellite</td>
<td>100-500kg</td>
</tr>
<tr>
<td>Micro satellite</td>
<td>10-100kg</td>
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<tr>
<td>Nano satellite</td>
<td>1-10kg</td>
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<tr>
<td>Small Satellites</td>
<td></td>
</tr>
<tr>
<td>Pico satellite</td>
<td>0.1-1kg</td>
</tr>
<tr>
<td>Femto satellite</td>
<td>&lt;100g</td>
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How about a satellite that fits in your Pocket?
Miniaturize to fit in your pocket?

Here is an example.

Shrink
The electronics industry has evolved as packages have gotten smaller and smaller. For example, the 14-pin dual-inline package (DIP) is now today's micro-SMD.
How about a 5cm cube?

Fempto Sat?
What should we call it?

How about PocketQub?
Put 8 together -

Use P-POD concept to launch 8
P-POD compatible
Notes:
All dimensions in inches

Material:
Aluminum 6061-T6
Using English Dimensions?

Used metrics for CubeSat.

Why not metrics for PocketQub?

It is time those metric guys learned English units.
What is a private affordable launch cost?

What would be your budget?

Your salary - $100k

$5k?

$40k?

$100k?

$200k?

Pay $250k for a launch?
What does PocketQub do?

Reduce launch cost.

$40k/CubeSat - $5k/PocketQub

$80k/CubeSat - $10k/PocketQub
What are the benefits of this reduced launch cost?

Not the cost of an SUV anymore

Less than the cost of my last motorcycle.
Who is in the PocketQub Game?
PocketQub

* Small, 2” sided Cubes
* Launched in a configuration of 8
* Up to 24 in a single deployer
* Launched to very Low Earth Orbit

The next generation’s challenge by Bob Twiggs and SEFSpaceworks...
Supported by ISIS - Innovative Solutions In Space BV
space for launching mechanisms for PocketQubs and Tether storage and release

PS1D
PocketQub

PS1E
PocketQub

PA1A
1.5 U Cube Sat
solar panels and batteries

IR sensors to sense orientation with respect to Earth/Sun/Space

Tether for gravity gradient alignment tests

PS1C
PocketQub

CW Tx (433 MHz) with OB-PUCP-C call letters w. solar panels and small battery

PS1B
PocketQub
gets its energy from PS1A and sends back photos through cable

Measuring tape type support with umbilical cord. (~ 60 cm ?)

Broad arrows show PocketQubs' release

Pontificia Universidad Católica del Perú
CubeSat & PocketQub Project
PUCP-SAT-1

3 Feb. 2009
New launch goals:

First PocketQub within one year – March 2010 for Kentucky Space
Questions

What should the university community do now?

- Got CubeSat program started.

If you could ask the university to push space activities, what should/could they do?

Just educate students?
Develop new hardware?
Pursue science missions?
Research?
Alternatives?

We need low cost launches!
What about this company Interorbital?

- $8k for Launch & Sat Kit
- LEO Launch to 312km
- Short orbit life
- Launch 4th quarter 2010
What is your opinion?

• “This is incredible”
• “$8000 to orbit would definitely be a game changer”
• “This can’t really be true”
• “I like it!”
• “Looks like another wannabe launch vehicle company to me.”
• “This is just awesome!”
• “Yes, I think they are very much for real!”
• “Interesting. Who are these people?”
• “Well, I am not sending them a check”
• “It would be great to see another launch facility available.”
What’s there now?

The TubeSat

The Launcher
The design concept

NEPTUNE 30 Core Stage

Satellite Module

Satellite Ejection Tubes (32 Satellite Capacity)

Satellite Module

Nose Cone

Propellant Tanks

Rocket Engine

Valves

TubeSat Deployment Unit
8 Ejection Tubes with four satellites per tube: 32 TubeSat Maximum
Interorbital

Real?
Scam?

Where will you put your money?

I would like just to encourage alternatives.

Kentucky Space purchased first TubeSat launch from Interorbital.

Is there another game in town?
Get a flight on a test launch.

I will. The educational value is great.

Kentucky Space will purchase at least one test launch.
Why would I buy into test and orbital launches with Interorbital?

Motivation

Motivation

Motivation

Motivate those students!
You have a launch, finish that satellite.

Go!
Go!
Go!
Go!
Also, Encourage Community Outreach

- Just tell them about what you do.
- Do party balloons for payloads.
- Small rockets – always fun.
- High power amateur rockets – ARLISS.
- Near space balloons.
- Sounding rockets.
- Suborbital launches.
- Orbital – PocketQub, CubeSat, etc.
What is menu of small sats?

3 U CubeSat
2 U CubeSat
1 U CubeSat
TubeSat
PocketQub
CanSats
Gamble a little – DieSat
Moon Beams ??
What are next questions you will be asked after looking at the menu?
You want fries or onion rings?

How about super sizing that?
Thank You