1
00:00:00,539 --> 00:00:04,180
George Diller: Satellites play vital roles
in everyday life.

2
00:00:04,180 --> 00:00:09,230
From weather observations to navigation to
communications, Earth-orbiting spacecraft

3
00:00:09,230 --> 00:00:10,230
now are

4
00:00:10,230 --> 00:00:13,099
so prevalent they could easily be taken for
granted.

5
00:00:13,099 --> 00:00:19,110
Since April 2011, engineers at NASA's Kennedy
Space Center in Florida have partnered with

6
00:00:19,110 --> 00:00:24,270
the Satellite Servicing Capabilities Office
at the Goddard Space Flight Center in Maryland

7
00:00:24,270 --> 00:00:30,130
to develop robotic satellite servicing technologies
necessary to bring in-orbit inspection,

8
00:00:30,130 --> 00:00:35,250
repair, refueling, component replacement and
assembly capabilities to extend the life of

9
00:00:35,250 --> 00:00:36,250
these

10
00:00:36,250 --> 00:00:38,050
important spacecraft.

11
00:00:38,050 --> 00:00:43,650
The orbital path of 22,000 miles above Earth

is home to more than 400 satellites serving

12
00:00:43,650 --> 00:00:47,620
customers worldwide, but occasionally these
spacecraft fail or

13
00:00:47,620 --> 00:00:50,020
simply run out of maneuvering propellant.

14
00:00:50,020 --> 00:00:55,489
A team at Kennedy, collaborating with counterparts
at Goddard, recently demonstrated

15
00:00:55,489 --> 00:00:59,620
groundbreaking technology that could add years
of service to these satellites.

16
00:00:59,620 --> 00:01:06,630
Pepper Phillips: "As Kennedy has matured its
expertise in servicing spacecraft and launch

17
00:01:06,630 --> 00:01:12,600
vehicles, we've worked with a number of centers
in servicing their particular aspect and

18
00:01:12,600 --> 00:01:13,600
spacecraft."

19
00:01:13,600 --> 00:01:17,990
George Diller: Engineers at Goddard want to
take advantage of Kennedy's experience in

20
00:01:17,990 --> 00:01:18,990
launch

21
00:01:18,990 --> 00:01:22,190
vehicle and satellite processing, as well
as propellant loading.

22

00:01:22,190 --> 00:01:26,110
This expertise is being applied to help design
refueling components

23
00:01:26,110 --> 00:01:27,760
of a robotic servicing spacecraft.

24
00:01:27,760 --> 00:01:33,640
Brian Nufer: "Goddard came to KSC near the
end of the shuttle program so we could leverage

25
00:01:33,640 --> 00:01:35,330
all of our expertise in hypergolics."

26
00:01:35,330 --> 00:01:39,780
George Diller: Kennedy's know-how gained from
processing and launching spacecraft

27
00:01:39,780 --> 00:01:44,670
developed at other NASA centers now is allowing
its employees to branch out and become a

28
00:01:44,670 --> 00:01:47,080
part of the process of designing a satellite.

29
00:01:47,080 --> 00:01:51,400
Pepper Phillips: "We've primarily been servicing
spacecraft and vehicles using our

30
00:01:51,400 --> 00:01:54,770
ground systems and doing some spacecraft repair.

31
00:01:54,770 --> 00:01:56,880
For this particular aspect,

32
00:01:56,880 --> 00:01:59,240
we're actually designing flight hardware."

33
00:01:59,240 --> 00:02:04,159

George Diller: Over the past few years, the
team at Kennedy has been developing and testing

34
00:02:04,159 --> 00:02:08,459
the critical hypergolic propellant transfer
system for a servicing satellite.

35
00:02:08,459 --> 00:02:14,650
Thomas Aranyos: "We are actually starting
a unique role which is designing,

36
00:02:14,650 --> 00:02:20,859
developing and testing eventual satellite
hardware that will be used in future

37
00:02:20,859 --> 00:02:22,810
refueling a satellite."

38
00:02:22,810 --> 00:02:26,810
George Diller: The most recent run-through
took place in the Florida spaceport's

39
00:02:26,810 --> 00:02:32,859
Payload Hazardous Servicing Facility, or PHSF,
and focused on moving from a proof-of-concept

40
00:02:32,859 --> 00:02:37,319
phase to building the first engineering development
unit.

41
00:02:37,319 --> 00:02:43,510
During February 2014, a flight-like prototype
demonstrated that a robotically operated satellite

42
00:02:43,510 --> 00:02:48,620
could remotely refuel another orbiting spacecraft
not originally designed to be refueled.

43
00:02:48,620 --> 00:02:51,774
Brian Nufer: "This is an extremely unique

test that's never been done, as far as we

44
00:02:51,774 --> 00:02:52,774
know,

45
00:02:52,774 --> 00:02:53,774
anywhere in the world.

46
00:02:53,774 --> 00:02:58,860
We’re testing with hypergolic oxidizer,
nitrogen tetroxide.

47
00:02:58,860 --> 00:03:03,799
An end-to-end system that does the servicing
of a satellite in orbit."

48
00:03:03,799 --> 00:03:08,469
George Diller: The demonstration was called
RROxiTT for Remote Robotic Oxidizer Transfer

49
00:03:08,469 --> 00:03:09,469
Test.

50
00:03:09,469 --> 00:03:13,319
A Goddard-built robotic arm was shipped to
Kennedy for the operation.

51
00:03:13,319 --> 00:03:19,519
It has the capability to connect to a simulated
satellite servicing panel, including its propellant

52
00:03:19,519 --> 00:03:20,519
fill

53
00:03:20,519 --> 00:03:21,519
and drain valves.

54
00:03:21,519 --> 00:03:23,540
For the operation, the Kennedy team developed

55
00:03:23,540 --> 00:03:28,260
the propellant transfer assembly, also called
the PTA.

56
00:03:28,260 --> 00:03:33,279
From 800 miles away in Maryland, Goddard engineers
remotely controlled the robotic arm's

57
00:03:33,279 --> 00:03:38,239
connection to the Kennedy-provided propellant
transfer system and hose delivery assembly

58
00:03:38,239 --> 00:03:42,249
hooking it up to the simulated client satellite's
fill-drain valve,

59
00:03:42,249 --> 00:03:45,189
all located in Kennedy's PHSF in Florida.

60
00:03:45,189 --> 00:03:50,010
Thomas Aranyos: "This project has not only
been a challenge, but it's been a lot of fun

61
00:03:50,010 --> 00:03:52,540
for the entire team.

62
00:03:52,540 --> 00:03:57,249
And I have to say, I've never had to ask for
a volunteer for this project."

63
00:03:57,249 --> 00:04:03,019
Pepper Phillips: "KSC has largely focused
on ground processing and ground ops., and

64
00:04:03,019 --> 00:04:04,019
we've

65
00:04:04,019 --> 00:04:05,019

earned our expertise in that area.

66
00:04:05,019 --> 00:04:06,019
In this realm, it's literally spacecraft development work and it's

67
00:04:06,019 --> 00:04:07,019
venturing out beyond traditionally KSC.

68
00:04:07,019 --> 00:04:09,650
For our team it's expanding their capabilities.