NASA SILICON VALLEY

PODCAST

1
00:00:00,350 --> 00:00:03,549
Host (Matthew Buffington): You are listening
to NASA in Silicon Valley episode 67.

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00:00:03,549 --> 00:00:06,089
Kimberly, tell us about our guest today!

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00:00:06,089 --> 00:00:07,089
Kimberly Minafra: Hey, Matt!

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00:00:07,089 --> 00:00:08,340
Well, we have Roger Hunter.

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00:00:08,340 --> 00:00:13,660
He's the program manager for the NASA Spacecraft
Technology Program, where he actually oversees

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00:00:13,660 --> 00:00:18,950
the progress of technologies that are demonstrated
on small satellites, we also call them CubeSats

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00:00:18,950 --> 00:00:22,910
because they're the size of a shoebox, for
a variety of missions for NASA.

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00:00:22,910 --> 00:00:29,340
Host: This is a fun thing, the Small Sats,
because you think of these tiny, little, Kleenex

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00:00:29,340 --> 00:00:31,500
box sized small satellites.

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00:00:31,500 --> 00:00:35,769
And it's not just NASA working on this stuff,
you have tech companies in the area, in Silicon

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00:00:35,769 --> 00:00:40,670
Valley working on this, you have a ton of
universities and groups, all working on this

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00:00:40,670 --> 00:00:41,670
as a new platform.

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00:00:41,670 --> 00:00:45,629
Kimberly Minafra: Oh yeah, and they're so
popular that it's more actually encouraged

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00:00:45,629 --> 00:00:49,579
to have outside non-NASA people be a part
of this as our partners.

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00:00:49,579 --> 00:00:54,729
They can actually pack so much in these little
four inch by four inch cubes to go ride on

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00:00:54,729 --> 00:00:55,729
larger missions.

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00:00:55,729 --> 00:00:57,370
Like this one coming up on November 11th!

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00:00:57,370 --> 00:01:01,780
We actually have four small sat missions that
will be taking a ride to the International

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00:01:01,780 --> 00:01:02,780
Space Station.

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00:01:02,780 --> 00:01:07,030
Host: I get a kick out of this because you
think of the big rocket with the big multimillion

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00:01:07,030 --> 00:01:09,390
dollar payload.

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00:01:09,390 --> 00:01:12,979
Really expensive to catch a ride on a rocket,
but fortunately there's little nooks and

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00:01:12,979 --> 00:01:16,509
crannies on that rocket where you can put
little Small Sats and people can like take

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00:01:16,509 --> 00:01:17,509
advantage of it.

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00:01:17,509 --> 00:01:21,110
Kimberly Minafra: Oh yeah, and it's a lot
lower cost for the actual missions themselves.

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00:01:21,110 --> 00:01:25,350
It costs about a quarter of the price of a
larger mission.

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00:01:25,350 --> 00:01:30,780
And even before that, which he may be talking
about in his podcast, he was the project manager

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00:01:30,780 --> 00:01:35,079
for the Kepler mission, which was our mission
to see and look for Earth-sized habitable

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00:01:35,079 --> 00:01:37,409
zone planets in the Milky Way Galaxy.

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00:01:37,409 --> 00:01:44,600
Host: So before we completely spoil the entire
episode, just a reminder we have a phone number.

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00:01:44,600 --> 00:01:50,670
If you have any comments, questions, we are
at (650) 604-1400.

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00:01:50,670 --> 00:01:54,750
You can give us a call, just like our friend
Raymond did, but Raymond called and said he

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00:01:54,750 --> 00:01:57,200
had a question, and asked us to call him back.

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00:01:57,200 --> 00:02:02,020
And Raymond, if you're listening out there,
go ahead and just call us back, leave your

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00:02:02,020 --> 00:02:08,149
question, we'll record it, and then we'll
add that to a future episode as we go along.

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00:02:08,149 --> 00:02:11,801
But for the folks who don't want to call
and actually use your voice, and you want

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00:02:11,801 --> 00:02:16,750
to type it on the internet, we're using
the hashtag #NASASiliconValley.

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00:02:16,750 --> 00:02:19,200
But before we jump in, I want to give a shout
out.

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00:02:19,200 --> 00:02:23,000
We are a NASA podcast, we are not the only
NASA podcast!

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00:02:23,000 --> 00:02:26,100
And there is a new podcast that's going
to be starting out of headquarters, hosted

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00:02:26,100 --> 00:02:31,130
by NASA's very own director of planetary
science, Dr. Jim Green.

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00:02:31,130 --> 00:02:35,780
This is called Gravity Assist, and basically
it's a virtual tour of the solar system

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00:02:35,780 --> 00:02:39,380

and beyond, talking to a whole wide range
of scientists.

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00:02:39,380 --> 00:02:43,140
I think they're actually kicking it off
with the Sun, and working their way through

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00:02:43,140 --> 00:02:47,760
10 episodes, all the way until they end up
talking about Pluto and beyond.

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00:02:47,760 --> 00:02:50,100
But today, for this episode…

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00:02:50,220 --> 00:02:53,600
Kimberly Minafra: … Now let's hear from
Roger Hunter.

48
00:02:57,620 --> 00:03:05,320
[Music]

49
00:03:05,320 --> 00:03:06,480
Matthew Buffington: What brought you to NASA?

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00:03:06,480 --> 00:03:07,920
How did you end up in Silicon Valley?

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00:03:07,920 --> 00:03:09,060
Tell us about you.

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00:03:09,060 --> 00:03:14,310
Roger Hunter: I was working for The Boeing
Corporation, running global positioning systems

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00:03:14,310 --> 00:03:15,910
for them.

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00:03:15,910 --> 00:03:17,680
And that was after I had a career in the Air

Force.

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00:03:17,680 --> 00:03:22,450
And I retired from the Air Force after 22
years and went to work for The Boeing Corporation

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00:03:22,450 --> 00:03:28,160
afterward because they had a position lined
up that just seemed right up my alley.

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00:03:28,160 --> 00:03:30,120
And it was all space systems, again.

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00:03:30,120 --> 00:03:35,050
Because most of the time that I was with the
Air Force, I was doing a lot of space systems'

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00:03:35,050 --> 00:03:39,430
activities, whether it was designing ground
systems or actually operating a spacecraft

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00:03:39,430 --> 00:03:42,120
or planning systems for the future.

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00:03:42,120 --> 00:03:46,040
And when I decided to retire from the Air
Force, The Boeing Corporation recruited me

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00:03:46,040 --> 00:03:50,980
to come run their global positioning system
activities in Colorado Springs.

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00:03:50,980 --> 00:03:52,830
And it was in support of, guess who?

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00:03:52,830 --> 00:03:53,830
The U.S. Air Force, again.

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00:03:53,830 --> 00:03:59,281

And so, I spent a lot of time redoing some
of the things I had done when I was in the

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00:03:59,281 --> 00:04:04,830
Air Force, and ended up managing a nice team
of people there that was providing sustainment

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00:04:04,830 --> 00:04:10,110
for all of the Air Force ground systems that
controlled GPS satellites, and also helping

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00:04:10,110 --> 00:04:14,360
perform the analysis for the Air Force on
how well the GPS satellites were performing.

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00:04:14,360 --> 00:04:18,071
Host: Well, I would imagine, it's very much
the same way -- because you're thinking of

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00:04:18,071 --> 00:04:23,070
NASA, and you think of the astronauts and
how much infrastructure and humans go to support

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00:04:23,070 --> 00:04:24,560
them doing their work.

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00:04:24,560 --> 00:04:26,550
I would imagine, it was probably the same
for you in the Air Force.

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00:04:26,550 --> 00:04:30,370
It was like you have the people who fly the
planes, obviously a much larger group than

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00:04:30,370 --> 00:04:32,750
astronauts, but there's a whole --

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00:04:32,750 --> 00:04:35,890
Roger Hunter: There's a whole infrastructure
that supports the team.

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00:04:35,890 --> 00:04:36,890
Host: Exactly.

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00:04:36,890 --> 00:04:37,890
Yeah.

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00:04:37,890 --> 00:04:40,230
Roger Hunter: And, as a matter of fact, they
talk about the pointy end of the stick when

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00:04:40,230 --> 00:04:41,230
you're in the Air Force.

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00:04:41,230 --> 00:04:46,870
Were the ones that actually were, if you will,
guns on target or bombs on target -- things

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00:04:46,870 --> 00:04:47,990
like that.

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00:04:47,990 --> 00:04:52,320
But there's a whole infrastructure behind
that that helps that team be successful.

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00:04:52,320 --> 00:04:56,340
And it was, while I was working for Boeing
in Colorado Springs, that I received a phone

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00:04:56,340 --> 00:05:02,470
call, out of the blue, from the former NASA
Ames Center Director, Pete Worden and one

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00:05:02,470 --> 00:05:05,010
of his directors, Alan Weston.

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00:05:05,010 --> 00:05:09,889
And I thought it was just a casual conversation
at first, and all of a sudden, he says --

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00:05:09,889 --> 00:05:11,020
Host: Then the pitch came.

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00:05:11,020 --> 00:05:12,020
Roger Hunter: The pitch came.

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00:05:12,020 --> 00:05:16,270
He says, "We would like for you to come work
with us on a mission called Kepler."

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00:05:16,270 --> 00:05:20,560
And I didn't know that NASA had a mission
called Kepler because I was keeping up with

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00:05:20,560 --> 00:05:21,560
NASA at the time.

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00:05:21,560 --> 00:05:27,260
And, I knew who Johannes Kepler was from my
math and physics days at the University of

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00:05:27,260 --> 00:05:28,260
Georgia.

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00:05:28,260 --> 00:05:32,240
And they said, "Oh, we're building a telescope
to go search the galaxy to see if there are

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00:05:32,240 --> 00:05:33,290
other earth's out there."

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00:05:33,290 --> 00:05:34,639
And I said, "You have my attention."

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00:05:34,639 --> 00:05:36,780
[Laughter] I said, "Go on.

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00:05:36,780 --> 00:05:39,889
Tell me more about when you're going to do
this."

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00:05:39,889 --> 00:05:47,260
And this was early 2008, and the Kepler space
telescope was still under development.

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00:05:47,260 --> 00:05:51,330
And they wanted somebody to come work with
the team, who had some experience managing

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00:05:51,330 --> 00:05:58,919
large teams, and also had experience bringing
a space telescope or a space system from development

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00:05:58,919 --> 00:06:00,490
into operations.

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00:06:00,490 --> 00:06:03,910
And I said, "Well, where do I sign?"

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00:06:03,910 --> 00:06:10,970
And I said, "You only get two chances in life,
to go either, one, work for NASA, or run a

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00:06:10,970 --> 00:06:16,250
mission called Kepler that is in search of
one of the most fundamental questions that

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00:06:16,250 --> 00:06:17,860
humankind has always had.

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00:06:17,860 --> 00:06:18,860
Are we alone?"

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00:06:18,860 --> 00:06:19,860
Host: Yeah.

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00:06:19,860 --> 00:06:20,860
Absolutely.

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00:06:20,860 --> 00:06:22,710
Roger Hunter: And you want to go look for
-- you think about this when you're a kid.

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00:06:22,710 --> 00:06:23,710
Host: Yeah.

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00:06:23,710 --> 00:06:24,710
Totally.

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00:06:24,710 --> 00:06:27,390
Roger Hunter: You look up in the sky and say,
"Is there another earth out there?"

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00:06:27,390 --> 00:06:30,780
And I thought, "Wow, we're actually going
to go do this.

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00:06:30,780 --> 00:06:35,270
And NASA is actually going to go build a telescope
called Kepler to go look for another earth."

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00:06:35,270 --> 00:06:36,470
And I said, "Where do I sign?"

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00:06:36,470 --> 00:06:37,470
Host: Exactly.

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00:06:37,470 --> 00:06:41,370
Well, it's like instead of daydreaming about
science fiction, you get to do science fact

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00:06:41,370 --> 00:06:42,370
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00:06:42,370 --> 00:06:43,370

Roger Hunter: Exactly.

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00:06:43,370 --> 00:06:44,370
Host: -- and actually prove: Is this the real thing or not?

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00:06:44,370 --> 00:06:45,370
Roger Hunter: You're right.

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00:06:45,370 --> 00:06:46,370
Because it was.

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00:06:46,370 --> 00:06:47,560
It was turning science fiction into science fact.

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00:06:47,560 --> 00:06:52,940
And so, I left Boeing and moved to Silicon Valley in early 2008.

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00:06:52,940 --> 00:06:59,220
And we helped continue the development of this space telescope, until we launched it

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00:06:59,220 --> 00:07:01,740
in early 2009.

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00:07:01,740 --> 00:07:04,420
And so, I was a Kepler program manager for about six years.

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00:07:04,420 --> 00:07:09,230
And towards the end of the baseline mission --

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00:07:09,230 --> 00:07:10,230
Host: Yeah.

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00:07:10,230 --> 00:07:11,230

The primary mission.

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00:07:11,230 --> 00:07:13,840
Roger Hunter: -- the primary mission, Pete Worden, who was still the Center Director,

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00:07:13,840 --> 00:07:19,260
asked me to move over into a new area called the Small Spacecraft Technology Program.

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00:07:19,260 --> 00:07:21,900
And that's what I've been doing for the last two or three years at NASA.

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00:07:21,900 --> 00:07:27,940
Host: So moving over into small spacecraft, was it mainly just looking at smaller missions?

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00:07:27,940 --> 00:07:34,300
Or were you moving into the territory of CubeSats and that kind of work?

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00:07:34,300 --> 00:07:35,370
Roger Hunter: It's both.

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00:07:35,370 --> 00:07:40,240
It was moving into CubeSats, which is sort of a new paradigm out there.

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00:07:40,240 --> 00:07:48,180
Because we, as in NASA, also academia, and industry have been looking at these small

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00:07:48,180 --> 00:07:53,460
spacecraft, which were basically the size of a tissue box or the size of a loaf of bread.

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00:07:53,460 --> 00:07:58,470
And looking where technology and electronics revolution has brought us, we were thinking,

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00:07:58,470 --> 00:08:00,680
"We can actually do science with these things."

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00:08:00,680 --> 00:08:01,680
Host: Yeah.

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00:08:01,680 --> 00:08:02,770
Roger Hunter: And so, that's what has happened.

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00:08:02,770 --> 00:08:05,010
That's where the industry has brought us now.

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00:08:05,010 --> 00:08:11,130
And NASA is now looking at using spacecraft,
of this size, to actually go do science.

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00:08:11,130 --> 00:08:16,740
Host: And so, I would imagine, when you moved
into the Air Force and you're working -- I'm

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00:08:16,740 --> 00:08:21,260
sure there was, obviously, some set mission,
set program, some projects.

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00:08:21,260 --> 00:08:24,460
You move in and you're kind of filling in
a position on the team.

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00:08:24,460 --> 00:08:25,960
And it's already a well-oiled machine.

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00:08:25,960 --> 00:08:30,250
But, especially, even at NASA, there's certain
-- whether it's a telescope that's already

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00:08:30,250 --> 00:08:35,169
in the sky, a mission that's already ongoing
-- but you're going in to do small spacecraft.

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00:08:35,169 --> 00:08:37,820
You're accepting into something that hasn't
been done.

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00:08:37,820 --> 00:08:41,589
You're almost kind of building it from scratch
that is going to be a whole different thing.

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00:08:41,589 --> 00:08:43,289
It's not like you're moving into something
that's already established.

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00:08:43,289 --> 00:08:45,019
Roger Hunter: It's a new mindset.

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00:08:45,019 --> 00:08:49,740
Because when you look at some of the -- many
of the telescopes that NASA has flown before,

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00:08:49,740 --> 00:08:51,230
they're rather large.

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00:08:51,230 --> 00:08:52,230
They're big entities.

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00:08:52,230 --> 00:08:54,670
Host: Millions and billions -- are millions
of dollars.

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00:08:54,670 --> 00:08:56,740
Roger Hunter: Millions and billions of dollars,
in some cases.

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00:08:56,740 --> 00:08:57,740
Host: Wow.

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00:08:57,740 --> 00:09:02,500
Roger Hunter: And they're called, "Great Observatories,"

because of the magnitude of the mission that

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00:09:02,500 --> 00:09:06,339
they're either conducting or the amount of
money and time that has gone into the development

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00:09:06,339 --> 00:09:07,339
of these things.

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00:09:07,339 --> 00:09:08,339
They're, essentially, one-offs.

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00:09:08,339 --> 00:09:13,550
You know, no one had built a Tubble before
a Hubble was built.

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00:09:13,550 --> 00:09:17,470
No one had built a James Webb Space Telescope
before it was built.

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00:09:17,470 --> 00:09:19,009
And they're one-of-a-kind.

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00:09:19,009 --> 00:09:20,850
And they are artisanal, if you will.

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00:09:20,850 --> 00:09:22,020
But we are looking --

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00:09:22,020 --> 00:09:23,020
Host: It's custom-made.

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00:09:23,020 --> 00:09:24,020
Roger Hunter: They're custom-made.

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00:09:24,020 --> 00:09:25,389
They're custom-made units.

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00:09:25,389 --> 00:09:30,600
But we're looking at CubeSats and small satellites
as more of a commodity.

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00:09:30,600 --> 00:09:35,250
How can you make lots of these, and then go
do a mission with them.

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00:09:35,250 --> 00:09:38,769
And if a few of them fail, you don't jeopardize
the mission?

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00:09:38,769 --> 00:09:39,769
Host: Yeah.

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00:09:39,769 --> 00:09:43,660
Roger Hunter: Think about that, from the perspective,
if a singular system onboard one of those

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00:09:43,660 --> 00:09:46,010
giant spacecraft's fails.

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00:09:46,010 --> 00:09:48,730
You're in jeopardy of losing the mission itself.

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00:09:48,730 --> 00:09:54,019
You build in redundancy, of course, but now
we're looking in making these small spacecraft

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00:09:54,019 --> 00:09:57,069
much more redundant, much more robust, much
more flexible.

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00:09:57,069 --> 00:09:58,069
Host: Yeah.

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00:09:58,069 --> 00:10:02,259
And even for like a large thing, like a Hubble
or a Kepler, there's a whole lot of -- you

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00:10:02,260 --> 00:10:04,620
have to be very conservative on what you're
doing.

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00:10:04,620 --> 00:10:07,940
You have to make for sure you have the redundancy
built in.

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00:10:07,949 --> 00:10:09,100
This thing is going to work.

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00:10:09,100 --> 00:10:13,319
We're not wasting millions of taxpayer dollars
on this thing.

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00:10:13,319 --> 00:10:18,379
So you have to be very conservative and thoughtful
in doing this.

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00:10:18,379 --> 00:10:22,800
But for something like SmallSats, where you're
kind of opening it up, you're in an opportunity

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00:10:22,800 --> 00:10:25,179
where you can get kind of ambitious --

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00:10:25,179 --> 00:10:26,179
Roger Hunter: Right.

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00:10:26,179 --> 00:10:27,179
You can.

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00:10:27,179 --> 00:10:28,179
You can actually --

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00:10:28,179 --> 00:10:29,179
Host: -- and stretch your legs out.

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00:10:29,179 --> 00:10:30,179
Roger Hunter: You can take more risk.

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00:10:30,179 --> 00:10:31,179
Host: Yes.

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00:10:31,179 --> 00:10:32,179
Exactly.

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00:10:32,179 --> 00:10:33,179
Roger Hunter: That's the name of the game
in the small spacecraft area.

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00:10:33,179 --> 00:10:36,060
Because you can build more of them at a much
lower cost.

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00:10:36,060 --> 00:10:38,779
And when you can do that, you can take more
risk for the things that you're trying to

203
00:10:38,779 --> 00:10:39,779
do.

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00:10:39,779 --> 00:10:43,059
Host: And so, talk a little bit about starting
those programs and working in those early

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00:10:43,059 --> 00:10:44,059
days.

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00:10:44,059 --> 00:10:46,519
How do you even begin something from scratch
like that?

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00:10:46,519 --> 00:10:47,850
Roger Hunter: Well, you do it from an envelope.

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00:10:47,850 --> 00:10:48,850

[Laughter]

209
00:10:48,850 --> 00:10:49,850
Host: Nice.

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00:10:49,850 --> 00:10:51,880
Roger Hunter: Sometimes you scratch these
things on the back of an envelope.

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00:10:51,880 --> 00:10:57,860
But we're looking at: What are the things
that we can do with the electronics and technology

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00:10:57,860 --> 00:11:01,050
revolution that has brought us to today?

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00:11:01,050 --> 00:11:05,750
And just package that into something that
you can go do science with.

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00:11:05,750 --> 00:11:07,800
For example, if you look at your smartphone.

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00:11:07,800 --> 00:11:08,800
Host: Absolutely.

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00:11:08,800 --> 00:11:11,869
Roger Hunter: Yet, we have built a spacecraft
that we called PhoneSat.

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00:11:11,869 --> 00:11:18,230
Because we want to prove that you can take
the guts out of a smartphone and put it into

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00:11:18,230 --> 00:11:25,230
one of these 1U size -- which is like 10 centimeters
-- on the edge of a CubeSat -- 10 x 10 x 10

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00:11:25,230 --> 00:11:30,009

centimeters -- and put the guts of the smartphone inside that, launch it into space, and see

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00:11:30,009 --> 00:11:31,009
what it does.

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00:11:31,009 --> 00:11:32,009
Host: How nice.

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00:11:32,009 --> 00:11:33,899
Roger Hunter: And we turned that into the first spacecraft.

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00:11:33,899 --> 00:11:37,050
So let's call it PhoneSat because it was based upon a smartphone.

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00:11:37,050 --> 00:11:38,050
Host: Yeah.

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00:11:38,050 --> 00:11:42,490
And it makes sense because you couldn't have done this in the '80s or in the '90s, you

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00:11:42,490 --> 00:11:43,490
know?

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00:11:43,490 --> 00:11:44,490
Roger Hunter: No, you couldn't.

228
00:11:44,490 --> 00:11:49,370
Host: This is only with the advent of smartphones, and electronics getting smaller and smaller

229
00:11:49,370 --> 00:11:52,660
and smaller, and batteries, and sensors, and cameras.

230
00:11:52,660 --> 00:11:54,879

Now, it's able to take advantage of it.

231
00:11:54,879 --> 00:11:55,879
Roger Hunter: Absolutely.

232
00:11:55,879 --> 00:12:01,089
Because if you look at the processing power
in your smartphone today and the computers

233
00:12:01,089 --> 00:12:06,149
back in the '60s, it took a room size to provide
the processing power that little smartphone

234
00:12:06,149 --> 00:12:07,149
gives you today.

235
00:12:07,149 --> 00:12:10,980
Host: And so talk a little bit more about
PhoneSat.

236
00:12:10,980 --> 00:12:14,190
Is this just one phone?

237
00:12:14,190 --> 00:12:15,199
Are these CubeSat things?

238
00:12:15,199 --> 00:12:17,990
Is it like a swarm of them?

239
00:12:17,990 --> 00:12:18,990
How does it work?

240
00:12:18,990 --> 00:12:19,990
What are you doing with that?

241
00:12:19,990 --> 00:12:20,990
Roger Hunter: Well, the first ones were just
singular.

242
00:12:20,990 --> 00:12:22,899
And we also proved that the technology works,
and we can get it into space --

243
00:12:22,899 --> 00:12:23,899
Host: You got it there.

244
00:12:23,899 --> 00:12:26,319
Roger Hunter: -- got it there -- and see how
it reacts.

245
00:12:26,319 --> 00:12:29,619
And, of course, the first couple we actually
-- we broke them.

246
00:12:29,619 --> 00:12:30,619
Host: [Laughs] Nice.

247
00:12:30,619 --> 00:12:31,660
Roger Hunter: But that's what happens.

248
00:12:31,660 --> 00:12:32,660
Host: Of course.

249
00:12:32,660 --> 00:12:35,079
Roger Hunter: You break these things, but
you learn from that.

250
00:12:35,079 --> 00:12:37,609
And then the next ones, you get a little better.

251
00:12:37,609 --> 00:12:39,240
Then you get to the point where you don't
break them.

252
00:12:39,240 --> 00:12:44,550
And now, we're looking at -- for example,
let's think about how GPS operates.

253
00:12:44,550 --> 00:12:46,639
That was a constellation of spacecraft.

254
00:12:46,639 --> 00:12:50,309
To provide you worldwide coverage, you needed
an entire constellation.

255
00:12:50,309 --> 00:12:52,709
Well, the way NASA does science --

256
00:12:52,709 --> 00:12:54,840
Host: When you say constellation, what -- for
people who --

257
00:12:54,840 --> 00:12:58,290
Roger Hunter: That's mini-spacecraft orbiting
the earth, and they're all interconnected.

258
00:12:58,290 --> 00:13:00,220
They're all doing the same kind of mission.

259
00:13:00,220 --> 00:13:01,220
Host: Okay.

260
00:13:01,220 --> 00:13:08,630
Roger Hunter: Now, think of having a bunch
of satellites that are oriented towards science.

261
00:13:08,630 --> 00:13:13,329
And you want to collect a lot of science data
because the more data you have, the better

262
00:13:13,329 --> 00:13:14,329
the science.

263
00:13:14,329 --> 00:13:19,160
And so, if you can orbit a bunch of satellites
at one time, and they're all very small, you

264
00:13:19,160 --> 00:13:24,809
can launch them all at once, on one rocket,
deploy them, and then collect science across

265
00:13:24,809 --> 00:13:30,110
the entire globe or across an entire region,
allowing you more data collection, which gives

266
00:13:30,110 --> 00:13:31,510
a scientist more data to analyze.

267
00:13:31,510 --> 00:13:36,350
Host: And then, I would imagine, that also
plays into -- typically a satellite is looking

268
00:13:36,350 --> 00:13:38,259
at one part of the earth.

269
00:13:38,259 --> 00:13:39,610
And it can't look at it all at once, obviously.

270
00:13:39,610 --> 00:13:40,610
Roger Hunter: That's right.

271
00:13:40,610 --> 00:13:45,619
Host: But with many of these smaller satellites,
you can cover a bigger width.

272
00:13:45,619 --> 00:13:50,670
Roger Hunter: Exactly, as opposed to just
collecting data singularly across a path,

273
00:13:50,670 --> 00:13:51,670
across the earth.

274
00:13:51,670 --> 00:13:56,439
As the spacecraft orbits the earth, you can
deploy many of these and collect data from

275
00:13:56,439 --> 00:13:58,629
many different advantage points.

276
00:13:58,629 --> 00:14:02,009
And when you can do that, then that improves
the science that you can collect.

277
00:14:02,009 --> 00:14:10,290
And it informs the scientists better about
what the earth is doing, for example, climate

278
00:14:10,290 --> 00:14:11,290
change.

279
00:14:11,290 --> 00:14:17,399
If you can collect multiple data points of
science across the entire globe, simultaneously,

280
00:14:17,399 --> 00:14:22,540
that can give you a better feel of how the
climate is reacting, how the climate is changing,

281
00:14:22,540 --> 00:14:26,689
and how you can assess what's going to happen
on the surface of the planet better.

282
00:14:26,689 --> 00:14:31,199
Host: And so, I'm guessing, during the early
days of starting, you know, working with SmallSats,

283
00:14:31,199 --> 00:14:36,790
CubeSats, doing this kind of stuff -- was
it primarily NASA researchers and NASA engineers

284
00:14:36,790 --> 00:14:38,300
and scientists working on this stuff?

285
00:14:38,300 --> 00:14:43,460
At what point do you start branching out into

Universities, companies, startups?

286
00:14:43,460 --> 00:14:44,320
How does that work out?

287
00:14:44,320 --> 00:14:48,180
Roger Hunter: Oh, in many cases, the Universities
and the other industry were leading the way.

288
00:14:48,189 --> 00:14:49,189
Host: Oh, wow.

289
00:14:49,189 --> 00:14:53,009
Roger Hunter: As a matter of fact, when you
look at the form, fit, and function of CubeSats,

290
00:14:53,009 --> 00:14:55,529
they were established at a University level.

291
00:14:55,529 --> 00:14:57,089
And NASA is following this.

292
00:14:57,089 --> 00:15:00,910
As a matter of fact, a lot of the innovation
that's going on now is happening at University

293
00:15:00,910 --> 00:15:02,429
or in industry.

294
00:15:02,429 --> 00:15:06,619
And NASA is partnering with a number of these
Universities and a number of these industries

295
00:15:06,619 --> 00:15:13,209
across not just the United States, but around
the globe to accelerate the development in

296
00:15:13,209 --> 00:15:14,629
small spacecraft technologies.

297
00:15:14,629 --> 00:15:19,040
Host: And, I know a big thing that Ames has
been working on are, what we affectionately

298
00:15:19,040 --> 00:15:20,579
call, the Virtual Institutes.

299
00:15:20,579 --> 00:15:21,579
Roger Hunter: Right.

300
00:15:21,579 --> 00:15:26,589
Host: Where it's not only just NASA working
with special space act agreements with other

301
00:15:26,589 --> 00:15:32,059
people, but it's actually creating an institute,
bringing in all of these different communities

302
00:15:32,059 --> 00:15:35,689
who are working on the stuff so that people
aren't like silos.

303
00:15:35,689 --> 00:15:40,730
And they can share information and share their
progress -- and that even moved into the whole

304
00:15:40,730 --> 00:15:43,070
virtual institute for small satellites.

305
00:15:43,070 --> 00:15:44,249
Roger Hunter: Correct.

306
00:15:44,249 --> 00:15:47,980
We've had some virtual institutes already
established that are oriented towards, for

307
00:15:47,980 --> 00:15:51,389
example, solar system exploration and research.

308
00:15:51,389 --> 00:15:58,110
And so, NASA saw the need to copy that success
from a small spacecraft perspective.

309
00:15:58,110 --> 00:16:05,179
And so now, NASA has established a Small Spacecraft
Virtual Institute, which is going to, hopefully,

310
00:16:05,179 --> 00:16:08,809
mimic the success that we've had in these
other virtual institutes and further the sharing

311
00:16:08,809 --> 00:16:16,209
of knowledge, further the collaboration, further
the coordination between not just NASA centers,

312
00:16:16,209 --> 00:16:18,459
but across academia and industry alike.

313
00:16:18,459 --> 00:16:24,109
So that we can all take advantage of the revolution
that's going on in electronics and technology

314
00:16:24,109 --> 00:16:27,959
to make small spacecraft even more capable
and flexible than they are today.

315
00:16:27,959 --> 00:16:32,540
Host: Well, even thinking about the people
who are listening to this podcast or your

316
00:16:32,540 --> 00:16:38,749
students, interns, who are wanting to get
jobs with NASA, getting jobs working in the

317
00:16:38,749 --> 00:16:40,160
space industry.

318

00:16:40,160 --> 00:16:45,959
It's like now those people who are applying
for these internships, applying for jobs,

319
00:16:45,959 --> 00:16:50,570
could literally have small satellite missions
on their resume that they did through high

320
00:16:50,570 --> 00:16:51,779
school or college.

321
00:16:51,779 --> 00:16:54,079
You know, they've already done this stuff.

322
00:16:54,079 --> 00:16:55,079
Roger Hunter: That's true.

323
00:16:55,079 --> 00:16:57,860
As a matter of fact, there's a number of Universities
that are flying their own missions.

324
00:16:57,860 --> 00:16:58,860
Host: Oh, wow.

325
00:16:58,860 --> 00:17:02,540
Roger Hunter: And they are using that to further
the research and development that's going

326
00:17:02,540 --> 00:17:06,730
on at their institute so that they can infuse
that into industry.

327
00:17:06,730 --> 00:17:10,720
There's even elementary schools that are now
building small spacecraft and launching them.

328
00:17:10,720 --> 00:17:15,309
Host: So talk a little bit about yourself,
like your day-to-day, what you're working

329
00:17:15,309 --> 00:17:16,569
with on SmallSats now.

330
00:17:16,569 --> 00:17:18,510
What do you come in?

331
00:17:18,510 --> 00:17:20,829
You know, you get your coffee, open your laptop.

332
00:17:20,829 --> 00:17:21,899
How's it look?

333
00:17:21,899 --> 00:17:25,230
Roger Hunter: Well, we're actually marching
towards some upcoming launches.

334
00:17:25,230 --> 00:17:30,210
And so, we spend a bit of time right now on,
what we call, the end-game of getting the

335
00:17:30,210 --> 00:17:31,860
spacecraft into orbit.

336
00:17:31,860 --> 00:17:35,880
We have two spacecraft that are launching
on September 12th.

337
00:17:35,880 --> 00:17:40,130
And that they're going to go up on a Cygnus
resupply mission to the International Space

338
00:17:40,130 --> 00:17:41,400
Station.

339
00:17:41,400 --> 00:17:47,750
And these two spacecraft, one is called OCSD
and it's an acronym for the: Optical Communications

340

00:17:47,750 --> 00:17:49,130
and Sensor Demonstration.

341
00:17:49,130 --> 00:17:50,690
Host: Of course, NASA, you have to have an
acronym.

342
00:17:50,690 --> 00:17:51,690
Roger Hunter: Yes.

343
00:17:51,690 --> 00:17:52,690
Oh, absolutely.

344
00:17:52,690 --> 00:17:53,690
We live by acronyms.

345
00:17:53,690 --> 00:17:54,690
Host: Exactly.

346
00:17:54,690 --> 00:17:58,340
Roger Hunter: And another one is called ISARA,
which stands for: Integrated Solar Array Reflectarray.

347
00:17:58,340 --> 00:18:06,210
Now, both of these are demonstrations of first-time
uses for NASA and for anybody, for that matter.

348
00:18:06,210 --> 00:18:13,139
And this is another example of where NASA
is at the cutting-edge of developing some

349
00:18:13,139 --> 00:18:16,179
technologies that are going to improve our
small spacecraft technology.

350
00:18:16,179 --> 00:18:21,470
Now, the first one, the OCSD, is going to
demonstrate, for the first time, laser communications

351

00:18:21,470 --> 00:18:26,889
from a CubeSat to earth and, also, laser communications
from the earth to the CubeSat.

352
00:18:26,889 --> 00:18:31,440
We think it is necessary, given the expected
number of small satellites that are going

353
00:18:31,440 --> 00:18:33,809
to be launched in the coming years.

354
00:18:33,809 --> 00:18:36,790
And there will be many spacecraft out there.

355
00:18:36,790 --> 00:18:42,350
And the regular electromagnetic band radio
frequencies are getting crowded.

356
00:18:42,350 --> 00:18:47,510
And so, we see the necessity of moving to
communication by laser or communication by

357
00:18:47,510 --> 00:18:48,510
light.

358
00:18:48,510 --> 00:18:51,480
Host: I was going to say -- normally when
you talk about communications you specifically

359
00:18:51,480 --> 00:18:53,500
said, "Laser communications."

360
00:18:53,500 --> 00:18:59,669
So the sci-fi sense is going off, of like,
"Oh, laser is into communications."

361
00:18:59,669 --> 00:19:03,960
So this is, basically, electromagnetic -- I
would imagine, yeah, it just doesn't work

362
00:19:03,960 --> 00:19:05,110
the same, I guess.

363
00:19:05,110 --> 00:19:06,710
Roger Hunter: No, it doesn't.

364
00:19:06,710 --> 00:19:07,710
There is a difference.

365
00:19:07,710 --> 00:19:08,780
Host: There's different factors involved.

366
00:19:08,780 --> 00:19:11,730
Roger Hunter: Because it has to use -- there's
a lot of things that you have to take into

367
00:19:11,730 --> 00:19:14,639
consideration when you're using laser communication
from space.

368
00:19:14,639 --> 00:19:16,940
You have to point the thing accurately.

369
00:19:16,940 --> 00:19:22,480
Because when you're pointing a laser, it's
very precise in where you originate the laser

370
00:19:22,480 --> 00:19:26,630
from and also where you terminate the laser
on the ground.

371
00:19:26,630 --> 00:19:31,080
And so, we have to make sure that that type
of pointing is accurate enough so that you

372
00:19:31,080 --> 00:19:37,010
can complete, if you will, the circuit between
the small spacecraft and the ground terminal.

373
00:19:37,010 --> 00:19:39,940
Now, we had only done laser communication
once before.

374
00:19:39,940 --> 00:19:43,250
It was a bigger spacecraft, and it was from
the moon.

375
00:19:43,250 --> 00:19:44,250
Remember, LADEE?

376
00:19:44,250 --> 00:19:45,250
Host: Yeah.

377
00:19:45,250 --> 00:19:46,990
Roger Hunter: And that was just a one-way
communication.

378
00:19:46,990 --> 00:19:49,760
And that was to gather a lot of information
on the LADEE spacecraft.

379
00:19:49,760 --> 00:19:54,620
And then we blasted it back down to the earth,
and it worked perfectly.

380
00:19:54,620 --> 00:19:57,510
Well, now we want to extend that to CubeSats.

381
00:19:57,510 --> 00:19:59,210
So, no one's done this before.

382
00:19:59,210 --> 00:20:05,750
And so, when this spacecraft launches it's
going to spend a little bit of time inside

383
00:20:05,750 --> 00:20:11,200
this Cygnus resupply capsule while it's attached
to the International Space Station.

384
00:20:11,200 --> 00:20:13,090
Because they've got to resupply the space station.

385
00:20:13,090 --> 00:20:19,490
They're going to take material off the capsule and then exchange stuff that was used on the

386
00:20:19,490 --> 00:20:20,490
ISS back onto the capsule.

387
00:20:20,490 --> 00:20:26,370
And then the Cygnus capsule will maneuver away from the International Space Station

388
00:20:26,370 --> 00:20:27,429
to a higher orbit.

389
00:20:27,429 --> 00:20:30,960
And then it will deploy our CubeSats.

390
00:20:30,960 --> 00:20:33,919
We will go through a readiness checkout of the CubeSats.

391
00:20:33,919 --> 00:20:36,519
And then we will conduct the experiment.

392
00:20:36,519 --> 00:20:40,230
We will lase from the ground to the CubeSats.

393
00:20:40,230 --> 00:20:44,670
And then, when they collect more data, they will lase from the CubeSat to the ground.

394
00:20:44,670 --> 00:20:47,639
And there will be two of them that will be doing this mission.

395
00:20:47,639 --> 00:20:48,720
Host: And this is critical.

396
00:20:48,720 --> 00:20:54,960
Because if you can prove this, show that it
works, have it functioning -- then that is

397
00:20:54,960 --> 00:20:59,830
just -- for the next generation, those SmallSats
that go up, and like, "Hey, we've already

398
00:20:59,830 --> 00:21:00,830
done this.

399
00:21:00,830 --> 00:21:01,830
Let's add this."

400
00:21:01,830 --> 00:21:02,830
And then have other functionality put on top.

401
00:21:02,830 --> 00:21:03,830
Roger Hunter: Exactly.

402
00:21:03,830 --> 00:21:08,810
And there will be other users out there -- whether
they're within NASA or within the Air Force,

403
00:21:08,810 --> 00:21:14,460
perhaps, or within industry -- who would be
very interested in the success of this mission.

404
00:21:14,460 --> 00:21:16,649
They want to see that this laser communications
is going to work.

405
00:21:16,649 --> 00:21:21,360
And if we can prove that it does, then they
will welcome that new technology into their

406
00:21:21,360 --> 00:21:22,360
systems.

407
00:21:22,360 --> 00:21:23,360
Host: So, talk about the other one.

408
00:21:23,360 --> 00:21:24,360
Roger Hunter: Okay.

409
00:21:24,360 --> 00:21:25,360
Integrated Solar Array Reflectarray.

410
00:21:25,360 --> 00:21:26,789
Host: I was going to see if I could remember.

411
00:21:26,789 --> 00:21:28,120
All I could remember is "array" something,
so --

412
00:21:28,120 --> 00:21:29,120
Roger Hunter: Yes.

413
00:21:29,120 --> 00:21:30,520
Host: -- I'm glad you have it.

414
00:21:30,520 --> 00:21:33,240
Roger Hunter: This is another first of its
kind.

415
00:21:33,240 --> 00:21:40,350
In this case, we have the first demonstration
of Ka-band communications from a CubeSat.

416
00:21:40,350 --> 00:21:46,779
But what's also interesting about this is
that we have an antenna onboard the CubeSat.

417

00:21:46,779 --> 00:21:53,200
One side of it is the antenna, but the other side of that structure are solar cells.

418
00:21:53,200 --> 00:21:57,809
So you have a part of the spacecraft that provides two functions.

419
00:21:57,809 --> 00:22:04,509
One side helps reflect the Ka-band or the signal from the CubeSat to the ground while

420
00:22:04,509 --> 00:22:12,269
the other side of that structure is collecting solar energy and providing power to the spacecraft.

421
00:22:12,269 --> 00:22:15,570
So this will be a first demonstration of that technology as well.

422
00:22:15,570 --> 00:22:16,570
Host: Oh, wow.

423
00:22:16,570 --> 00:22:18,000
And where do you see that that could go?

424
00:22:18,000 --> 00:22:21,389
You know, for other people -- I mean, is it just more of -- I don't know -- like a way

425
00:22:21,389 --> 00:22:23,500
that these SmallSats can gather more power or power from just the --

426
00:22:23,500 --> 00:22:24,670
Roger Hunter: Well, yeah.

427
00:22:24,670 --> 00:22:27,100
It's like a dual-use technology.

428
00:22:27,100 --> 00:22:31,460
For example, you're using to not just generate
power for your spacecraft, but you're also

429
00:22:31,460 --> 00:22:33,660
using it to help generate your communications
for your spacecraft.

430
00:22:33,660 --> 00:22:35,679
Host: Oh, so it's more like -- it's just self-sustaining.

431
00:22:35,679 --> 00:22:36,910
Roger Hunter: Yeah.

432
00:22:36,910 --> 00:22:38,259
You become a dual-use technology, essentially.

433
00:22:38,259 --> 00:22:46,900
What happens, in this case, is that most of
your subsystems are one function.

434
00:22:46,900 --> 00:22:51,330
And this is a stepping on the path of making
multifunctional spacecraft.

435
00:22:51,330 --> 00:22:52,659
Host: Oh, wow.

436
00:22:52,659 --> 00:22:54,080
And then that just exponentially grows.

437
00:22:54,080 --> 00:22:57,590
Not only do you have multiple small satellites
out there, you have your swarm.

438
00:22:57,590 --> 00:23:00,330
But then each one can do multiple things.

439

00:23:00,330 --> 00:23:01,330
Roger Hunter: Yes.

440
00:23:01,330 --> 00:23:02,440
Think of the chassis for your car.

441
00:23:02,440 --> 00:23:04,240
It serves one function.

442
00:23:04,240 --> 00:23:10,480
And for your spacecraft, you have a chassis
that you bolt all your things inside.

443
00:23:10,480 --> 00:23:14,950
Whether it's your sensors, your batteries
or your attitude, determination, control subsystem

444
00:23:14,950 --> 00:23:21,950
-- think if that structure was also not only
providing a form for your spacecraft to attach

445
00:23:21,950 --> 00:23:24,360
parts to, but also served as a battery.

446
00:23:24,360 --> 00:23:27,750
Now, you're getting into a spacecraft that's
multifunctional.

447
00:23:27,750 --> 00:23:33,299
And that helps you reduce the weight of your
spacecraft, but also gives you more capability

448
00:23:33,299 --> 00:23:36,120
and more robustness to your spacecraft.

449
00:23:36,120 --> 00:23:38,700
Those are some of the things we're working
on for the future.

450

00:23:38,700 --> 00:23:42,649
Host: And so, if I understand, you have another
launch coming up that's apart from these two?

451
00:23:42,649 --> 00:23:43,649
Roger Hunter: Yes.

452
00:23:43,649 --> 00:23:45,019
It's apart from the first two I mentioned.

453
00:23:45,019 --> 00:23:51,980
This one that launches in October is called
CPOD for: CubeSat Proximity Operations Demonstration.

454
00:23:51,980 --> 00:23:53,220
Host: Always with the acronym.

455
00:23:53,220 --> 00:23:54,970
Roger Hunter: Always the acronyms.

456
00:23:54,970 --> 00:24:00,820
And this one is going to be the first demonstration
ever of two spacecraft, two small spacecraft,

457
00:24:00,820 --> 00:24:04,730
two CubeSat spacecraft that are going to dock
with each other.

458
00:24:04,730 --> 00:24:06,090
Host: Okay.

459
00:24:06,090 --> 00:24:10,890
I remember -- we are recording this in June,
and we just recently had -- the Centennial

460
00:24:10,890 --> 00:24:13,990
Challenge of SmallSats awards were announced.

461
00:24:13,990 --> 00:24:14,990

And we have animations.

462
00:24:14,990 --> 00:24:18,600
I've seen this, of the SmallSats, circling each other, docking.

463
00:24:18,600 --> 00:24:19,600
Roger Hunter: Yeah.

464
00:24:19,600 --> 00:24:22,020
They deploy attached to each other.

465
00:24:22,020 --> 00:24:27,289
And then after they maneuver some distance from the stage of the rocket that gets them

466
00:24:27,289 --> 00:24:37,530
into orbit, they will detach, move to a distance, tens of kilometers, and then we will initiate

467
00:24:37,530 --> 00:24:38,530
them.

468
00:24:38,530 --> 00:24:39,530
We'll turn them on.

469
00:24:39,530 --> 00:24:41,660
And then they will start looking for each other.

470
00:24:41,660 --> 00:24:42,660
Host: Nice.

471
00:24:42,660 --> 00:24:45,789
Roger Hunter: And then they will start homing in on each other, and they do this circular

472
00:24:45,789 --> 00:24:46,789
pattern.

473
00:24:46,789 --> 00:24:47,789
Host: They're kind of circling around.

474
00:24:47,789 --> 00:24:48,789
Roger Hunter: Yeah.

475
00:24:48,789 --> 00:24:50,740
And they circle around, and then, eventually,
they will come together.

476
00:24:50,740 --> 00:24:56,529
And there is a mechanical docking mechanism;
they're like little fingers.

477
00:24:56,529 --> 00:24:58,730
And then they grab each other.

478
00:24:58,730 --> 00:25:03,639
And then there are electromagnets that are
turned on, and it finishes the docking of

479
00:25:03,639 --> 00:25:05,000
the two.

480
00:25:05,000 --> 00:25:07,790
We've never done this before for CubeSats.

481
00:25:07,790 --> 00:25:10,269
And so, we want to demonstrate this for the
first time.

482
00:25:10,269 --> 00:25:12,179
Why is this important?

483
00:25:12,179 --> 00:25:20,940
We envision that many of the large observatories,
that we may send into space in the future,

484
00:25:20,940 --> 00:25:26,990
are going to be manufactured in orbit and
assembled in orbit, which means that some

485
00:25:26,990 --> 00:25:30,940
parts of these spacecraft will have to dock
with each other.

486
00:25:30,940 --> 00:25:35,309
And so we're proving out some of the concepts
today that will enable some of the missions

487
00:25:35,309 --> 00:25:36,710
that we will fly in the future.

488
00:25:36,710 --> 00:25:37,710
Host: Wow.

489
00:25:37,710 --> 00:25:38,990
And you can just think about that.

490
00:25:38,990 --> 00:25:43,080
You have the laser communication, so you're
gathering data and sending it back, probably,

491
00:25:43,080 --> 00:25:44,529
in like real-time.

492
00:25:44,529 --> 00:25:46,590
They're doing multiple functions; they're
dual-use.

493
00:25:46,590 --> 00:25:51,240
But then also moving it into: they can dock,
they can separate.

494
00:25:51,240 --> 00:25:55,389
You have this swarm of SmallSats that are
able to serve different functions.

495
00:25:55,389 --> 00:25:56,389
Roger Hunter: Exactly.

496
00:25:56,389 --> 00:26:00,669
Host: And so, for anybody who is listening,
who is like, you've peaked their interest

497
00:26:00,669 --> 00:26:05,100
-- they're all about learning more about SmallSats
-- I believe, you have nasa.gov/smallsat.

498
00:26:05,100 --> 00:26:06,350
Roger Hunter: Right.

499
00:26:06,350 --> 00:26:10,350
Host: So for anybody who is looking for information,
I'm sure there's a lot of information from

500
00:26:10,350 --> 00:26:13,330
the Centennial Challenge that happened in
June.

501
00:26:13,330 --> 00:26:17,870
And all that you could hope for, to learn
all there is about the small satellites --

502
00:26:17,870 --> 00:26:18,870
Roger Hunter: Yep.

503
00:26:18,870 --> 00:26:21,520
Just google: NASA and small spacecraft technology
program.

504
00:26:21,520 --> 00:26:26,320
In the show notes, we'll add links to everything
so if anybody has any questions, want to learn

505
00:26:26,320 --> 00:26:27,440

more about that.

506
00:26:27,440 --> 00:26:30,250
Also, we are on Twitter @nasaames.

507
00:26:30,250 --> 00:26:33,120
We're using the #NASASiliconValley.

508
00:26:33,120 --> 00:26:36,920
So if anybody has questions for Roger, feel
free to ping us there, and we'll get back

509
00:26:36,920 --> 00:26:39,700
to Roger and go ahead and send some responses
back and forth.

510
00:26:39,700 --> 00:26:40,700
Roger Hunter: Sounds awesome.

511
00:26:40,700 --> 00:26:41,560
Host: So, excellent.