

A Big Change in Small Things in Space

August 9, 2009

CubeSat Workshop Logan, Utah

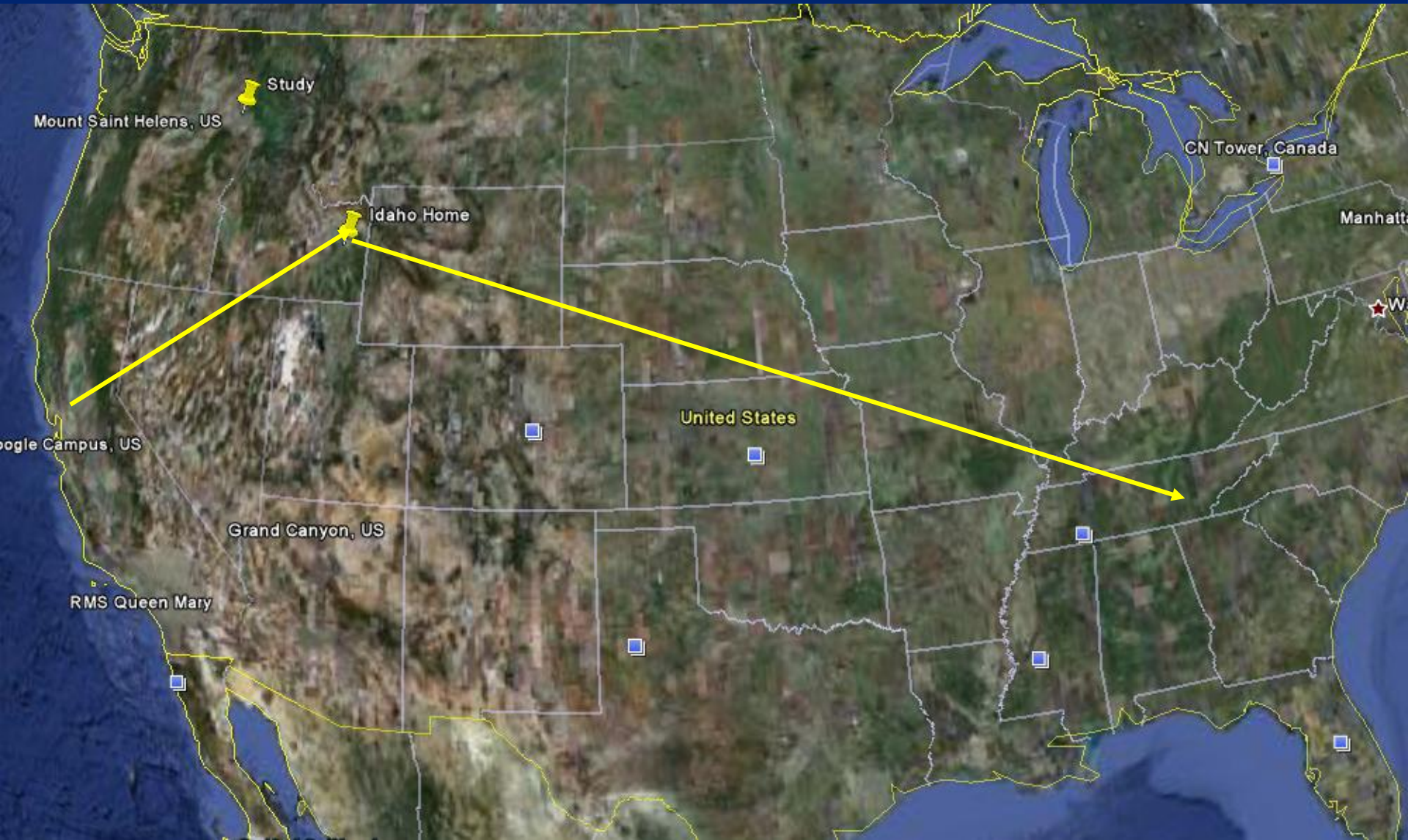
Prof. Bob Twiggs
R.Twiggs@MoreheadState.Edu

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 thought 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?

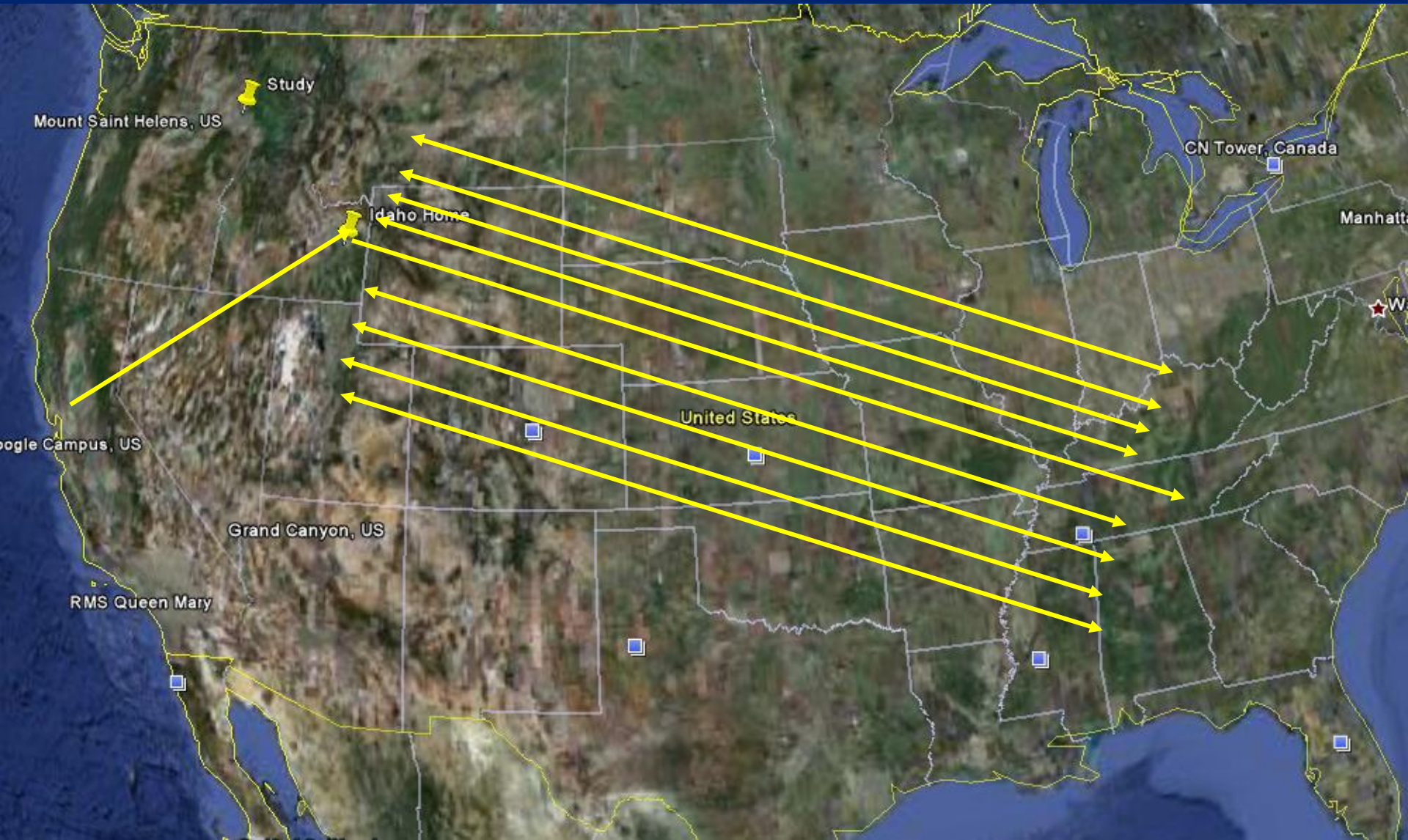
I want to play too.

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

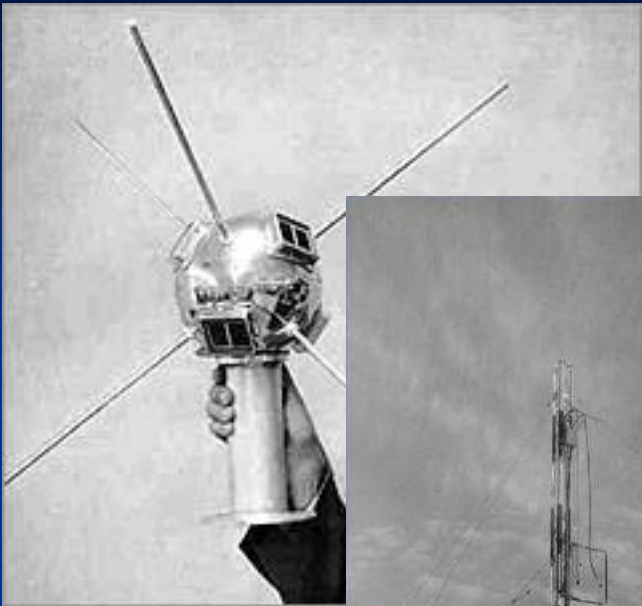
Kentucky is committed to Space education and Space for economic development in Kentucky.

Who is here from Kentucky?

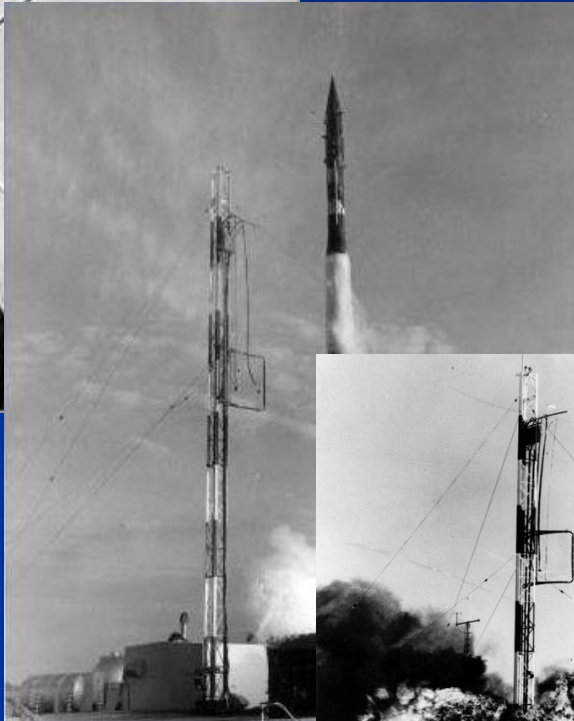
How did we get to small
satellites?

Remember we started with small satellites.

We built a satellite called Vanguard.



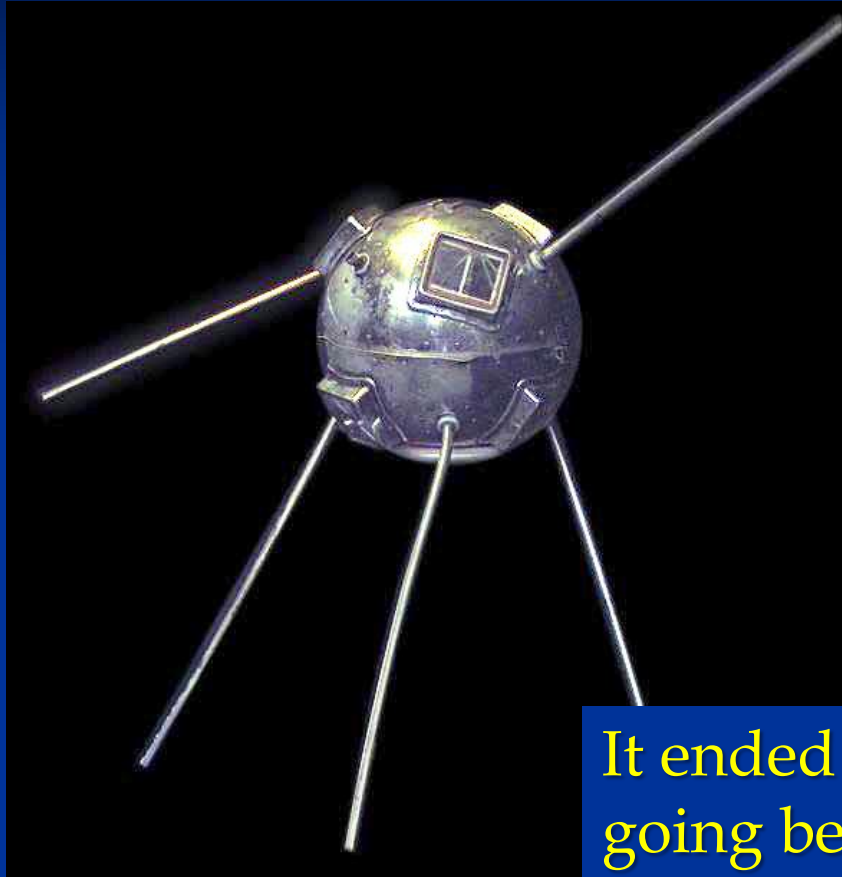
We had a big rocket.



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

AMERICA'S much-ballyhooped bid to launch a satellite to join Russia's two Sputniks in space ended yesterday in a huge billow of orange flame—on the ground.

For the first time, a rocket-attack will go down in history as the "Flopnik"—after sweeping a message of failure as its three-stage rocket blew up on the launching ramp.

It happened at Cape Canaveral, Florida, where America's missile operations are at their best because of the world-wide publicity given to this attempt to keep up with the Russians.

The satellite, with its two-stage launching system, was prepared to fly with one stage after President Eisenhower ordered a "test" program to get more facts and ideas to use for space.

General A. W. Flinn, who had been named as a leader of the launching job, was one of several present at Florida's main launching site, the Cape Canaveral Launch Complex, when the rocket blew up.

The rocket, a single stage, was launched at 11:30 a.m. and was in the air for about 10 seconds.

TOPPLED

The rocket, which was launched at 11:30 a.m., was in the air for about 10 seconds before it toppled.

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TEN SECONDS TO DISASTER



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

Belsky's Cartoons



THE BIRTH OF A BRIGHT IDEA: A cartoon by Belsky.

'ESCAPED PATIENT'

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 Westsexshire Regiment at Belize, capital of the "banana colony," it was announced that they had been sent at the Governor's request.

QUIT ORDER TO 50,000 DUTCH








THE 50,000 Dutch troops were ordered to quit their positions in the Dutch East Indies by the end of the year, it was announced today.

The Future?

Further Miniaturization?

Comments - present satellites

- Present CubeSat too Big?
- Cost too much to launch!
- Everyone needs new challenges.

Group name	Wet Mass	
 Large satellite	>1000kg	
 Medium sized satellite	500-1000kg	
 Mini satellite	100-500kg	
 Micro satellite	10-100kg	
 Nano satellite	1-10kg	Small Satellites
 Pico satellite	0.1-1kg	
 Femto satellite	<100g	



How about a satellite that fits in your Pocket?

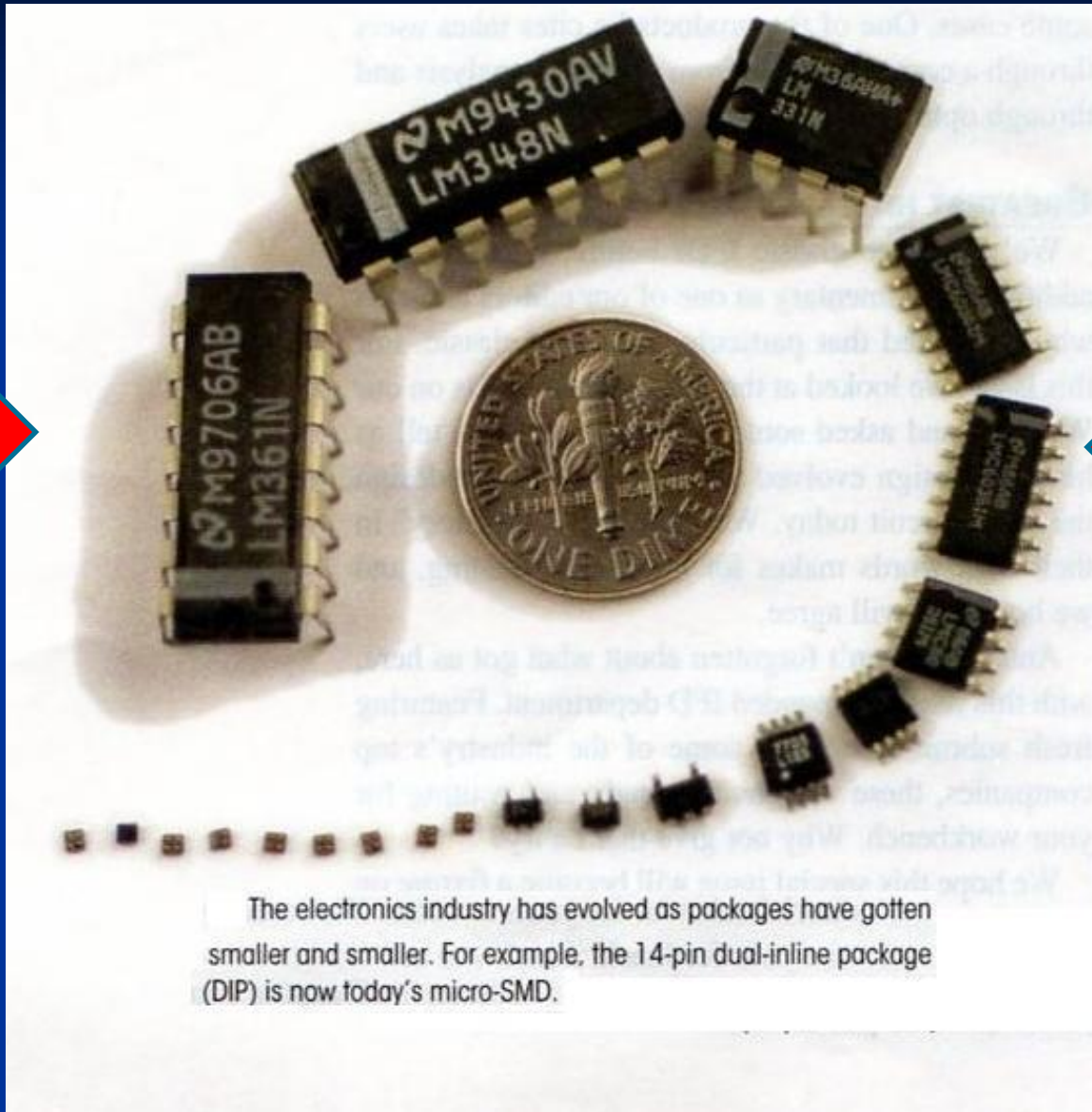
Miniaturize to fit in your pocket? Here is an example.



Shrink



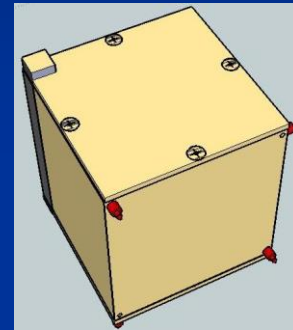
Shrink



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.

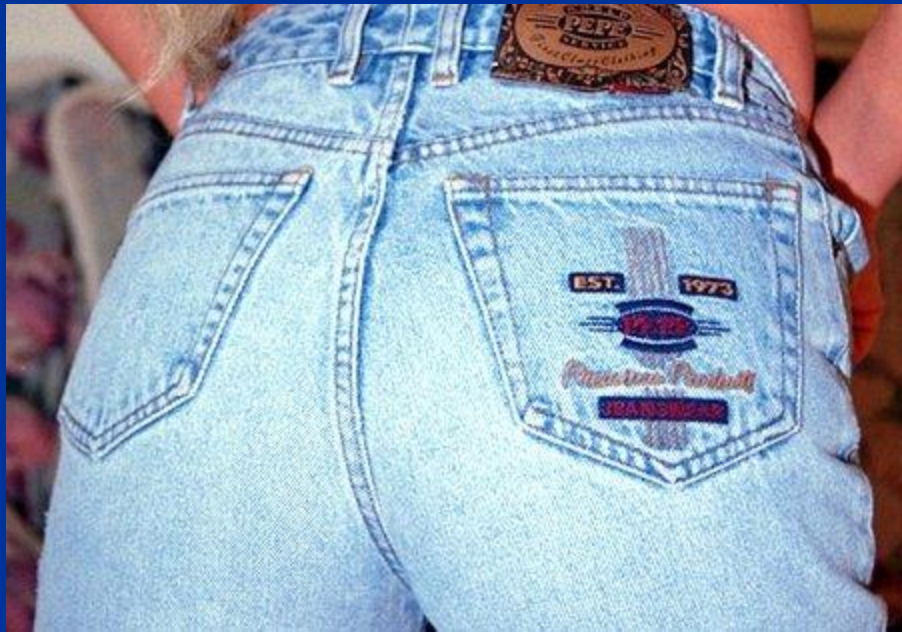
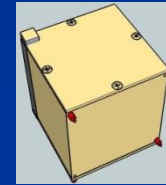
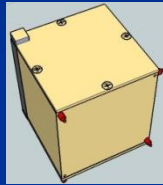
How about a 5cm cube?



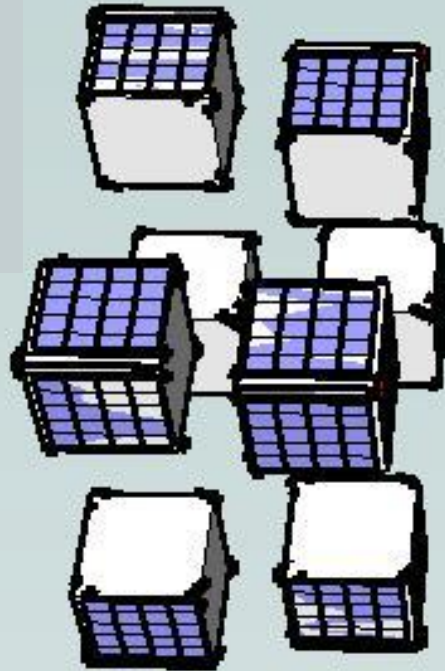
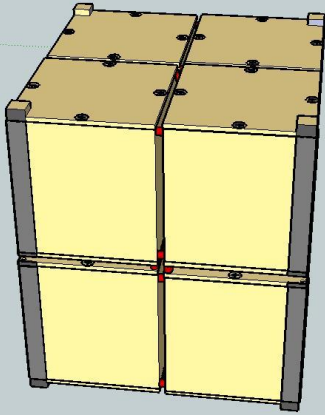
Femto Sat?

What should we call it?

How about PocketQub?



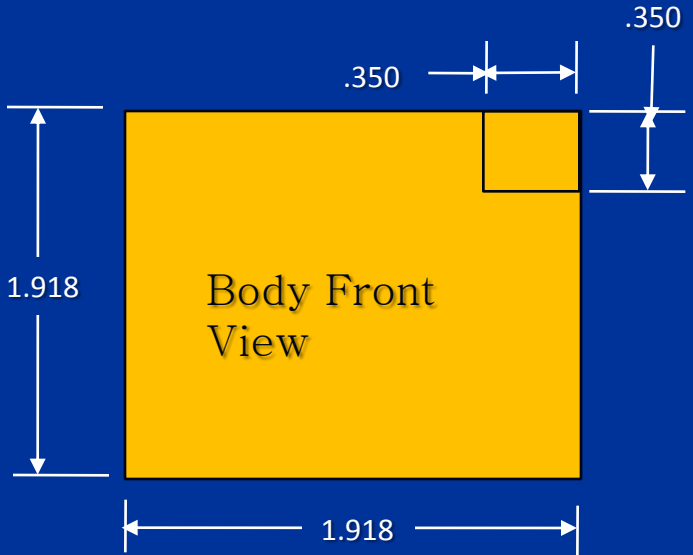
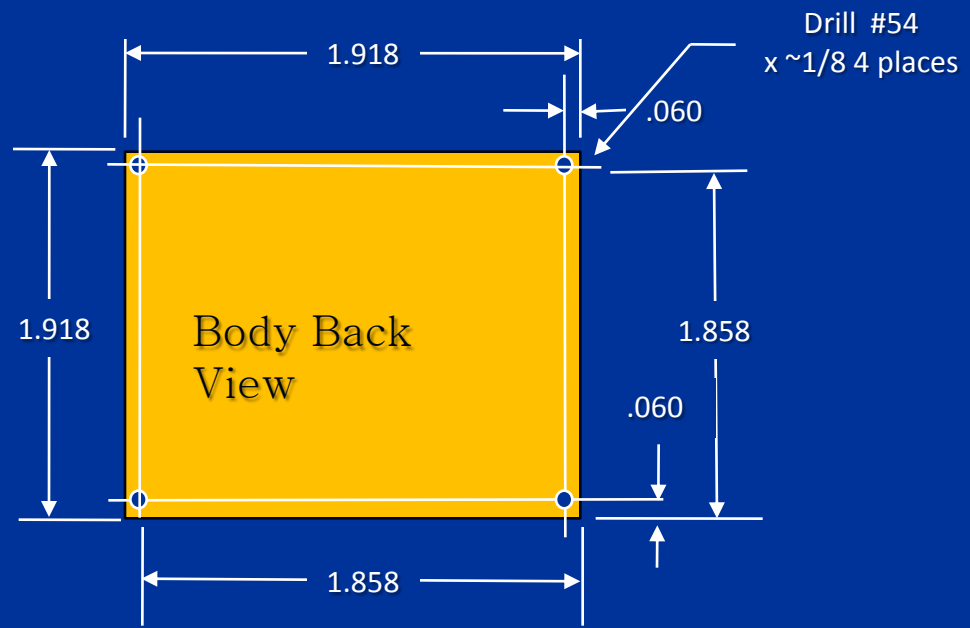
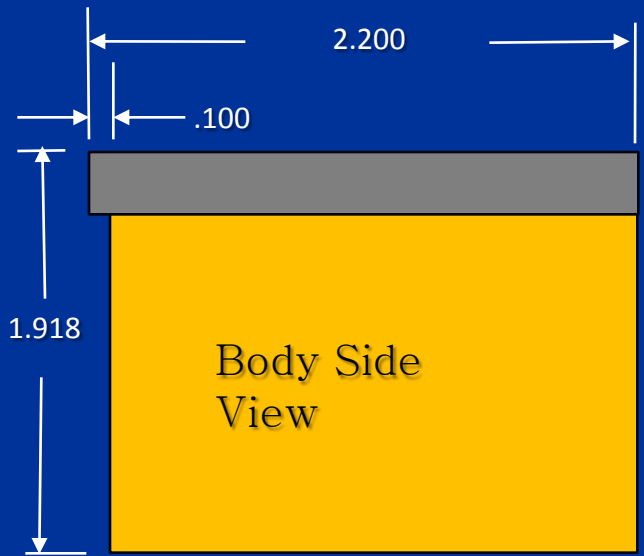
Put 8 together -



Use P-POD concept to launch 8



P-POD compatible



Material:
Aluminum 6061-T6



Notes:
All dimensions in
inches

Title			
PocketQub External Dimensions			
Drawn	Date	Drawing No.	Rev.
by Job	03/20/09	0000018	A

Twiggs

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?

Pay \$250k for a launch?

\$200k?

\$100k?

\$40k?

\$5k?

Your salary - \$100k



What does PocketQub do?

Reduce launch cost.

\$40k/CubeSat - \$5k/PocketQub

\$80k/CubeSat - \$10k/PocketQub

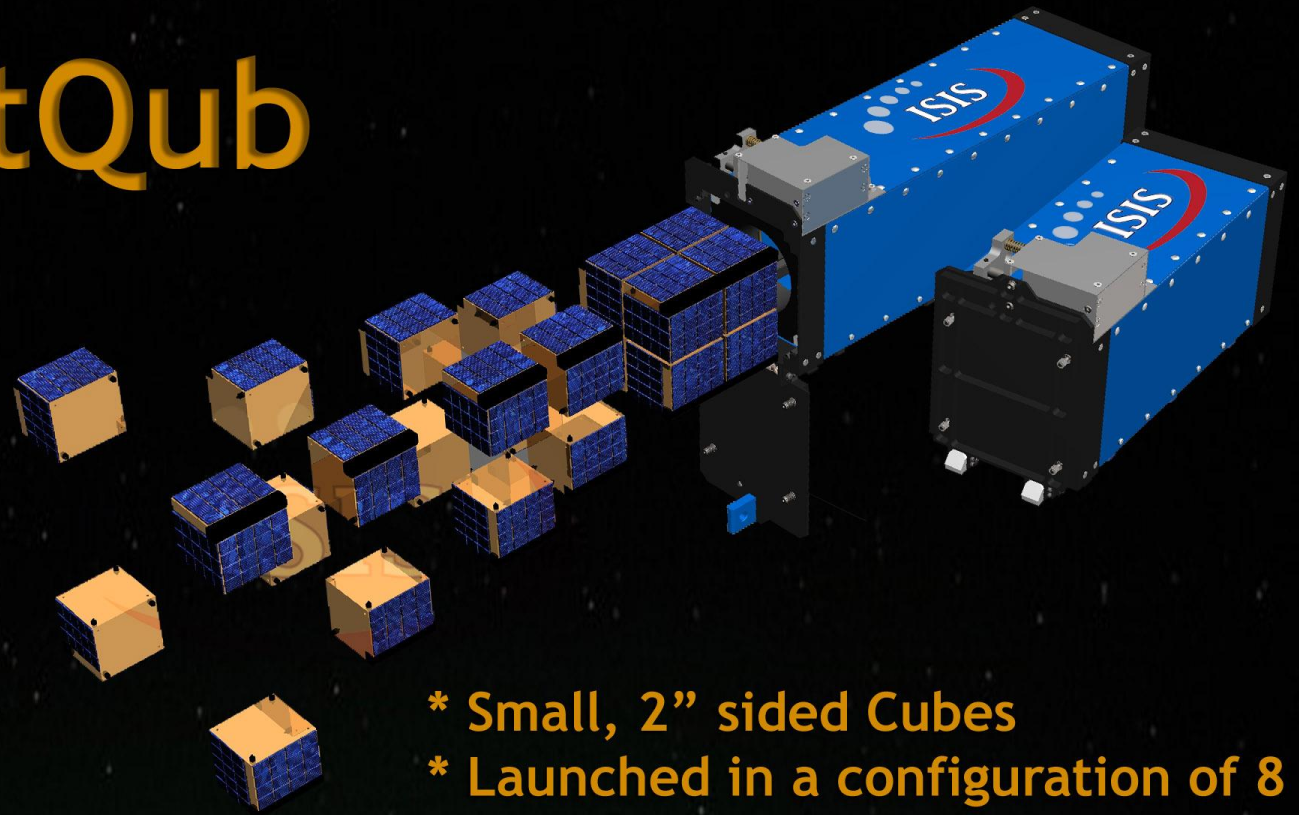
What are the benefits of this reduced launch cost?

Not the cost of an SUV anymore

Less than the cost of my last motorcycle.

Who is in the PocketQub
Game?

PocketQub



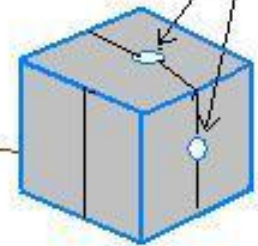
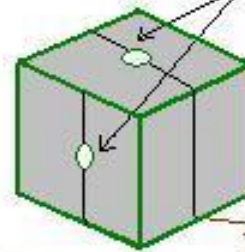
- * Small, 2" sided Cubes
- * Launched in a configuration of 8
- * Up to 24 in a single deployer
- * Launched to very Low Earth Orbit

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

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



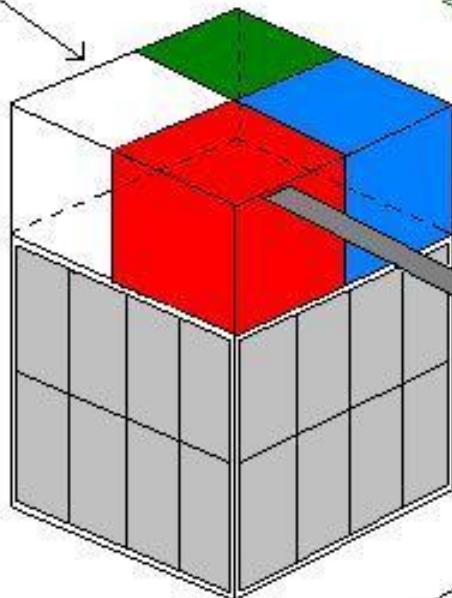
Tether for gravity gradient alignment tests

PS1C
PocketQub

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

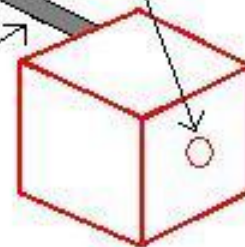
PS1E
PocketQub

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



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

PA1A
1.5 U
Cube Sat
solar panels and batteries



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!

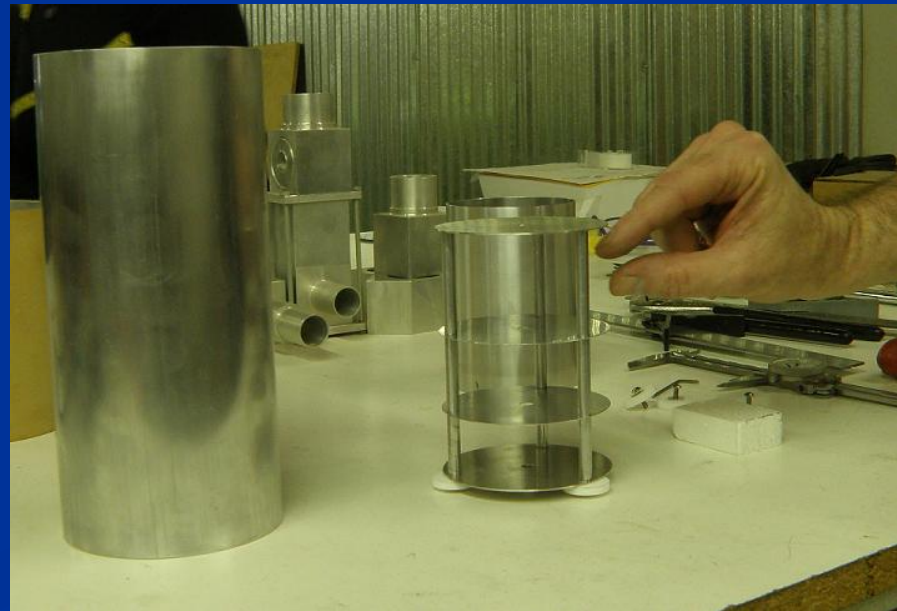
What about this company Interorbital?

- \$8k for Launch & Sat Kit
- LEO Launch to 312km
- Short orbit life
- Launch 4th quarter 2010

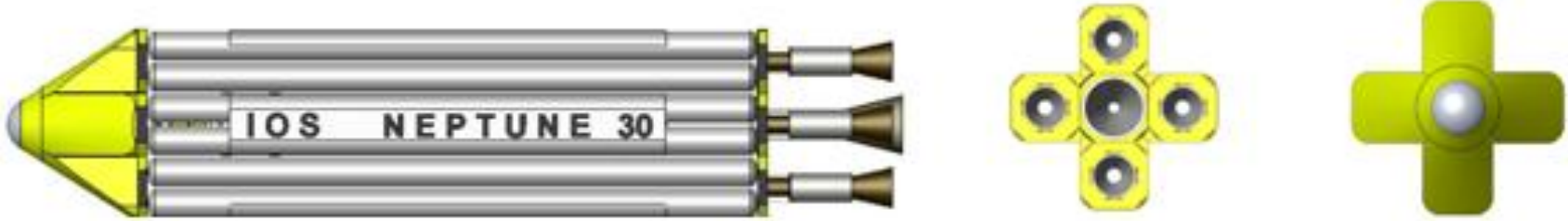
What is your opinion?

- “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?

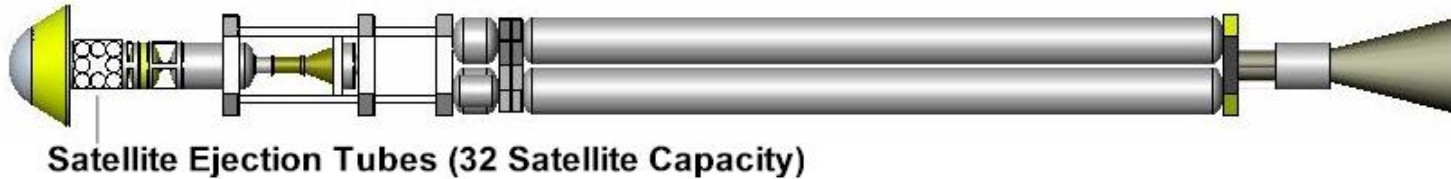


The design concept

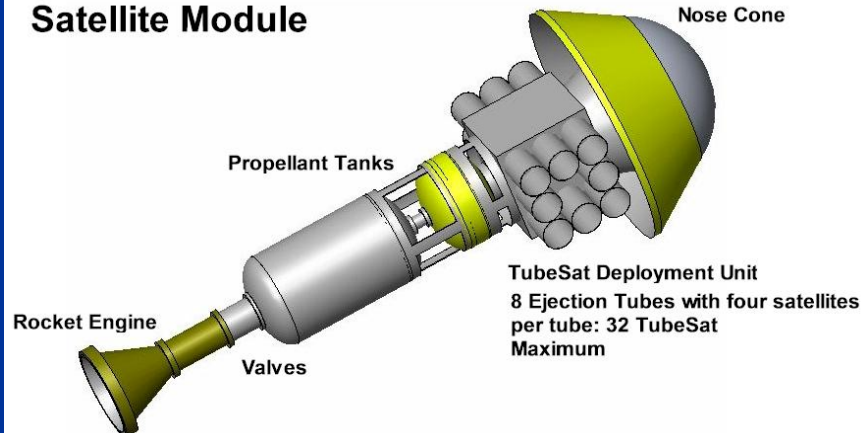


NEPTUNE 30 Core Stage

Satellite Module



Satellite Module



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.



Payload space is currently available on these pre-orbital test flights at a cost of \$500.00 per kilogram (\$227.00 per pound). Payloads can include TubeSats, CubeSats, or single payloads weighing up to 30 kg. Universities and individuals are encouraged to contact Interorbital if they would like to fly a test payload.

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!

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

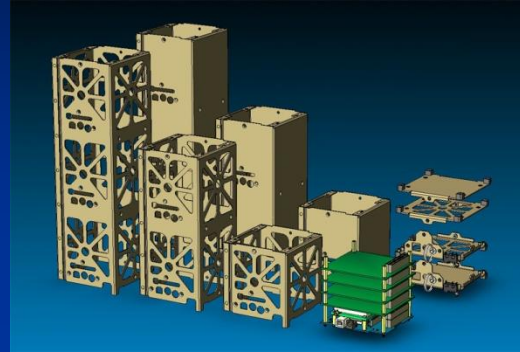
TubeSat

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