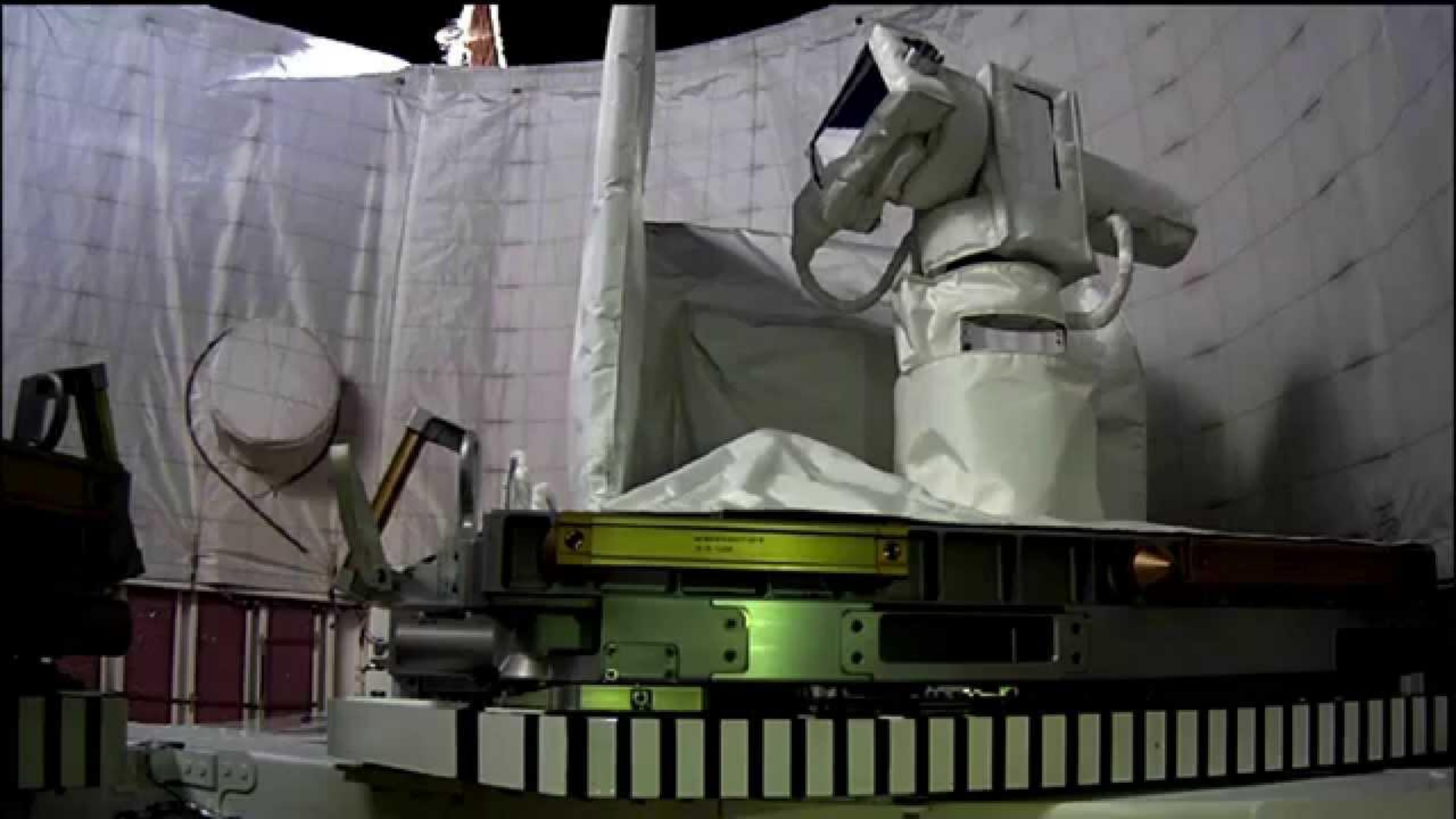

1
00:00:05,990 --> 00:00:03,379
now the International Space Station is

2
00:00:07,369 --> 00:00:06,000
not only a laboratory in which science

3
00:00:09,709 --> 00:00:07,379
experiments are conducted

4
00:00:11,450 --> 00:00:09,719
it's a a testbed for new technologies

5
00:00:13,310 --> 00:00:11,460
that will support future space

6
00:00:15,379 --> 00:00:13,320
exploration and one of those new

7
00:00:18,260 --> 00:00:15,389
technologies is getting its first big

8
00:00:21,200 --> 00:00:18,270
test tomorrow the optical payload for

9
00:00:22,820 --> 00:00:21,210
laser comes science known as opals was

10
00:00:24,950 --> 00:00:22,830
delivered to the space station on the

11
00:00:27,080 --> 00:00:24,960
most recent dragon cargo ship back in

12
00:00:28,339 --> 00:00:27,090
April the opals team at the Jet

13
00:00:31,130 --> 00:00:28,349

Propulsion Laboratory in Pasadena

14
00:00:34,010 --> 00:00:31,140
California wrapped up the commissioning

15
00:00:35,930 --> 00:00:34,020
activities this past weekend yesterday I

16
00:00:38,420 --> 00:00:35,940
talked with opals mission manager Matt

17
00:00:40,670 --> 00:00:38,430
Abrahamson about this project and the

18
00:00:43,100 --> 00:00:40,680
plans for the first optical downlink

19
00:00:45,529 --> 00:00:43,110
attempt which at that time was planned

20
00:00:47,900 --> 00:00:45,539
for earlier today Wednesday morning and

21
00:00:50,240 --> 00:00:47,910
you will hear us reference that as he

22
00:00:52,819 --> 00:00:50,250
explains just how this experiments

23
00:00:55,220 --> 00:00:52,829
designed to work however late yesterday

24
00:00:57,590 --> 00:00:55,230
that first optical downlink attempt was

25
00:01:00,950 --> 00:00:57,600
rescheduled it's now planned to take

26
00:01:04,460 --> 00:01:00,960
place tomorrow evening about 8:20 2 p.m.

27
00:01:07,190 --> 00:01:04,470
Pacific time on June 5th I started our

28
00:01:10,789 --> 00:01:07,200
talk by asking Matt Abrahamson where the

29
00:01:13,580 --> 00:01:10,799
idea for opals came from opals came from

30
00:01:15,890 --> 00:01:13,590
a couple different desires by JPL first

31
00:01:19,010 --> 00:01:15,900
desire was to develop a low-cost optical

32
00:01:22,039 --> 00:01:19,020
communications platform in space so back

33
00:01:24,679 --> 00:01:22,049
in 2009 JPL had demonstrated an aircraft

34
00:01:26,690 --> 00:01:24,689
to ground laser communications link and

35
00:01:29,030 --> 00:01:26,700
so the next logical step was to go up to

36
00:01:30,980 --> 00:01:29,040
low-earth orbit and at about the same

37
00:01:33,380 --> 00:01:30,990
time the international space station was

38
00:01:35,990 --> 00:01:33,390

looking for external payloads to operate

39
00:01:37,789 --> 00:01:36,000
on the outside of the ISS so it was

40
00:01:39,170 --> 00:01:37,799
really a natural match to put hopefuls

41
00:01:40,340 --> 00:01:39,180
up in space on the International Space

42
00:01:43,310 --> 00:01:40,350
Station

43
00:01:44,990 --> 00:01:43,320
the second desire was for JPL to develop

44
00:01:48,310 --> 00:01:45,000
a flight projects program for early

45
00:01:50,450 --> 00:01:48,320
career hires so these are hires they're

46
00:01:55,670 --> 00:01:50,460
within three years of graduating from

47
00:01:57,350 --> 00:01:55,680
college and so everyone on opals from

48
00:01:59,590 --> 00:01:57,360
the project manager to the lead

49
00:02:01,580 --> 00:01:59,600
scientist is an early career hire

50
00:02:04,429 --> 00:02:01,590
interesting something special for them

51
00:02:06,080 --> 00:02:04,439
to work on that's right it gives much

52
00:02:07,999 --> 00:02:06,090
more responsibility to early crew hires

53
00:02:10,400 --> 00:02:08,009
than they would typically get with other

54
00:02:12,320 --> 00:02:10,410
projects let me go take you back to the

55
00:02:13,530 --> 00:02:12,330
to the first reason but why is there a

56
00:02:15,240 --> 00:02:13,540
need for an

57
00:02:18,000 --> 00:02:15,250
turn ative to communicating with

58
00:02:21,690 --> 00:02:18,010
satellites an alternative to doing so by

59
00:02:24,809 --> 00:02:21,700
radio it's all about data we have too

60
00:02:27,750 --> 00:02:24,819
much of it so our ability to collect it

61
00:02:29,459 --> 00:02:27,760
in space has greatly outpaced our

62
00:02:31,020 --> 00:02:29,469
ability to transmit it back to Kirsten

63
00:02:33,270 --> 00:02:31,030

so we're collecting all the scientific

64
00:02:35,789 --> 00:02:33,280
data and we need to get it back to the

65
00:02:37,949 --> 00:02:35,799
ground and radio communications have a

66
00:02:39,720 --> 00:02:37,959
limitation on the data rates that we can

67
00:02:42,899 --> 00:02:39,730
use to use this data back to earth and

68
00:02:44,640 --> 00:02:42,909
if we use laser communications that

69
00:02:47,369 --> 00:02:44,650
really opens up the amount of data we

70
00:02:48,990 --> 00:02:47,379
can get back to the ground well what's

71
00:02:51,899 --> 00:02:49,000
the difference in in terms of the

72
00:02:53,759 --> 00:02:51,909
quantity it's really a difference in

73
00:02:56,879 --> 00:02:53,769
terms of data rates so it can go faster

74
00:02:58,830 --> 00:02:56,889
if you think of the past the

75
00:03:01,830 --> 00:02:58,840
transmission paths of getting data back

76
00:03:03,449 --> 00:03:01,840
to earth and think of it as a pipe we're

77
00:03:05,940 --> 00:03:03,459
widening that pipe so right now it's

78
00:03:08,429 --> 00:03:05,950
very narrow pipe if we put if we widen

79
00:03:10,050 --> 00:03:08,439
that pipe the overall flow that earth is

80
00:03:11,849 --> 00:03:10,060
much faster and you can get much more

81
00:03:15,149 --> 00:03:11,859
material transport in the same amount of

82
00:03:17,580 --> 00:03:15,159
time I see okay but help set the stage

83
00:03:20,909 --> 00:03:17,590
in terms of where this is where is opals

84
00:03:22,500 --> 00:03:20,919
located out on the station so we're on a

85
00:03:25,680 --> 00:03:22,510
platform called Express logistics

86
00:03:28,020 --> 00:03:25,690
carrier one and that's a platform that

87
00:03:30,719 --> 00:03:28,030
provides data and power to payloads and

88
00:03:33,000 --> 00:03:30,729

the space station this is on the port

89
00:03:34,800 --> 00:03:33,010
side of the space station so if you're

90
00:03:36,960 --> 00:03:34,810
on the ISS and you're looking along the

91
00:03:39,229 --> 00:03:36,970
forward direction of travel we're over

92
00:03:41,969 --> 00:03:39,239
on the left side and we're on the

93
00:03:43,819 --> 00:03:41,979
Express logistics carrier that faces the

94
00:03:46,080 --> 00:03:43,829
earth so we're down on the bottom and

95
00:03:48,449 --> 00:03:46,090
we're down there because we require a

96
00:03:51,420 --> 00:03:48,459
clear line of sight with our ground

97
00:03:54,390 --> 00:03:51,430
receiver which is in California and so

98
00:03:57,270 --> 00:03:54,400
we currently have a window that's 110

99
00:03:58,619 --> 00:03:57,280
degrees by 40 degrees and that's where

100
00:04:02,039 --> 00:03:58,629
we're allowed to point our laser beam

101
00:04:03,539 --> 00:04:02,049
when we're transmitting and by allowed

102
00:04:05,789 --> 00:04:03,549
you mean that's in order to make sure

103
00:04:09,659 --> 00:04:05,799
that you don't impact any of the other

104
00:04:12,509 --> 00:04:09,669
station components that's right so we

105
00:04:15,449 --> 00:04:12,519
don't want to radiate our laser at any

106
00:04:17,909 --> 00:04:15,459
parts of the station we also don't want

107
00:04:19,770 --> 00:04:17,919
to violate any reasons where part of the

108
00:04:21,959 --> 00:04:19,780
station might rotate through for example

109
00:04:23,610 --> 00:04:21,969
these solar array envelopes and we also

110
00:04:25,140 --> 00:04:23,620
don't want to fire any location where

111
00:04:27,390 --> 00:04:25,150
there might be a doctor vehicle such as

112
00:04:28,860 --> 00:04:27,400
the SpaceX Dragon

113
00:04:31,320 --> 00:04:28,870

so you've been you've been getting set

114
00:04:33,480 --> 00:04:31,330
for for this first downlink have the all

115
00:04:36,659 --> 00:04:33,490
the preps and checkouts through the

116
00:04:38,370 --> 00:04:36,669
weekend gone well they've gone

117
00:04:40,020 --> 00:04:38,380
exceptionally well we turned on our

118
00:04:43,830 --> 00:04:40,030
payload for the first time on May 10th

119
00:04:46,830 --> 00:04:43,840
and on that first turn on all of our

120
00:04:48,840 --> 00:04:46,840
systems we're operating as expected over

121
00:04:50,490 --> 00:04:48,850
the last few weeks we've had a few other

122
00:04:53,070 --> 00:04:50,500
checkouts one called an open-loop

123
00:04:55,200 --> 00:04:53,080
commissioning test that's where we test

124
00:04:57,090 --> 00:04:55,210
out our pointing capabilities to point

125
00:04:58,980 --> 00:04:57,100
down at our ground station and then a

126
00:05:00,779 --> 00:04:58,990
closed-loop commissioning test is what

127
00:05:02,790 --> 00:05:00,789
we just completed this past weekend and

128
00:05:04,700 --> 00:05:02,800
that demonstrated we were able to track

129
00:05:07,080 --> 00:05:04,710
our ground station very precisely

130
00:05:09,000 --> 00:05:07,090
because a major component of this

131
00:05:10,290 --> 00:05:09,010
technology is to have very precise

132
00:05:13,770 --> 00:05:10,300
pointing to point this laser beam

133
00:05:17,310 --> 00:05:13,780
directly to ground station because opal

134
00:05:19,800 --> 00:05:17,320
will have to will have to rotate or tilt

135
00:05:21,930 --> 00:05:19,810
ER or one of those in order to keep

136
00:05:25,560 --> 00:05:21,940
pointed at the target as the station

137
00:05:28,230 --> 00:05:25,570
moves absolutely that's right the

138
00:05:30,540 --> 00:05:28,240

station is in relatively low orbit at an

139
00:05:32,670 --> 00:05:30,550
altitude of 400 kilometers and it's

140
00:05:35,159 --> 00:05:32,680
traveling at around 7 and a half

141
00:05:36,900 --> 00:05:35,169
kilometers per second so when we pass

142
00:05:39,270 --> 00:05:36,910
over a ground station we need to rotate

143
00:05:40,920 --> 00:05:39,280
at a speed of about one degree per

144
00:05:43,500 --> 00:05:40,930
second to keep a lock on our ground

145
00:05:46,080 --> 00:05:43,510
station so the the first optical

146
00:05:48,020 --> 00:05:46,090
downlink attempt is is on Wednesday

147
00:05:50,760 --> 00:05:48,030
morning tell us what is going to happen

148
00:05:52,589 --> 00:05:50,770
that's right so Wednesday morning will

149
00:05:54,839 --> 00:05:52,599
attempt to transmit a high-definition

150
00:05:56,760 --> 00:05:54,849
video over our laser link to our ground

151
00:05:59,460 --> 00:05:56,770
station which is at Table Mountain in

152
00:06:02,700 --> 00:05:59,470
California with our current predictions

153
00:06:05,219 --> 00:06:02,710
we expect that for 27 a.m. local Pacific

154
00:06:07,170 --> 00:06:05,229
time the ISS will start to rise with the

155
00:06:09,420 --> 00:06:07,180
horizon relative to our ground station

156
00:06:11,129 --> 00:06:09,430
in California and at that point we'll

157
00:06:13,860 --> 00:06:11,139
fire a laser beacon from our ground

158
00:06:17,189 --> 00:06:13,870
station up to the ISS a few minutes

159
00:06:19,080 --> 00:06:17,199
later at about 4:30 a.m. the ISS is

160
00:06:21,510 --> 00:06:19,090
going to reach 25 degrees above the

161
00:06:24,270 --> 00:06:21,520
local elevation in the sky and that

162
00:06:27,060 --> 00:06:24,280
point opals will initiate a sequence to

163
00:06:29,339 --> 00:06:27,070

point back at that ground station and so

164
00:06:30,750 --> 00:06:29,349
it will attempt to lock on to that laser

165
00:06:32,909 --> 00:06:30,760
beacon that the ground station sending

166
00:06:35,279 --> 00:06:32,919
up and once it locks on it's going to

167
00:06:36,779 --> 00:06:35,289
fire our flight laser back of the ground

168
00:06:39,510 --> 00:06:36,789
station at that point we'll have a

169
00:06:41,140 --> 00:06:39,520
bi-directional optical link and it will

170
00:06:43,600 --> 00:06:41,150
begin transmitting our high definite

171
00:06:47,650 --> 00:06:43,610
in video at 50 megabits per second how

172
00:06:49,630 --> 00:06:47,660
long a pass do you get each time the

173
00:06:51,880 --> 00:06:49,640
past is typically about a hundred and

174
00:06:53,800 --> 00:06:51,890
fifty seconds and that's really driven

175
00:06:56,170 --> 00:06:53,810
by that restricted window I was talking

176
00:06:58,180 --> 00:06:56,180
about before the fact that it's only 110

177
00:06:59,770 --> 00:06:58,190
degrees wide we only have about a

178
00:07:02,830 --> 00:06:59,780
hundred and fifty seconds where we can

179
00:07:05,920 --> 00:07:02,840
transmit the ISS is above the horizon

180
00:07:07,120 --> 00:07:05,930
for about six minutes but again we only

181
00:07:09,010 --> 00:07:07,130
get about two-and-a-half minutes of that

182
00:07:10,390 --> 00:07:09,020
because of the restricted pointing now

183
00:07:12,940 --> 00:07:10,400
how long it's going to take for you

184
00:07:15,700 --> 00:07:12,950
folks to know whether or not the test is

185
00:07:17,560 --> 00:07:15,710
successful well well we'll know almost

186
00:07:19,720 --> 00:07:17,570
immediately so our first indication is

187
00:07:23,110 --> 00:07:19,730
we have a scope up at the ground station

188
00:07:25,240 --> 00:07:23,120

and if we are seeing the signal we'll

189
00:07:27,610 --> 00:07:25,250
see a very bright laser beam shining

190
00:07:28,750 --> 00:07:27,620
back down at us and then about ten

191
00:07:30,430 --> 00:07:28,760
minutes later

192
00:07:33,220 --> 00:07:30,440
we'll be able to reconstruct the video

193
00:07:34,630 --> 00:07:33,230
on the ground and if that video

194
00:07:37,030 --> 00:07:34,640
reconstruction were able to play it back

195
00:07:39,720 --> 00:07:37,040
and we know that we're successful will

196
00:07:42,310 --> 00:07:39,730
there be more tests after this first one

197
00:07:44,920 --> 00:07:42,320
absolutely this is just the start of our

198
00:07:46,690 --> 00:07:44,930
testing opals are the technology

199
00:07:48,210 --> 00:07:46,700
demonstration and so our whole point up

200
00:07:51,340 --> 00:07:48,220
there is to test out this technology

201
00:07:52,840 --> 00:07:51,350
learn about it and get some of the

202
00:07:55,870 --> 00:07:52,850
answers so that we can build a better

203
00:07:59,950 --> 00:07:55,880
smarter optic communications system in

204
00:08:02,440 --> 00:07:59,960
the future and how might a system of

205
00:08:05,350 --> 00:08:02,450
this kind be used on future missions

206
00:08:07,300 --> 00:08:05,360
well it'll be used as a communications

207
00:08:10,150 --> 00:08:07,310
package or an antenna on future deep

208
00:08:13,390 --> 00:08:10,160
space missions it will be kind of like

209
00:08:14,770 --> 00:08:13,400
the the high rate option so I'm sure

210
00:08:16,180 --> 00:08:14,780
that in future missions you will

211
00:08:17,800 --> 00:08:16,190
probably still have a low rate option

212
00:08:21,400 --> 00:08:17,810
that will be a standard radio antenna

213
00:08:23,620 --> 00:08:21,410

just for system safety but this would be

214
00:08:27,460 --> 00:08:23,630
a capable system where we could downlink

215
00:08:30,010 --> 00:08:27,470
high rate scientific data to the ground

216
00:08:32,710 --> 00:08:30,020
when there's a bidirectional on a site

217
00:08:35,050 --> 00:08:32,720
with the ground stations that allows us

218
00:08:38,230 --> 00:08:35,060
to get high-definition video videos back

219
00:08:39,490 --> 00:08:38,240
high-definition scientific data and more

220
00:08:40,960 --> 00:08:39,500
scientific a that then we're able to

221
00:08:44,170 --> 00:08:40,970
bring back today with their current

222
00:08:45,970 --> 00:08:44,180
antennas it's very exciting look eager

223
00:08:48,940 --> 00:08:45,980
just to see how it all goes Matt good

224
00:08:51,400 --> 00:08:48,950
luck Thank You Pat Matt Abrahamson D is

225
00:08:52,510 --> 00:08:51,410
the opals mission manager at the Jet

226
00:08:54,110 --> 00:08:52,520
Propulsion Laboratory in Pasadena

227
00:08:56,480 --> 00:08:54,120
California

228
00:08:58,970 --> 00:08:56,490
and reminder once again that the first

229
00:09:00,710 --> 00:08:58,980
optical downlink attempt for the opals

230
00:09:03,319 --> 00:09:00,720
payload is now scheduled for tomorrow

231
00:09:05,329 --> 00:09:03,329
June 5th International Space Station

232
00:09:10,009 --> 00:09:05,339
pass above the ground site in California