
Radisson

1
00:00:07,349 --> 00:00:05,430
all right

2
00:00:08,870 --> 00:00:07,359
thank you noel can you guys can you hear

3
00:00:10,310 --> 00:00:08,880
me okay in the back

4
00:00:12,070 --> 00:00:10,320
yeah okay

5
00:00:13,589 --> 00:00:12,080
well um

6
00:00:15,110 --> 00:00:13,599
i still have the how much time do i have

7
00:00:17,189 --> 00:00:15,120
those

8
00:00:18,950 --> 00:00:17,199
same okay yeah that'd be fine

9
00:00:21,189 --> 00:00:18,960
uh so first of all i want to thank you

10
00:00:22,310 --> 00:00:21,199
for uh giving me the time to talk to you

11
00:00:24,070 --> 00:00:22,320
today

12
00:00:26,230 --> 00:00:24,080
uh over the course of my career you know

13
00:00:28,390 --> 00:00:26,240

this is my second stint at nasa

14
00:00:29,349 --> 00:00:28,400
and in my first stand at nasa i used to

15
00:00:31,509 --> 00:00:29,359
love

16
00:00:32,470 --> 00:00:31,519
uh going to the apple courses like this

17
00:00:34,870 --> 00:00:32,480
one

18
00:00:36,310 --> 00:00:34,880
uh i never got to come to florida i

19
00:00:37,670 --> 00:00:36,320
always had to go to wallops island it

20
00:00:39,830 --> 00:00:37,680
was a little closer

21
00:00:40,950 --> 00:00:39,840
and this is this is definitely cooler

22
00:00:41,830 --> 00:00:40,960
but

23
00:00:43,350 --> 00:00:41,840
you know

24
00:00:45,190 --> 00:00:43,360
i'm actually really excited to be here

25
00:00:46,549 --> 00:00:45,200
with you all today

26
00:00:47,670 --> 00:00:46,559
pretty much anytime i get out of

27
00:00:49,670 --> 00:00:47,680
washington

28
00:00:51,750 --> 00:00:49,680
is a good day

29
00:00:53,750 --> 00:00:51,760
so thank you for having me uh what i'd

30
00:00:55,189 --> 00:00:53,760
like to do is

31
00:00:57,990 --> 00:00:55,199
talk to you about

32
00:01:00,630 --> 00:00:58,000
the new technology programs

33
00:01:02,549 --> 00:01:00,640
and really the plan embodied in the

34
00:01:06,149 --> 00:01:02,559
president's fy 11

35
00:01:09,510 --> 00:01:08,310
for nasa as you know there's a lot of

36
00:01:11,270 --> 00:01:09,520
debate

37
00:01:13,429 --> 00:01:11,280
over this plan

38
00:01:15,429 --> 00:01:13,439

i would caution you to

39
00:01:17,270 --> 00:01:15,439
not believe the debate as it's been

40
00:01:19,990 --> 00:01:17,280
reported in the newspapers

41
00:01:22,469 --> 00:01:20,000
uh you know newspaper reporters are in

42
00:01:24,830 --> 00:01:22,479
the business of selling newspapers and

43
00:01:26,550 --> 00:01:24,840
so it helps you know when they

44
00:01:28,390 --> 00:01:26,560
uh

45
00:01:31,190 --> 00:01:28,400
dramatize

46
00:01:32,710 --> 00:01:31,200
sensationalize the story i mean there is

47
00:01:35,109 --> 00:01:32,720
definitely a vigorous debate don't get

48
00:01:37,270 --> 00:01:35,119
me wrong and those of us in washington

49
00:01:39,749 --> 00:01:37,280
are right in the middle of it

50
00:01:41,990 --> 00:01:39,759
but it's not exactly as it's been

51
00:01:44,149 --> 00:01:42,000
reported uh in my view

52
00:01:45,350 --> 00:01:44,159
and so what i want to do is if it's okay

53
00:01:47,910 --> 00:01:45,360
with you guys is i want to walk you

54
00:01:49,910 --> 00:01:47,920
through at least the way i view

55
00:01:51,510 --> 00:01:49,920
the president's budget request now you

56
00:01:54,389 --> 00:01:51,520
need to realize that

57
00:01:57,510 --> 00:01:54,399
i came back to nasa on february 1st

58
00:01:59,670 --> 00:01:57,520
the day the budget was rolled out so

59
00:02:01,350 --> 00:01:59,680
it was quite an exciting day and it's

60
00:02:03,749 --> 00:02:01,360
been quite an exciting

61
00:02:07,510 --> 00:02:03,759
three months as a result and i should

62
00:02:09,350 --> 00:02:07,520
also admit to you up front my bias okay

63
00:02:11,830 --> 00:02:09,360

um

64
00:02:15,270 --> 00:02:11,840
i had a great job at georgia tech in

65
00:02:17,350 --> 00:02:15,280
fact i have a great job at georgia tech

66
00:02:19,830 --> 00:02:17,360
you know i left nasa in 2003 i went to

67
00:02:21,670 --> 00:02:19,840
georgia tech i've been on the faculty in

68
00:02:23,350 --> 00:02:21,680
aerospace engineering

69
00:02:24,550 --> 00:02:23,360
working with undergraduate and graduate

70
00:02:27,670 --> 00:02:24,560
students

71
00:02:29,910 --> 00:02:27,680
mostly on advanced technology projects

72
00:02:31,990 --> 00:02:29,920
for nasa sometimes for the dod but

73
00:02:35,030 --> 00:02:32,000
mostly for nasa

74
00:02:36,630 --> 00:02:35,040
and that job you know really

75
00:02:37,910 --> 00:02:36,640
gets my juices going it's just something

76
00:02:40,150 --> 00:02:37,920
i really like

77
00:02:43,509 --> 00:02:40,160
and i'm telling you that because i made

78
00:02:44,869 --> 00:02:43,519
the conscious choice to leave that life

79
00:02:46,869 --> 00:02:44,879
that i liked

80
00:02:47,910 --> 00:02:46,879
and come be the chief technologist at

81
00:02:50,790 --> 00:02:47,920
nasa

82
00:02:53,670 --> 00:02:50,800
in this time of change

83
00:02:54,550 --> 00:02:53,680
so you can imagine where i sit on this

84
00:02:57,190 --> 00:02:54,560
uh

85
00:02:58,949 --> 00:02:57,200
this debate right i'm obviously

86
00:03:00,149 --> 00:02:58,959
you know admitted up front i'm obviously

87
00:03:03,110 --> 00:03:00,159
in favor

88
00:03:05,350 --> 00:03:03,120

of the president's fy 11 budget request

89
00:03:07,110 --> 00:03:05,360
or i wouldn't allow georgia tech okay

90
00:03:09,430 --> 00:03:07,120
just just so you know where i stand and

91
00:03:11,910 --> 00:03:09,440
let me walk through that a little bit

92
00:03:13,589 --> 00:03:11,920
and explain to you why

93
00:03:15,910 --> 00:03:13,599
okay and by the way if you want to wait

94
00:03:18,229 --> 00:03:15,920
with questions at the end that's fine

95
00:03:20,390 --> 00:03:18,239
or if you want to ask as i go through

96
00:03:22,550 --> 00:03:20,400
this that's that's fine as well

97
00:03:23,990 --> 00:03:22,560
so this is a summary

98
00:03:25,030 --> 00:03:24,000
uh you guys probably all have this

99
00:03:26,949 --> 00:03:25,040
material

100
00:03:28,309 --> 00:03:26,959
i'm told that it gets posted you know as

101
00:03:31,509 --> 00:03:28,319
soon as i give a presentation it gets

102
00:03:33,350 --> 00:03:31,519
posted somewhere it seems like

103
00:03:36,390 --> 00:03:33,360
that's also a big change for me nobody

104
00:03:40,789 --> 00:03:38,550
uh i'm not sure they still care but they

105
00:03:42,789 --> 00:03:40,799
they definitely post it um so here's a

106
00:03:45,430 --> 00:03:42,799
summary from my perspective of the

107
00:03:46,869 --> 00:03:45,440
president's fy11 budget request a couple

108
00:03:48,149 --> 00:03:46,879
of key points

109
00:03:49,830 --> 00:03:48,159
and you've probably heard some of these

110
00:03:50,789 --> 00:03:49,840
points already but let me just say them

111
00:03:53,750 --> 00:03:50,799
again

112
00:03:56,229 --> 00:03:53,760
nasa got a top-line budget increase

113
00:03:57,910 --> 00:03:56,239

it's about 300 million dollars in fy11

114
00:04:00,630 --> 00:03:57,920
and over the five-year

115
00:04:03,350 --> 00:04:00,640
projected budget we're talking about

116
00:04:05,750 --> 00:04:03,360
six billion dollars of an increase

117
00:04:07,350 --> 00:04:05,760
and that's important to me for one

118
00:04:09,190 --> 00:04:07,360
reason

119
00:04:11,190 --> 00:04:09,200
this is a very challenging time for our

120
00:04:12,869 --> 00:04:11,200
country economically

121
00:04:15,030 --> 00:04:12,879
and as you know

122
00:04:17,349 --> 00:04:15,040
the discretionary part of

123
00:04:20,390 --> 00:04:17,359
the federal budget was capped

124
00:04:22,550 --> 00:04:20,400
by president obama it did not increase

125
00:04:25,110 --> 00:04:22,560
you know discretionary funding excluding

126
00:04:27,670 --> 00:04:25,120
defense did not increase okay that means

127
00:04:30,710 --> 00:04:27,680
that if nasa got an increase somebody

128
00:04:32,070 --> 00:04:30,720
else actually took a cut

129
00:04:34,710 --> 00:04:32,080
okay that's something that's you know a

130
00:04:36,310 --> 00:04:34,720
little difficult for people at nasa even

131
00:04:38,950 --> 00:04:36,320
myself included

132
00:04:40,469 --> 00:04:38,960
to realize if you look across the

133
00:04:43,270 --> 00:04:40,479
federal government and you look at who

134
00:04:45,270 --> 00:04:43,280
got increases you'll find that all of

135
00:04:47,670 --> 00:04:45,280
the federal agencies that were doing

136
00:04:49,430 --> 00:04:47,680
research and technology or that the

137
00:04:51,670 --> 00:04:49,440
president and the administration would

138
00:04:53,030 --> 00:04:51,680

like to be doing research in technology

139
00:04:54,790 --> 00:04:53,040
got increases

140
00:04:57,270 --> 00:04:54,800
and all the federal agencies that were

141
00:04:58,310 --> 00:04:57,280
not doing research and technology took

142
00:05:00,550 --> 00:04:58,320
cuts

143
00:05:03,670 --> 00:05:00,560
so to pay for the agencies that did get

144
00:05:05,110 --> 00:05:03,680
an increase okay that's a that's a theme

145
00:05:06,469 --> 00:05:05,120
in the federal budget that you need to

146
00:05:09,110 --> 00:05:06,479
be aware of

147
00:05:10,950 --> 00:05:09,120
uh so we got this top line increase that

148
00:05:13,590 --> 00:05:10,960
increase was distributed

149
00:05:16,550 --> 00:05:13,600
there was a relatively large in my view

150
00:05:18,390 --> 00:05:16,560
increase for science uh primarily for

151
00:05:20,150 --> 00:05:18,400
earth science two and a half billion

152
00:05:22,390 --> 00:05:20,160
over five years

153
00:05:24,310 --> 00:05:22,400
aeronautics got what i would call a

154
00:05:26,870 --> 00:05:24,320
modest increase it's actually pretty

155
00:05:29,830 --> 00:05:26,880
large um you know 15 percentage-wise at

156
00:05:32,150 --> 00:05:29,840
least it's 15 percent which is uh you

157
00:05:33,830 --> 00:05:32,160
know reduces the decline in aeronautics

158
00:05:34,950 --> 00:05:33,840
that had been ongoing for five or ten

159
00:05:36,870 --> 00:05:34,960
years

160
00:05:39,189 --> 00:05:36,880
uh dollar wise it's small because the

161
00:05:40,790 --> 00:05:39,199
aeronautics budget is small

162
00:05:42,310 --> 00:05:40,800
and perhaps the thing that you've heard

163
00:05:44,870 --> 00:05:42,320

about the most and the thing that's been

164
00:05:46,710 --> 00:05:44,880
debated the most is the shift in human

165
00:05:48,870 --> 00:05:46,720
exploration and i'm going to talk about

166
00:05:50,950 --> 00:05:48,880
that a lot more on the coming slides but

167
00:05:53,110 --> 00:05:50,960
there's a couple points there one the

168
00:05:56,230 --> 00:05:53,120
goal of our human exploration program

169
00:05:57,830 --> 00:05:56,240
has not changed the goal today is the

170
00:05:59,590 --> 00:05:57,840
same as the goal

171
00:06:02,629 --> 00:05:59,600
three months ago and the same as the

172
00:06:04,550 --> 00:06:02,639
goal a couple years ago the goal is to

173
00:06:05,590 --> 00:06:04,560
extend human presence beyond low earth

174
00:06:08,230 --> 00:06:05,600
orbit

175
00:06:11,189 --> 00:06:08,240
okay what has changed is the approach

176
00:06:12,790 --> 00:06:11,199
by which nasa is pursuing that goal

177
00:06:15,110 --> 00:06:12,800
and here are some of the characteristics

178
00:06:17,029 --> 00:06:15,120
just from a budget perspective about

179
00:06:18,870 --> 00:06:17,039
that changed approach there is an

180
00:06:20,710 --> 00:06:18,880
addition there are additional funds to

181
00:06:22,790 --> 00:06:20,720
complete what were five remaining

182
00:06:24,950 --> 00:06:22,800
shuttle flights what today

183
00:06:27,029 --> 00:06:24,960
there were down to three

184
00:06:28,550 --> 00:06:27,039
potentially four i guess remaining

185
00:06:30,950 --> 00:06:28,560
shuttle flights

186
00:06:32,830 --> 00:06:30,960
uh the inclusion of the iss the

187
00:06:35,510 --> 00:06:32,840
extension of the iss and the full

188
00:06:37,670 --> 00:06:35,520

utilization of the iss as a national

189
00:06:38,710 --> 00:06:37,680
laboratory through 2020

190
00:06:41,510 --> 00:06:38,720
bringing i

191
00:06:43,670 --> 00:06:41,520
putting iss as the central focus of our

192
00:06:45,670 --> 00:06:43,680
human spaceflight program this is a

193
00:06:49,189 --> 00:06:45,680
major shift as well one that's by the

194
00:06:52,230 --> 00:06:49,199
way very underreported in my view

195
00:06:53,830 --> 00:06:52,240
extending iss through at least 2020

196
00:06:55,350 --> 00:06:53,840
the commercial approach to low-earth

197
00:06:56,629 --> 00:06:55,360
orbit access we just heard a little bit

198
00:06:57,990 --> 00:06:56,639
about that

199
00:06:59,909 --> 00:06:58,000
there's six billion dollars in the

200
00:07:01,430 --> 00:06:59,919
budget over five years

201
00:07:04,309 --> 00:07:01,440
to foster

202
00:07:05,270 --> 00:07:04,319
commercial industry in providing leo

203
00:07:06,950 --> 00:07:05,280
access

204
00:07:08,950 --> 00:07:06,960
there's modernization of the kennedy

205
00:07:10,230 --> 00:07:08,960
space center launch complex which you

206
00:07:13,110 --> 00:07:10,240
all know

207
00:07:15,029 --> 00:07:13,120
like many of the facilities at nasa

208
00:07:16,550 --> 00:07:15,039
hasn't had significant upgrades in

209
00:07:20,309 --> 00:07:16,560
decades

210
00:07:22,870 --> 00:07:20,319
and is you know in some cases rather old

211
00:07:24,629 --> 00:07:22,880
um the flexible pass strategy to human

212
00:07:25,830 --> 00:07:24,639
exploration beyond low earth orbit i'm

213
00:07:27,510 --> 00:07:25,840

sure you've read about that in the

214
00:07:28,950 --> 00:07:27,520
augustine committee report it actually

215
00:07:30,550 --> 00:07:28,960
wasn't originally their idea it's been

216
00:07:31,990 --> 00:07:30,560
around for a while

217
00:07:34,550 --> 00:07:32,000
but the latest version of that is

218
00:07:36,230 --> 00:07:34,560
captured in augustine's report

219
00:07:38,629 --> 00:07:36,240
and of course the other thing that has

220
00:07:40,950 --> 00:07:38,639
been discussed over and over and over

221
00:07:42,790 --> 00:07:40,960
again in the press is the

222
00:07:45,270 --> 00:07:42,800
cancellation cancellation or

223
00:07:46,150 --> 00:07:45,280
restructuring of the constellation

224
00:07:50,070 --> 00:07:46,160
program

225
00:07:52,869 --> 00:07:50,080
uh to include an update in mid-april uh

226
00:07:55,510 --> 00:07:52,879
a modified orion development continuing

227
00:07:59,430 --> 00:07:55,520
uh as a crew return vehicle and as a

228
00:08:01,430 --> 00:07:59,440
technology testbed for future missions

229
00:08:02,710 --> 00:08:01,440
you heard a lot about this theme the

230
00:08:04,150 --> 00:08:02,720
shift in approach for the human

231
00:08:06,390 --> 00:08:04,160
exploration program

232
00:08:08,230 --> 00:08:06,400
what you may not have heard is enough as

233
00:08:10,950 --> 00:08:08,240
much about and what i want to focus on

234
00:08:13,510 --> 00:08:10,960
today is this significant focus on

235
00:08:15,029 --> 00:08:13,520
technology development sure it's there

236
00:08:16,550 --> 00:08:15,039
it's always in the newspaper articles

237
00:08:18,390 --> 00:08:16,560
it's down like in the third or fourth

238
00:08:21,189 --> 00:08:18,400

paragraph it's never you know it always

239
00:08:23,510 --> 00:08:21,199
says obama cancels moon program right

240
00:08:25,189 --> 00:08:23,520
and then down in on page four

241
00:08:28,070 --> 00:08:25,199
it says by the way there's a big focus

242
00:08:34,230 --> 00:08:31,510
it's this focus on technology that

243
00:08:38,310 --> 00:08:34,240
i was excited about personally and is

244
00:08:40,870 --> 00:08:38,320
why i came back to nasa to this position

245
00:08:43,110 --> 00:08:40,880
there's a strong focus on technology in

246
00:08:45,509 --> 00:08:43,120
our human exploration strategy and

247
00:08:47,750 --> 00:08:45,519
there's both technology pull programs

248
00:08:50,790 --> 00:08:47,760
that i'll define in just a moment and

249
00:08:54,470 --> 00:08:50,800
technology push programs uh that we are

250
00:08:57,350 --> 00:08:54,480
formulating to begin in fy 11. there's

251
00:09:00,070 --> 00:08:57,360
also a major increase in emphasis on

252
00:09:02,150 --> 00:09:00,080
partnerships the obama administration is

253
00:09:04,070 --> 00:09:02,160
all about partnerships they want us to

254
00:09:06,230 --> 00:09:04,080
partner across government agencies they

255
00:09:08,070 --> 00:09:06,240
want us to partner internationally they

256
00:09:10,949 --> 00:09:08,080
want us to partner with academia and

257
00:09:13,190 --> 00:09:10,959
industry and they are incentivizing all

258
00:09:15,350 --> 00:09:13,200
the government agencies to

259
00:09:16,389 --> 00:09:15,360
engage in these partnership activities

260
00:09:18,070 --> 00:09:16,399
in full

261
00:09:20,230 --> 00:09:18,080
right it's part of their strategy

262
00:09:22,790 --> 00:09:20,240
frankly because the discretionary budget

263
00:09:24,790 --> 00:09:22,800

is capped right and it may actually go

264
00:09:27,670 --> 00:09:24,800
down next year

265
00:09:29,110 --> 00:09:27,680
okay so we need to think about that

266
00:09:29,990 --> 00:09:29,120
uh where's that

267
00:09:32,150 --> 00:09:30,000
here it is

268
00:09:34,550 --> 00:09:32,160
so let me jump into human exploration

269
00:09:37,110 --> 00:09:34,560
because i imagine that's maybe the topic

270
00:09:39,190 --> 00:09:37,120
that most people are interested in

271
00:09:41,910 --> 00:09:39,200
there is a renewed emphasis

272
00:09:44,550 --> 00:09:41,920
on of technology

273
00:09:46,070 --> 00:09:44,560
in the president's fy 11 budget and in

274
00:09:47,990 --> 00:09:46,080
my view

275
00:09:49,269 --> 00:09:48,000
what the budget really represents at its

276
00:09:51,350 --> 00:09:49,279
highest level

277
00:09:54,230 --> 00:09:51,360
is a balancing

278
00:09:56,790 --> 00:09:54,240
among the three long-standing core

279
00:09:58,470 --> 00:09:56,800
competencies of nasa if you think back

280
00:10:01,430 --> 00:09:58,480
in time and you in your head you think

281
00:10:04,310 --> 00:10:01,440
about what is nasa what makes nasa

282
00:10:06,470 --> 00:10:04,320
unique why is nasa not the air force why

283
00:10:08,710 --> 00:10:06,480
is it not nsf

284
00:10:11,030 --> 00:10:08,720
why is it nasa there's some things that

285
00:10:13,750 --> 00:10:11,040
come to your mind at least to my mind

286
00:10:15,590 --> 00:10:13,760
what comes to my mind are a strong

287
00:10:16,790 --> 00:10:15,600
research and technology

288
00:10:19,350 --> 00:10:16,800

competency

289
00:10:21,350 --> 00:10:19,360
a strong flight hardware development

290
00:10:24,710 --> 00:10:21,360
competency and a strong mission

291
00:10:25,910 --> 00:10:24,720
operations competency in fact it's the

292
00:10:28,230 --> 00:10:25,920
synergy

293
00:10:30,630 --> 00:10:28,240
of all three of those core competencies

294
00:10:31,590 --> 00:10:30,640
that make nasa the unique agency that it

295
00:10:36,310 --> 00:10:31,600
is

296
00:10:38,790 --> 00:10:36,320
where those three things are together

297
00:10:41,030 --> 00:10:38,800
and it's because that nasa embodies

298
00:10:43,110 --> 00:10:41,040
those three core competencies and always

299
00:10:44,870 --> 00:10:43,120
has actually you can go all the way back

300
00:10:47,110 --> 00:10:44,880
to the space act and the formation of

301
00:10:49,430 --> 00:10:47,120
nasa and it calls out these three

302
00:10:51,670 --> 00:10:49,440
critical core competencies it's because

303
00:10:53,110 --> 00:10:51,680
nasa embodies all three of those

304
00:10:55,990 --> 00:10:53,120
competencies

305
00:10:56,870 --> 00:10:56,000
is why nasa is so inspiring to young

306
00:10:57,829 --> 00:10:56,880
people

307
00:10:59,910 --> 00:10:57,839
right

308
00:11:01,190 --> 00:10:59,920
if all we do is research in technology

309
00:11:02,790 --> 00:11:01,200
right so i'm the chief technologist and

310
00:11:04,550 --> 00:11:02,800
i'll tell you this if all we do is

311
00:11:06,069 --> 00:11:04,560
research in technology and we don't do

312
00:11:09,110 --> 00:11:06,079
flight hardware development we don't do

313
00:11:10,710 --> 00:11:09,120

mission operations then what's the point

314
00:11:12,069 --> 00:11:10,720
we're just nsf

315
00:11:13,350 --> 00:11:12,079
right we're just off playing in our

316
00:11:15,829 --> 00:11:13,360
sandbox

317
00:11:17,509 --> 00:11:15,839
developing little toys technology toys i

318
00:11:19,030 --> 00:11:17,519
don't want that

319
00:11:21,269 --> 00:11:19,040
on the other hand if we don't have any

320
00:11:23,829 --> 00:11:21,279
research and technology and we're just

321
00:11:24,790 --> 00:11:23,839
building flight hardware and and flying

322
00:11:27,110 --> 00:11:24,800
it

323
00:11:29,190 --> 00:11:27,120
then we can only take

324
00:11:30,150 --> 00:11:29,200
what i would call a rather incremental

325
00:11:32,230 --> 00:11:30,160
approach

326
00:11:35,509 --> 00:11:32,240
to that flight hardware development

327
00:11:38,150 --> 00:11:35,519
right so to me a healthy nasa a nasa on

328
00:11:39,430 --> 00:11:38,160
the cutting edge is strong in research

329
00:11:41,509 --> 00:11:39,440
and technology

330
00:11:43,190 --> 00:11:41,519
in space flight hardware development and

331
00:11:45,190 --> 00:11:43,200
in mission operations

332
00:11:47,269 --> 00:11:45,200
and what the president's fy 11 budget

333
00:11:49,350 --> 00:11:47,279
request really embodies

334
00:11:50,949 --> 00:11:49,360
is kind of a bringing up

335
00:11:53,190 --> 00:11:50,959
of the research and technology

336
00:11:54,629 --> 00:11:53,200
competency by the way not to an equal

337
00:11:56,230 --> 00:11:54,639
point there's still more dollars in

338
00:11:58,790 --> 00:11:56,240

flight hardware development and mission

339
00:12:00,470 --> 00:11:58,800
operations as there probably should be

340
00:12:02,150 --> 00:12:00,480
but bringing it up to the point where

341
00:12:04,150 --> 00:12:02,160
it's actually visible

342
00:12:06,949 --> 00:12:04,160
because over the past decade research

343
00:12:08,790 --> 00:12:06,959
and technology in nasa has been

344
00:12:11,030 --> 00:12:08,800
almost drummed out of business

345
00:12:13,269 --> 00:12:11,040
frankly and that's not my opinion by the

346
00:12:15,509 --> 00:12:13,279
way that's the opinion of a whole host

347
00:12:17,750 --> 00:12:15,519
of external panels that have looked at

348
00:12:19,990 --> 00:12:17,760
this over and over again including an

349
00:12:21,509 --> 00:12:20,000
nrc committee that reported back uh just

350
00:12:24,629 --> 00:12:21,519
a day or two ago

351
00:12:26,150 --> 00:12:24,639
about the abysmal state of the research

352
00:12:28,150 --> 00:12:26,160
of the laboratories

353
00:12:30,230 --> 00:12:28,160
and the r d and technology development

354
00:12:32,389 --> 00:12:30,240
programs within nasa that's their word

355
00:12:33,590 --> 00:12:32,399
by the way abysmal state it's not my

356
00:12:34,389 --> 00:12:33,600
work

357
00:12:36,870 --> 00:12:34,399
okay

358
00:12:38,710 --> 00:12:36,880
so that that top line there is important

359
00:12:40,629 --> 00:12:38,720
okay that's that's the way you need to

360
00:12:41,509 --> 00:12:40,639
think in my view that's that's the way i

361
00:12:43,110 --> 00:12:41,519
think

362
00:12:45,190 --> 00:12:43,120
about the budget

363
00:12:47,350 --> 00:12:45,200

now for human exploration what does this

364
00:12:49,910 --> 00:12:47,360
mean well it means

365
00:12:51,509 --> 00:12:49,920
a whole host of technology development

366
00:12:53,670 --> 00:12:51,519
and demonstrations and i'll show you

367
00:12:55,750 --> 00:12:53,680
some of those in just a minute

368
00:12:57,829 --> 00:12:55,760
designed to reduce the cost and prove

369
00:12:59,829 --> 00:12:57,839
the required capabilities for our future

370
00:13:01,350 --> 00:12:59,839
human exploration systems

371
00:13:03,350 --> 00:13:01,360
it means things like heavy lift

372
00:13:05,350 --> 00:13:03,360
propulsion technology

373
00:13:08,230 --> 00:13:05,360
it means things like in-space propulsion

374
00:13:09,990 --> 00:13:08,240
technology in this one program it means

375
00:13:11,509 --> 00:13:10,000
robotic precursors to some of the

376
00:13:13,430 --> 00:13:11,519
destinations where we want to send

377
00:13:16,870 --> 00:13:13,440
humans to you know if we want to really

378
00:13:19,030 --> 00:13:16,880
send humans to an asteroid in 2025

379
00:13:21,590 --> 00:13:19,040
i'd certainly like to it probably makes

380
00:13:23,590 --> 00:13:21,600
sense to visit that asteroid or several

381
00:13:26,629 --> 00:13:23,600
asteroids like the one we might want to

382
00:13:28,550 --> 00:13:26,639
visit robotically first right if we

383
00:13:30,629 --> 00:13:28,560
really want to send humans to mars there

384
00:13:32,069 --> 00:13:30,639
are a number of things we need to learn

385
00:13:33,829 --> 00:13:32,079
about mars

386
00:13:35,269 --> 00:13:33,839
from a safety perspective from a risk

387
00:13:37,430 --> 00:13:35,279
perspective

388
00:13:40,629 --> 00:13:37,440

before we send humans there

389
00:13:43,110 --> 00:13:40,639
uh the fourth on this list is a greatly

390
00:13:44,949 --> 00:13:43,120
increased program of human research

391
00:13:47,110 --> 00:13:44,959
human research program

392
00:13:49,350 --> 00:13:47,120
uh basically uh long term human

393
00:13:51,430 --> 00:13:49,360
adaptation to space utilizing the

394
00:13:53,829 --> 00:13:51,440
international space station uh to

395
00:13:56,069 --> 00:13:53,839
prepare for long journeys right going to

396
00:13:58,150 --> 00:13:56,079
a new earth asteroid is a lot different

397
00:13:59,990 --> 00:13:58,160
right than going to the moon

398
00:14:01,990 --> 00:14:00,000
it's going it's venturing into deep

399
00:14:03,509 --> 00:14:02,000
space to me there's something really

400
00:14:06,069 --> 00:14:03,519
exciting about that we're actually going

401
00:14:07,509 --> 00:14:06,079
to leave the earth sphere of influence

402
00:14:09,590 --> 00:14:07,519
right when we go to the moon we don't

403
00:14:11,590 --> 00:14:09,600
really do that

404
00:14:13,750 --> 00:14:11,600
but going into deep space for months at

405
00:14:15,430 --> 00:14:13,760
a time we will and there are

406
00:14:17,350 --> 00:14:15,440
things uh you know if we want to keep we

407
00:14:19,910 --> 00:14:17,360
need to keep the humans safe and there's

408
00:14:22,069 --> 00:14:19,920
radiation protection there's adaptation

409
00:14:23,590 --> 00:14:22,079
to the microgravity environment

410
00:14:26,389 --> 00:14:23,600
there's environmental control and life

411
00:14:28,150 --> 00:14:26,399
support systems

412
00:14:29,750 --> 00:14:28,160
that we need to greatly improve to do

413
00:14:31,910 --> 00:14:29,760

that

414
00:14:35,030 --> 00:14:31,920
a u.s commercial human spaceflight

415
00:14:36,629 --> 00:14:35,040
capability to get to low earth orbit

416
00:14:38,550 --> 00:14:36,639
now how are we going to make these

417
00:14:39,990 --> 00:14:38,560
technology investments and this is a key

418
00:14:41,590 --> 00:14:40,000
point

419
00:14:45,030 --> 00:14:41,600
the way we're going to go about that is

420
00:14:47,829 --> 00:14:45,040
by identifying the needed capabilities

421
00:14:49,110 --> 00:14:47,839
and then investing in multiple competing

422
00:14:51,590 --> 00:14:49,120
approaches

423
00:14:53,430 --> 00:14:51,600
multiple competing technologies to

424
00:14:57,110 --> 00:14:53,440
achieve that capability

425
00:14:59,189 --> 00:14:57,120
the challenge with this program is that

426
00:15:01,829 --> 00:14:59,199
in my view we're not actually wise

427
00:15:03,350 --> 00:15:01,839
enough today to know exactly what

428
00:15:05,829 --> 00:15:03,360
technology is the one that's going to

429
00:15:07,670 --> 00:15:05,839
allow us to send humans to mars or send

430
00:15:10,389 --> 00:15:07,680
humans to an asteroid

431
00:15:13,350 --> 00:15:10,399
right so we don't want to you know i i

432
00:15:15,829 --> 00:15:13,360
for one don't want to bank my entire

433
00:15:17,990 --> 00:15:15,839
human exploration program on some

434
00:15:20,230 --> 00:15:18,000
technology that's not yet proven

435
00:15:22,470 --> 00:15:20,240
so instead we know there's a certain

436
00:15:24,949 --> 00:15:22,480
capability that we need and we need to

437
00:15:27,829 --> 00:15:24,959
invest in multiple competing approaches

438
00:15:29,910 --> 00:15:27,839

to advance that capability and then make

439
00:15:32,150 --> 00:15:29,920
a down selection a little bit later in

440
00:15:34,150 --> 00:15:32,160
time and take that down selected

441
00:15:35,990 --> 00:15:34,160
technology and prove it in a flight

442
00:15:38,150 --> 00:15:36,000
relevant environment

443
00:15:40,870 --> 00:15:38,160
and i'll give you some examples of that

444
00:15:42,629 --> 00:15:40,880
uh in just a minute now the other thing

445
00:15:44,230 --> 00:15:42,639
that people ask me all the time is well

446
00:15:45,749 --> 00:15:44,240
we're going to spend two years figuring

447
00:15:48,230 --> 00:15:45,759
out what technologies or what

448
00:15:51,189 --> 00:15:48,240
capabilities we need to go after

449
00:15:53,189 --> 00:15:51,199
well thankfully we don't need to

450
00:15:55,269 --> 00:15:53,199
in my office today you can you can come

451
00:15:57,269 --> 00:15:55,279
to my office anytime and you can see i

452
00:15:59,430 --> 00:15:57,279
have a stack of reports

453
00:16:01,030 --> 00:15:59,440
and they go from the floor to almost my

454
00:16:02,790 --> 00:16:01,040
height i'm just barely taller than the

455
00:16:04,310 --> 00:16:02,800
stack i'm very proud of that i'm

456
00:16:05,910 --> 00:16:04,320
tolerant

457
00:16:06,790 --> 00:16:05,920
it's like the only thing that i'm taller

458
00:16:09,990 --> 00:16:06,800
than

459
00:16:11,590 --> 00:16:10,000
um and and this these reports are all by

460
00:16:13,829 --> 00:16:11,600
the way they're done by blue ribbon

461
00:16:16,629 --> 00:16:13,839
panels presidential panels they're done

462
00:16:18,389 --> 00:16:16,639
by nasa folks they're done by nrc

463
00:16:20,629 --> 00:16:18,399

they're done you know by all kinds of

464
00:16:22,269 --> 00:16:20,639
groups and here's a list of some of them

465
00:16:25,509 --> 00:16:22,279
going all the way back on the left to

466
00:16:27,269 --> 00:16:25,519
1969 the post apollo uh space group the

467
00:16:28,710 --> 00:16:27,279
space task group that was chartered to

468
00:16:30,470 --> 00:16:28,720
figure out what are we going to do after

469
00:16:32,310 --> 00:16:30,480
the apollo mission what kind of

470
00:16:34,829 --> 00:16:32,320
technologies do we need to invest in to

471
00:16:38,150 --> 00:16:34,839
enable future human exploration

472
00:16:40,230 --> 00:16:38,160
1969 jumping forward in time in 1986

473
00:16:42,150 --> 00:16:40,240
pioneering the space frontier which by

474
00:16:44,310 --> 00:16:42,160
the way if you haven't read it is

475
00:16:46,870 --> 00:16:44,320
perhaps the most well done report on

476
00:16:48,870 --> 00:16:46,880
this subject of all time it is by far

477
00:16:50,870 --> 00:16:48,880
and away my favorite report

478
00:16:53,430 --> 00:16:50,880
uh done you know the leader the chairman

479
00:16:55,590 --> 00:16:53,440
of that report was tom payne uh it's

480
00:16:57,430 --> 00:16:55,600
wonderfully uh presented

481
00:16:59,670 --> 00:16:57,440
uh and then you can jump forward you

482
00:17:02,310 --> 00:16:59,680
know we can jump over sally rides report

483
00:17:05,110 --> 00:17:02,320
in 87 some internal nasa reports

484
00:17:07,270 --> 00:17:05,120
including the 90 90-day study um that i

485
00:17:09,990 --> 00:17:07,280
was and actually phil sumrall were a

486
00:17:13,110 --> 00:17:10,000
part of back in 89

487
00:17:15,590 --> 00:17:13,120
the for augustine won in 1990 his first

488
00:17:18,069 --> 00:17:15,600

report going all the way to the latest

489
00:17:19,669 --> 00:17:18,079
augustine report on the hand side now

490
00:17:21,350 --> 00:17:19,679
you might not be able to read this slide

491
00:17:23,510 --> 00:17:21,360
all the way in the back

492
00:17:25,110 --> 00:17:23,520
but what i've listed here on the rows

493
00:17:27,189 --> 00:17:25,120
are some of the technologies that these

494
00:17:29,110 --> 00:17:27,199
reports have said we should invest in

495
00:17:31,270 --> 00:17:29,120
closed loop life support in space

496
00:17:33,430 --> 00:17:31,280
propulsion heavy lift launch vehicle

497
00:17:35,590 --> 00:17:33,440
enter descent and landing lightweight

498
00:17:38,150 --> 00:17:35,600
structures and materials

499
00:17:41,430 --> 00:17:38,160
advanced eva systems

500
00:17:42,950 --> 00:17:41,440
so on communications technology okay and

501
00:17:45,270 --> 00:17:42,960
you see the x's

502
00:17:46,870 --> 00:17:45,280
there's a remarkable consistency from

503
00:17:49,590 --> 00:17:46,880
report to report

504
00:17:51,110 --> 00:17:49,600
we know what capabilities we need

505
00:17:53,430 --> 00:17:51,120
we know

506
00:17:56,230 --> 00:17:53,440
it's been documented over and over again

507
00:17:58,870 --> 00:17:56,240
it's right here what we need is to

508
00:18:00,950 --> 00:17:58,880
synthesize this information and use it

509
00:18:02,549 --> 00:18:00,960
to develop plans forward right these are

510
00:18:04,950 --> 00:18:02,559
the capabilities

511
00:18:07,270 --> 00:18:04,960
what are the technological solutions

512
00:18:09,430 --> 00:18:07,280
that provide these capabilities so we

513
00:18:10,870 --> 00:18:09,440

can take these capabilities and we can

514
00:18:12,310 --> 00:18:10,880
you know if you wanted to do it purely

515
00:18:14,789 --> 00:18:12,320
in a competitive environment you could

516
00:18:17,190 --> 00:18:14,799
imagine like a call coming out for each

517
00:18:19,110 --> 00:18:17,200
one of these capabilities and different

518
00:18:21,909 --> 00:18:19,120
teams could could propose back different

519
00:18:23,270 --> 00:18:21,919
technological solutions or we could take

520
00:18:25,590 --> 00:18:23,280
one of these capabilities and we could

521
00:18:28,150 --> 00:18:25,600
say jsc you guys go lead a team to do

522
00:18:29,909 --> 00:18:28,160
this langley you go lead a team do that

523
00:18:31,830 --> 00:18:29,919
marshall you go lead a team to do that

524
00:18:33,909 --> 00:18:31,840
and we'll try three different approaches

525
00:18:35,190 --> 00:18:33,919
right we can do this either way and what

526
00:18:36,789 --> 00:18:35,200
we're planning to do actually is a

527
00:18:39,990 --> 00:18:36,799
combination of both there'll be both

528
00:18:41,270 --> 00:18:40,000
directed assignments and competed uh

529
00:18:43,510 --> 00:18:41,280
opportunities

530
00:18:46,310 --> 00:18:43,520
now why am i standing on my soapbox

531
00:18:47,909 --> 00:18:46,320
about technology okay it's not for the

532
00:18:50,630 --> 00:18:47,919
very next mission

533
00:18:52,630 --> 00:18:50,640
right it we don't need to invest in

534
00:18:54,470 --> 00:18:52,640
technology if all we want to do is go to

535
00:18:55,430 --> 00:18:54,480
the space station

536
00:18:57,590 --> 00:18:55,440
okay

537
00:19:00,310 --> 00:18:57,600
or if all we want to do is stay in the

538
00:19:02,150 --> 00:19:00,320

general vicinity of the earth but as we

539
00:19:04,950 --> 00:19:02,160
start considering destinations like

540
00:19:07,110 --> 00:19:04,960
sending humans to an asteroid or in my

541
00:19:09,750 --> 00:19:07,120
view the grand challenge of them all

542
00:19:11,750 --> 00:19:09,760
sending humans to the surface of mars

543
00:19:13,750 --> 00:19:11,760
technology development becomes very

544
00:19:16,710 --> 00:19:13,760
important and this slide from johnson

545
00:19:18,870 --> 00:19:16,720
space center illustrates why

546
00:19:21,190 --> 00:19:18,880
what we have here on the y-axis is the

547
00:19:23,430 --> 00:19:21,200
amount of mass required at the beginning

548
00:19:27,029 --> 00:19:23,440
of the mission not on the ground but in

549
00:19:29,909 --> 00:19:27,039
low earth orbit okay so to start one

550
00:19:31,830 --> 00:19:29,919
human round trip human mars mission i

551
00:19:33,510 --> 00:19:31,840
need that amount of mass in low earth

552
00:19:35,590 --> 00:19:33,520
orbit i have to somehow lift it all up

553
00:19:37,430 --> 00:19:35,600
to low earth orbit the reason this slide

554
00:19:39,510 --> 00:19:37,440
i think is interesting is it's plotted

555
00:19:41,110 --> 00:19:39,520
in units of international space station

556
00:19:41,909 --> 00:19:41,120
maps

557
00:19:43,990 --> 00:19:41,919
okay

558
00:19:46,150 --> 00:19:44,000
so with current technology all the way

559
00:19:50,710 --> 00:19:46,160
on the left hand

560
00:19:52,789 --> 00:19:50,720
i need something like 12

561
00:19:55,029 --> 00:19:52,799
international space stations assembled

562
00:19:56,390 --> 00:19:55,039
in low earth orbit for one round-trip

563
00:19:57,430 --> 00:19:56,400

mars mission

564
00:19:59,270 --> 00:19:57,440
okay

565
00:20:01,110 --> 00:19:59,280
i mean at that point should we even be

566
00:20:03,990 --> 00:20:01,120
having this dialogue

567
00:20:05,510 --> 00:20:04,000
i mean if i take this to congress i know

568
00:20:07,669 --> 00:20:05,520
i'll be thrown out of the room

569
00:20:09,590 --> 00:20:07,679
right and rightfully so

570
00:20:11,909 --> 00:20:09,600
okay but with an investment in

571
00:20:14,149 --> 00:20:11,919
technology i can bring the number of

572
00:20:16,470 --> 00:20:14,159
international space station masses

573
00:20:17,909 --> 00:20:16,480
down to something that approaches let's

574
00:20:19,990 --> 00:20:17,919
say two

575
00:20:23,510 --> 00:20:20,000
now two is still a grand challenge right

576
00:20:25,350 --> 00:20:23,520
it took us almost a decade to get to one

577
00:20:27,190 --> 00:20:25,360
on this axis

578
00:20:28,789 --> 00:20:27,200
uh but you have to also realize that

579
00:20:30,310 --> 00:20:28,799
about eighty percent of this mass is

580
00:20:31,350 --> 00:20:30,320
propellant

581
00:20:33,029 --> 00:20:31,360
okay

582
00:20:35,110 --> 00:20:33,039
and if we're fostering a commercial

583
00:20:37,510 --> 00:20:35,120
industry and if we're talking about

584
00:20:38,950 --> 00:20:37,520
propellant depots and in space resource

585
00:20:40,789 --> 00:20:38,960
utilization

586
00:20:43,190 --> 00:20:40,799
well then the fact that 80 percent of

587
00:20:45,430 --> 00:20:43,200
that mass is propellant really helps me

588
00:20:47,510 --> 00:20:45,440

and even if that doesn't come through

589
00:20:49,029 --> 00:20:47,520
if i get the the amount of mass required

590
00:20:50,230 --> 00:20:49,039
in low earth orbit down to something

591
00:20:52,710 --> 00:20:50,240
like two

592
00:20:54,630 --> 00:20:52,720
we can at least have a discussion about

593
00:20:56,630 --> 00:20:54,640
the possibility of one day sending

594
00:20:59,830 --> 00:20:56,640
humans to the service of mars

595
00:21:02,310 --> 00:20:59,840
as long as it's over 10 in my view an

596
00:21:04,630 --> 00:21:02,320
order of magnitude off

597
00:21:05,669 --> 00:21:04,640
it's out of our reach it's beyond our

598
00:21:07,830 --> 00:21:05,679
grasp

599
00:21:09,990 --> 00:21:07,840
okay and this to me

600
00:21:11,029 --> 00:21:10,000
graphically is the power of technology

601
00:21:12,549 --> 00:21:11,039
development

602
00:21:13,830 --> 00:21:12,559
the possibility

603
00:21:16,070 --> 00:21:13,840
now

604
00:21:18,710 --> 00:21:16,080
president obama when he spoke in florida

605
00:21:21,590 --> 00:21:18,720
on april 15th he laid out a set of

606
00:21:23,750 --> 00:21:21,600
destinations and a set of dates

607
00:21:25,590 --> 00:21:23,760
he talked about early crude missions of

608
00:21:27,830 --> 00:21:25,600
our new exploration system in the first

609
00:21:29,909 --> 00:21:27,840
part of the next decade he talked about

610
00:21:31,430 --> 00:21:29,919
humans going to a near-earth asteroid in

611
00:21:34,230 --> 00:21:31,440
2025

612
00:21:36,149 --> 00:21:34,240
orbiting mars in 2035 and returning

613
00:21:38,789 --> 00:21:36,159

safely

614
00:21:41,430 --> 00:21:38,799
which i certainly would hope for

615
00:21:43,590 --> 00:21:41,440
and then he threw in which i greatly

616
00:21:45,990 --> 00:21:43,600
appreciate he threw in landing on the

617
00:21:47,830 --> 00:21:46,000
service at mars of mars at some point in

618
00:21:50,149 --> 00:21:47,840
the future but he didn't give a date he

619
00:21:51,510 --> 00:21:50,159
did say in his lifetime that's important

620
00:21:52,789 --> 00:21:51,520
to me because he and i are about the

621
00:21:55,750 --> 00:21:52,799
same age

622
00:21:57,669 --> 00:21:55,760
and i would very much like to see that

623
00:22:00,070 --> 00:21:57,679
so at a high level

624
00:22:02,950 --> 00:22:00,080
this is where we are in my view in the

625
00:22:05,510 --> 00:22:02,960
human space flight program

626
00:22:08,470 --> 00:22:05,520
in this decade what we're talking about

627
00:22:10,870 --> 00:22:08,480
is involving the commercial sector both

628
00:22:13,430 --> 00:22:10,880
in launch and in other ways

629
00:22:15,029 --> 00:22:13,440
we're talking about robotic precursors

630
00:22:16,630 --> 00:22:15,039
and we're talk we're talking about

631
00:22:18,470 --> 00:22:16,640
utilizing the international space

632
00:22:21,510 --> 00:22:18,480
station as the core

633
00:22:23,830 --> 00:22:21,520
of our human space flight program flying

634
00:22:26,789 --> 00:22:23,840
it out if you will through its full life

635
00:22:29,270 --> 00:22:26,799
of 2020 and potentially beyond and we're

636
00:22:30,390 --> 00:22:29,280
talking about technology development to

637
00:22:32,470 --> 00:22:30,400
enable

638
00:22:34,470 --> 00:22:32,480

the systems development for the next

639
00:22:35,190 --> 00:22:34,480
human space flight system

640
00:22:39,029 --> 00:22:35,200
in

641
00:22:40,630 --> 00:22:39,039
frame

642
00:22:44,470 --> 00:22:40,640
so that we can get

643
00:22:47,029 --> 00:22:44,480
to a near-earth asteroid by 2025.

644
00:22:48,630 --> 00:22:47,039
so in 2015 or so we're talking about the

645
00:22:51,110 --> 00:22:48,640
design and development of heavy lift

646
00:22:53,270 --> 00:22:51,120
systems and in-space capabilities that

647
00:22:55,430 --> 00:22:53,280
would allow us to achieve that mission

648
00:22:57,590 --> 00:22:55,440
with the operations for those missions

649
00:22:59,750 --> 00:22:57,600
in the first part of the next decade

650
00:23:03,590 --> 00:22:59,760
first in the earth vicinity and then

651
00:23:04,789 --> 00:23:03,600
eventually uh to a near earth asteroid

652
00:23:07,110 --> 00:23:04,799
now

653
00:23:09,750 --> 00:23:07,120
a lot has been said about our technology

654
00:23:11,350 --> 00:23:09,760
development program in the press right

655
00:23:13,669 --> 00:23:11,360
how do we know what technologies to

656
00:23:15,590 --> 00:23:13,679
invest in we don't have any goals

657
00:23:17,110 --> 00:23:15,600
well that's not true

658
00:23:19,590 --> 00:23:17,120
i mean it might make a good sound bite

659
00:23:21,830 --> 00:23:19,600
on the news but it's frankly not true we

660
00:23:25,270 --> 00:23:21,840
have goals the president clearly

661
00:23:27,510 --> 00:23:25,280
enunciated those goals on april 15th

662
00:23:29,990 --> 00:23:27,520
and what we also have at nasa is a great

663
00:23:31,909 --> 00:23:30,000

team of people working right now through

664
00:23:33,909 --> 00:23:31,919
an activity called heft the human

665
00:23:35,830 --> 00:23:33,919
exploration frameworks team

666
00:23:37,510 --> 00:23:35,840
that's synthesizing all of the

667
00:23:40,149 --> 00:23:37,520
formulation work that's been done to

668
00:23:42,070 --> 00:23:40,159
date and putting in place an integrated

669
00:23:44,549 --> 00:23:42,080
plan those of you that know about the

670
00:23:46,070 --> 00:23:44,559
exploration systems architecture study

671
00:23:47,750 --> 00:23:46,080
the heft is doing

672
00:23:50,390 --> 00:23:47,760
what i would call something equivalent

673
00:23:51,590 --> 00:23:50,400
to that but for the flexible path

674
00:23:53,190 --> 00:23:51,600
approach

675
00:23:55,190 --> 00:23:53,200
and that is kind of illustrated on this

676
00:23:56,310 --> 00:23:55,200
slide right if we have a set of goals

677
00:23:58,789 --> 00:23:56,320
like we do

678
00:24:00,070 --> 00:23:58,799
an asteroid mission in 2025 going to

679
00:24:04,549 --> 00:24:00,080
mars

680
00:24:06,149 --> 00:24:04,559
surface after that from those goals we

681
00:24:07,590 --> 00:24:06,159
can develop mission architectures from

682
00:24:09,909 --> 00:24:07,600
those mission architectures we can

683
00:24:11,750 --> 00:24:09,919
develop flight system concepts from

684
00:24:13,990 --> 00:24:11,760
those flight system concepts we can

685
00:24:15,750 --> 00:24:14,000
develop the technologies required to

686
00:24:17,909 --> 00:24:15,760
enable those spacecraft to enable those

687
00:24:18,710 --> 00:24:17,919
missions to enable those goals it's a

688
00:24:21,269 --> 00:24:18,720

nice

689
00:24:23,590 --> 00:24:21,279
requirements flow down kind of approach

690
00:24:25,350 --> 00:24:23,600
and this is the approach that esmd the

691
00:24:26,470 --> 00:24:25,360
exploration systems mission directorate

692
00:24:28,390 --> 00:24:26,480
is using

693
00:24:29,830 --> 00:24:28,400
through the heft team this is not the

694
00:24:32,070 --> 00:24:29,840
only way we're doing technology

695
00:24:34,070 --> 00:24:32,080
development but it is a big part of the

696
00:24:35,990 --> 00:24:34,080
plan right and it's

697
00:24:39,269 --> 00:24:36,000
organized in a very what you would call

698
00:24:41,029 --> 00:24:39,279
a systems engineering uh way

699
00:24:42,070 --> 00:24:41,039
this is what the team has come up with

700
00:24:43,669 --> 00:24:42,080
to date

701
00:24:45,669 --> 00:24:43,679
okay and i know that it's maybe harder

702
00:24:46,549 --> 00:24:45,679
to view in the back of the uh the room

703
00:24:48,470 --> 00:24:46,559
here

704
00:24:50,870 --> 00:24:48,480
but without going through each

705
00:24:53,430 --> 00:24:50,880
individual line i want you to notice a

706
00:24:55,269 --> 00:24:53,440
couple things one there are a lot of

707
00:24:57,430 --> 00:24:55,279
missions

708
00:24:59,830 --> 00:24:57,440
there are actually a lot of things

709
00:25:02,789 --> 00:24:59,840
in terms of sheer number there are a

710
00:25:05,269 --> 00:25:02,799
large number of technology development

711
00:25:07,510 --> 00:25:05,279
items that are going to go into space

712
00:25:09,510 --> 00:25:07,520
there are a large number of launches as

713
00:25:11,590 --> 00:25:09,520

a result and there are a large number of

714
00:25:14,950 --> 00:25:11,600
mission operations

715
00:25:16,710 --> 00:25:14,960
opportunities as a result there are also

716
00:25:19,110 --> 00:25:16,720
a large number of hardware development

717
00:25:20,310 --> 00:25:19,120
opportunities to get these technologies

718
00:25:22,870 --> 00:25:20,320
ready

719
00:25:24,310 --> 00:25:22,880
and to develop them and fly them right

720
00:25:26,390 --> 00:25:24,320
whether we're talking about the human

721
00:25:29,350 --> 00:25:26,400
research program or the heavy lift

722
00:25:30,470 --> 00:25:29,360
program which has both a launch and an

723
00:25:31,750 --> 00:25:30,480
in-space

724
00:25:33,990 --> 00:25:31,760
component

725
00:25:36,310 --> 00:25:34,000
there are development opportunities this

726
00:25:38,630 --> 00:25:36,320
is not a technology program that is all

727
00:25:43,830 --> 00:25:41,029
you know playing in our academic labs

728
00:25:46,789 --> 00:25:43,840
this is a technology program that spans

729
00:25:49,909 --> 00:25:46,799
concepts ground and laboratory testing

730
00:25:53,909 --> 00:25:49,919
flight testing and testing in space

731
00:25:58,390 --> 00:25:56,390
now one last uh

732
00:25:59,830 --> 00:25:58,400
one last point on some of these missions

733
00:26:01,590 --> 00:25:59,840
there's also been a lot of talk about

734
00:26:03,430 --> 00:26:01,600
the need for these robotic precursor

735
00:26:05,590 --> 00:26:03,440
missions you know why do we need these

736
00:26:07,510 --> 00:26:05,600
robotic precursor missions we didn't you

737
00:26:09,669 --> 00:26:07,520
know really have that many robotic

738
00:26:11,909 --> 00:26:09,679

precursors before we sent the astronauts

739
00:26:13,190 --> 00:26:11,919
to the moon which by the way isn't true

740
00:26:18,549 --> 00:26:13,200
we did

741
00:26:23,990 --> 00:26:21,110
sure ranger would be another one yeah

742
00:26:26,230 --> 00:26:24,000
yeah so uh but here's here's my answer

743
00:26:28,310 --> 00:26:26,240
to that this is a very recent result uh

744
00:26:30,310 --> 00:26:28,320
this is not a robotic precursor mission

745
00:26:31,830 --> 00:26:30,320
by the way uh this is from the mars

746
00:26:33,430 --> 00:26:31,840
reconnaissance orbiter which is a

747
00:26:36,470 --> 00:26:33,440
science mission which has been circling

748
00:26:38,470 --> 00:26:36,480
mars for quite some time and what it uh

749
00:26:40,470 --> 00:26:38,480
mro has been there long enough

750
00:26:41,430 --> 00:26:40,480
that it has actually overflown the same

751
00:26:43,590 --> 00:26:41,440
region

752
00:26:45,909 --> 00:26:43,600
you know over a time period and it'll

753
00:26:47,669 --> 00:26:45,919
fly over this region and take an image

754
00:26:49,430 --> 00:26:47,679
and then fly over it say a few months

755
00:26:51,029 --> 00:26:49,440
later and take the same image at the

756
00:26:53,029 --> 00:26:51,039
same time of day

757
00:26:55,029 --> 00:26:53,039
and they'll see a drastic difference

758
00:26:57,190 --> 00:26:55,039
right look at the top two pictures and

759
00:27:00,230 --> 00:26:57,200
the amount of white that's present there

760
00:27:02,310 --> 00:27:00,240
and look at the bottom two pictures

761
00:27:06,310 --> 00:27:02,320
and the amount of white there

762
00:27:09,269 --> 00:27:06,320
what mro has uncovered is a very large

763
00:27:11,669 --> 00:27:09,279

amount of ice water ice

764
00:27:14,630 --> 00:27:11,679
very close to the surface and by the way

765
00:27:16,310 --> 00:27:14,640
at mid-latitudes not near the poles at

766
00:27:19,510 --> 00:27:16,320
mid-latitudes this is roughly the

767
00:27:20,470 --> 00:27:19,520
latitude of uh boston let's say

768
00:27:22,630 --> 00:27:20,480
okay

769
00:27:25,110 --> 00:27:22,640
uh the ice layer is about

770
00:27:27,350 --> 00:27:25,120
a half to one meter below the surface

771
00:27:28,549 --> 00:27:27,360
this was totally unknown

772
00:27:31,190 --> 00:27:28,559
a year ago

773
00:27:33,669 --> 00:27:31,200
actually totally unknown six months ago

774
00:27:35,990 --> 00:27:33,679
right six months ago

775
00:27:37,830 --> 00:27:36,000
we were all talking about methane we

776
00:27:39,110 --> 00:27:37,840
need a methane in space engine why do we

777
00:27:40,230 --> 00:27:39,120
need a methane in space engine because

778
00:27:42,389 --> 00:27:40,240
we're going to go to mars and we can

779
00:27:44,389 --> 00:27:42,399
make methane you know out of the mars

780
00:27:45,510 --> 00:27:44,399
atmosphere and therefore we need that

781
00:27:47,430 --> 00:27:45,520
engine

782
00:27:49,269 --> 00:27:47,440
look at this water

783
00:27:50,789 --> 00:27:49,279
all of a sudden locks hydrogen's back in

784
00:27:53,110 --> 00:27:50,799
the picture

785
00:27:54,470 --> 00:27:53,120
seriously with its higher performance

786
00:27:56,389 --> 00:27:54,480
harder to store

787
00:27:57,990 --> 00:27:56,399
but higher performance

788
00:27:59,350 --> 00:27:58,000

this is the kind of thing and i'm not

789
00:28:00,789 --> 00:27:59,360
saying that you know we need to throw

790
00:28:02,389 --> 00:28:00,799
away all the methane plants that's not

791
00:28:04,310 --> 00:28:02,399
what i'm saying at all and go locks

792
00:28:07,269 --> 00:28:04,320
hydrogen i'm saying these are the kinds

793
00:28:09,029 --> 00:28:07,279
of discoveries that greatly affect the

794
00:28:11,510 --> 00:28:09,039
architecture that we will use to do

795
00:28:14,710 --> 00:28:11,520
human exploration and this is why we

796
00:28:15,750 --> 00:28:14,720
need robotic precursor missions

797
00:28:17,830 --> 00:28:15,760
so

798
00:28:20,310 --> 00:28:17,840
to summarize the human exploration

799
00:28:22,389 --> 00:28:20,320
program uh in the as contained in the

800
00:28:23,909 --> 00:28:22,399
president's fy 11 budget

801
00:28:26,549 --> 00:28:23,919
uh a couple points

802
00:28:28,389 --> 00:28:26,559
the goal of the program has not changed

803
00:28:30,630 --> 00:28:28,399
the goal of the program is to extend

804
00:28:33,190 --> 00:28:30,640
human presence beyond low earth orbit

805
00:28:35,510 --> 00:28:33,200
what has changed is the approach to

806
00:28:37,590 --> 00:28:35,520
accomplishing that goal the president's

807
00:28:40,710 --> 00:28:37,600
approach focuses on developing the

808
00:28:43,029 --> 00:28:40,720
technological capabilities required for

809
00:28:45,269 --> 00:28:43,039
humans to reach multiple destinations

810
00:28:49,269 --> 00:28:45,279
not just the moon but the moon and

811
00:28:51,190 --> 00:28:49,279
near-earth asteroids and eventually mars

812
00:28:52,710 --> 00:28:51,200
the investments that we hope to that we

813
00:28:54,950 --> 00:28:52,720

plan to make

814
00:28:57,590 --> 00:28:54,960
are focused on gaining the knowledge

815
00:28:59,909 --> 00:28:57,600
needed to inform our future

816
00:29:01,669 --> 00:28:59,919
architectural decisions and building the

817
00:29:04,230 --> 00:29:01,679
capabilities the technological

818
00:29:06,630 --> 00:29:04,240
capabilities required for humans to

819
00:29:09,750 --> 00:29:06,640
venture not just beyond low earth orbit

820
00:29:11,269 --> 00:29:09,760
but into deep space itself to leave the

821
00:29:13,350 --> 00:29:11,279
earth

822
00:29:15,750 --> 00:29:13,360
right that's something we all

823
00:29:18,470 --> 00:29:15,760
i believe we all want

824
00:29:20,630 --> 00:29:18,480
uh and in my view this approach will

825
00:29:23,110 --> 00:29:20,640
expand the alternatives that are

826
00:29:25,830 --> 00:29:23,120
possible through for human exploration

827
00:29:27,590 --> 00:29:25,840
through timely strategic and significant

828
00:29:29,029 --> 00:29:27,600
technology investment

829
00:29:31,029 --> 00:29:29,039
now i talked to you about what we're

830
00:29:33,590 --> 00:29:31,039
doing in the human exploration program

831
00:29:35,990 --> 00:29:33,600
before i end let me tell you what we're

832
00:29:38,389 --> 00:29:36,000
doing in the other parts of the

833
00:29:40,470 --> 00:29:38,399
technology development programs

834
00:29:42,230 --> 00:29:40,480
by the way i mentioned to you already i

835
00:29:44,710 --> 00:29:42,240
know you can't read this

836
00:29:46,870 --> 00:29:44,720
you just have to trust me on this one

837
00:29:48,389 --> 00:29:46,880
um i i mentioned to you already that

838
00:29:50,950 --> 00:29:48,399

there were a whole bunch of external

839
00:29:52,870 --> 00:29:50,960
inputs that were made about the need to

840
00:29:55,750 --> 00:29:52,880
improve the research and technology

841
00:29:56,789 --> 00:29:55,760
competency at nasa this is a list of

842
00:29:59,190 --> 00:29:56,799
them

843
00:30:01,710 --> 00:29:59,200
there are let's see one two three four

844
00:30:03,350 --> 00:30:01,720
nrc reports from

845
00:30:05,830 --> 00:30:03,360
2008-2010

846
00:30:08,630 --> 00:30:05,840
there's an authorization act by congress

847
00:30:10,870 --> 00:30:08,640
in 2008 and then there's the augustine

848
00:30:12,310 --> 00:30:10,880
committee report they all say the same

849
00:30:14,230 --> 00:30:12,320
thing

850
00:30:15,830 --> 00:30:14,240
they all say that nasa has

851
00:30:18,230 --> 00:30:15,840
under-invested in research and

852
00:30:19,990 --> 00:30:18,240
technology by the way not just in the

853
00:30:21,430 --> 00:30:20,000
bush administration this is not about

854
00:30:23,350 --> 00:30:21,440
the bush administration versus the

855
00:30:25,669 --> 00:30:23,360
clinton versus the

856
00:30:27,510 --> 00:30:25,679
obama administration

857
00:30:29,190 --> 00:30:27,520
that's not what this is we've we've

858
00:30:32,070 --> 00:30:29,200
under-invested in research and

859
00:30:33,750 --> 00:30:32,080
technology for over a decade democrat

860
00:30:35,669 --> 00:30:33,760
and and republican

861
00:30:37,909 --> 00:30:35,679
administrations alike

862
00:30:39,510 --> 00:30:37,919
and that's what these reports cite

863
00:30:42,870 --> 00:30:39,520

you're welcome to read into the details

864
00:30:45,110 --> 00:30:42,880
in these reports but they all talk about

865
00:30:47,350 --> 00:30:45,120
new ways that nasa should increase its

866
00:30:49,590 --> 00:30:47,360
technology focus they talk about

867
00:30:52,389 --> 00:30:49,600
spending something like 10 percent of

868
00:30:55,029 --> 00:30:52,399
nasa's budget on non-mission-focused

869
00:30:56,470 --> 00:30:55,039
technology

870
00:30:58,230 --> 00:30:56,480
and there are and there are a number of

871
00:30:59,509 --> 00:30:58,240
reasons given for that

872
00:31:01,430 --> 00:30:59,519
so

873
00:31:03,669 --> 00:31:01,440
i'm the nasa chief technologist and one

874
00:31:04,630 --> 00:31:03,679
of my responsibilities is to plan out

875
00:31:06,870 --> 00:31:04,640
all

876
00:31:08,310 --> 00:31:06,880
of the nasa technology programs those

877
00:31:10,710 --> 00:31:08,320
within the mission

878
00:31:12,710 --> 00:31:10,720
directorates and the new technology

879
00:31:15,190 --> 00:31:12,720
program called the space technology

880
00:31:17,430 --> 00:31:15,200
program that's a brilliant name

881
00:31:19,430 --> 00:31:17,440
i didn't come up with it

882
00:31:22,230 --> 00:31:19,440
within my office the office of the chief

883
00:31:24,310 --> 00:31:22,240
technologist and here is a view

884
00:31:25,350 --> 00:31:24,320
of all of those technology programs

885
00:31:26,950 --> 00:31:25,360
together

886
00:31:29,509 --> 00:31:26,960
what i have at the top

887
00:31:32,710 --> 00:31:29,519
is the space technology program and what

888
00:31:33,990 --> 00:31:32,720

i have uh on the bottom here

889
00:31:35,909 --> 00:31:34,000
is just

890
00:31:38,230 --> 00:31:35,919
exploration systems mission directorate

891
00:31:40,070 --> 00:31:38,240
as one example of a mission director you

892
00:31:41,990 --> 00:31:40,080
should realize that there's technology

893
00:31:44,630 --> 00:31:42,000
investments being made in science

894
00:31:47,430 --> 00:31:44,640
certainly an aero and an somd

895
00:31:49,350 --> 00:31:47,440
as well uh but for esmd these are the

896
00:31:51,430 --> 00:31:49,360
programs that they're formulating and

897
00:31:54,389 --> 00:31:51,440
across the bottom here i have technology

898
00:31:56,789 --> 00:31:54,399
readiness level right so trl of one your

899
00:31:58,710 --> 00:31:56,799
concept studies your system studies are

900
00:32:02,070 --> 00:31:58,720
all the way over here on the left

901
00:32:03,830 --> 00:32:02,080
and flight missions operational missions

902
00:32:07,430 --> 00:32:03,840
are over here on the right right our

903
00:32:10,470 --> 00:32:07,440
operational portfolio of missions

904
00:32:13,430 --> 00:32:10,480
uh within space technology there will be

905
00:32:15,909 --> 00:32:13,440
uh low trl programs we're gonna we're

906
00:32:18,310 --> 00:32:15,919
going to look broad and wide for the

907
00:32:19,830 --> 00:32:18,320
best ideas wherever those ideas may be

908
00:32:21,430 --> 00:32:19,840
we're going to look internal nasa we're

909
00:32:23,269 --> 00:32:21,440
going to look at academia we're going to

910
00:32:25,190 --> 00:32:23,279
look internationally we're going to look

911
00:32:27,430 --> 00:32:25,200
at at industry

912
00:32:30,470 --> 00:32:27,440
you may remember the nasa institute for

913
00:32:32,789 --> 00:32:30,480

advanced concepts anybody remember that

914
00:32:33,750 --> 00:32:32,799
okay it was around for a large number of

915
00:32:36,230 --> 00:32:33,760
years

916
00:32:38,549 --> 00:32:36,240
its budget was cut

917
00:32:40,070 --> 00:32:38,559
a few years ago partially to make room

918
00:32:42,630 --> 00:32:40,080
for constellation

919
00:32:45,350 --> 00:32:42,640
uh it was by the way it wasn't a in my

920
00:32:46,630 --> 00:32:45,360
view it wasn't purposely cut it was just

921
00:32:48,630 --> 00:32:46,640
out with the suite you know there was a

922
00:32:51,190 --> 00:32:48,640
sweeping done of all the technology

923
00:32:53,430 --> 00:32:51,200
programs at nasa at that time and the

924
00:32:55,110 --> 00:32:53,440
niacc was eliminated along with a number

925
00:32:56,470 --> 00:32:55,120
of other things uh we're going to

926
00:32:57,909 --> 00:32:56,480
reinstate the niacc we're going to

927
00:33:00,950 --> 00:32:57,919
reinstate the nasa institute for

928
00:33:03,269 --> 00:33:00,960
advanced concepts that's one example of

929
00:33:04,310 --> 00:33:03,279
the kind of concept development program

930
00:33:07,269 --> 00:33:04,320
that we're going to have it's not the

931
00:33:09,750 --> 00:33:07,279
only one but it's just one example

932
00:33:12,470 --> 00:33:09,760
over here in the middle of the page

933
00:33:15,430 --> 00:33:12,480
we have what i call your mid

934
00:33:17,669 --> 00:33:15,440
trl kind of things your trl three four

935
00:33:19,190 --> 00:33:17,679
five kind of programs this is where all

936
00:33:22,710 --> 00:33:19,200
your ground-based testing your

937
00:33:24,310 --> 00:33:22,720
laboratory programs are going to be

938
00:33:26,470 --> 00:33:24,320

you know i've done a lot of concept

939
00:33:29,590 --> 00:33:26,480
studies in my life and i'll tell you on

940
00:33:31,509 --> 00:33:29,600
paper they all look beautiful

941
00:33:33,990 --> 00:33:31,519
and every time i get involved in a

942
00:33:36,549 --> 00:33:34,000
concept study there's only like this

943
00:33:38,789 --> 00:33:36,559
this one little piece of physics right

944
00:33:40,789 --> 00:33:38,799
that's holding it back if only i could

945
00:33:42,470 --> 00:33:40,799
prove this little piece of physics work

946
00:33:44,389 --> 00:33:42,480
then the whole system

947
00:33:46,470 --> 00:33:44,399
would look great just like i've shown on

948
00:33:48,310 --> 00:33:46,480
this in this system study well we're

949
00:33:50,950 --> 00:33:48,320
going to go after those little pieces of

950
00:33:53,269 --> 00:33:50,960
physics in these programs both within

951
00:33:55,269 --> 00:33:53,279
the mission directorates and within my

952
00:33:56,470 --> 00:33:55,279
office the office of the chief

953
00:33:57,990 --> 00:33:56,480
technologist

954
00:34:00,470 --> 00:33:58,000
and then we're going to take some of

955
00:34:02,149 --> 00:34:00,480
those things some of those uh

956
00:34:03,990 --> 00:34:02,159
pieces of physics that we prove in the

957
00:34:05,430 --> 00:34:04,000
lab prove that they are feasible and

958
00:34:07,190 --> 00:34:05,440
we're going to take them to flight and

959
00:34:09,669 --> 00:34:07,200
we're going to prove those technologies

960
00:34:11,510 --> 00:34:09,679
in a in a space environment now we've

961
00:34:13,190 --> 00:34:11,520
done this before right does anybody

962
00:34:15,109 --> 00:34:13,200
remember the

963
00:34:17,190 --> 00:34:15,119

new millennium program

964
00:34:18,310 --> 00:34:17,200
actually it still exists i believe it's

965
00:34:21,589 --> 00:34:18,320
it's in its

966
00:34:23,030 --> 00:34:21,599
last days uh but it still exists that it

967
00:34:24,149 --> 00:34:23,040
was funded out of the science mission

968
00:34:26,149 --> 00:34:24,159
directorate

969
00:34:27,270 --> 00:34:26,159
and that is the closest thing that i can

970
00:34:29,270 --> 00:34:27,280
think of

971
00:34:31,669 --> 00:34:29,280
uh to one of these kinds of programs

972
00:34:34,149 --> 00:34:31,679
where we're going to flight right so if

973
00:34:36,790 --> 00:34:34,159
you want to think about past programs

974
00:34:39,510 --> 00:34:36,800
this is a niacc-like program

975
00:34:42,470 --> 00:34:39,520
this is like a fundamental arrow

976
00:34:44,710 --> 00:34:42,480
for space this is a space equivalent of

977
00:34:46,629 --> 00:34:44,720
the fundamental aeronautics program

978
00:34:48,869 --> 00:34:46,639
and then out here is the new millennium

979
00:34:51,270 --> 00:34:48,879
program now you might ask me well why do

980
00:34:53,510 --> 00:34:51,280
i have two parallel lines okay why do i

981
00:34:55,669 --> 00:34:53,520
have stuff shown both in the mission

982
00:34:57,510 --> 00:34:55,679
directorates and in this new program

983
00:34:58,630 --> 00:34:57,520
that i've called the space technology

984
00:35:00,310 --> 00:34:58,640
program in the office of the chief

985
00:35:02,390 --> 00:35:00,320
technologist and there's a really good

986
00:35:04,069 --> 00:35:02,400
reason for that

987
00:35:06,310 --> 00:35:04,079
the mission directors are doing what i

988
00:35:07,750 --> 00:35:06,320

already discussed they have their goals

989
00:35:09,829 --> 00:35:07,760
they have their architectures their

990
00:35:11,670 --> 00:35:09,839
spacecraft and their technologies

991
00:35:13,829 --> 00:35:11,680
they're doing what you might call a

992
00:35:14,870 --> 00:35:13,839
requirements flow down approach

993
00:35:16,470 --> 00:35:14,880
okay

994
00:35:20,069 --> 00:35:16,480
but if we're talking about sending

995
00:35:22,150 --> 00:35:20,079
humans to mars do we really want to bank

996
00:35:24,390 --> 00:35:22,160
our whole human exploration architecture

997
00:35:26,470 --> 00:35:24,400
on the specific technology that the

998
00:35:28,950 --> 00:35:26,480
mission directorates think is going to

999
00:35:31,829 --> 00:35:28,960
pan out today or do we want to consider

1000
00:35:33,910 --> 00:35:31,839
some alternate approaches in parallel

1001
00:35:36,150 --> 00:35:33,920
and that's what we can do up here

1002
00:35:37,829 --> 00:35:36,160
in the space technology program i call

1003
00:35:39,990 --> 00:35:37,839
that disruptive

1004
00:35:41,829 --> 00:35:40,000
technology development or i call it

1005
00:35:43,750 --> 00:35:41,839
technology push

1006
00:35:46,470 --> 00:35:43,760
because these are technology investments

1007
00:35:48,710 --> 00:35:46,480
being made not because the next mission

1008
00:35:50,630 --> 00:35:48,720
is planning to use them but because if

1009
00:35:52,630 --> 00:35:50,640
they come through and some of them will

1010
00:35:54,470 --> 00:35:52,640
and by the way some of them won't

1011
00:35:57,270 --> 00:35:54,480
but if they come to fruition they'll

1012
00:35:59,190 --> 00:35:57,280
enable major advances in the way we

1013
00:36:01,670 --> 00:35:59,200

approach our system

1014
00:36:05,589 --> 00:36:01,680
does anybody have uh

1015
00:36:08,550 --> 00:36:07,190
anybody

1016
00:36:10,710 --> 00:36:08,560
i got one

1017
00:36:12,710 --> 00:36:10,720
right who doesn't

1018
00:36:14,310 --> 00:36:12,720
10 years ago did you

1019
00:36:16,390 --> 00:36:14,320
very good no you're the smartest man in

1020
00:36:19,109 --> 00:36:16,400
the room

1021
00:36:20,470 --> 00:36:19,119
10 years ago did you have one 15 years

1022
00:36:23,030 --> 00:36:20,480
ago

1023
00:36:25,430 --> 00:36:23,040
i don't think so right we all can't we

1024
00:36:26,870 --> 00:36:25,440
can't put our cell phones down now self

1025
00:36:29,829 --> 00:36:26,880
i mean this is

1026
00:36:32,470 --> 00:36:29,839
not a space example okay but the cell

1027
00:36:34,470 --> 00:36:32,480
phones change the way we do business

1028
00:36:36,150 --> 00:36:34,480
they change the way we think uh the

1029
00:36:37,589 --> 00:36:36,160
internet is another example right my

1030
00:36:39,829 --> 00:36:37,599
kids don't actually understand that

1031
00:36:41,190 --> 00:36:39,839
there didn't used to be an internet

1032
00:36:43,030 --> 00:36:41,200
what do you mean there was no internet

1033
00:36:45,109 --> 00:36:43,040
you didn't always have google

1034
00:36:48,150 --> 00:36:45,119
right they just can't understand that

1035
00:36:51,109 --> 00:36:48,160
right it's changed the way we do things

1036
00:36:52,870 --> 00:36:51,119
well in my view some of the technologies

1037
00:36:54,790 --> 00:36:52,880
that we're going to pursue here

1038
00:36:56,390 --> 00:36:54,800

will change the way we approach human

1039
00:36:58,630 --> 00:36:56,400
exploration will change the way we

1040
00:37:00,790 --> 00:36:58,640
approach our science missions now once

1041
00:37:02,870 --> 00:37:00,800
again they won't all pan out and we have

1042
00:37:05,430 --> 00:37:02,880
to be willing to accept that we're going

1043
00:37:07,750 --> 00:37:05,440
to take a lot of risk in this program

1044
00:37:09,109 --> 00:37:07,760
we're going to make our bets in a in an

1045
00:37:12,150 --> 00:37:09,119
informed manner

1046
00:37:13,589 --> 00:37:12,160
um kind of like uh you know i assume

1047
00:37:16,230 --> 00:37:13,599
that you're all in the thrift savings

1048
00:37:17,109 --> 00:37:16,240
program or some program like that

1049
00:37:19,190 --> 00:37:17,119
right

1050
00:37:19,990 --> 00:37:19,200
i mean how do you decide what stocks to

1051
00:37:22,310 --> 00:37:20,000
pick

1052
00:37:24,870 --> 00:37:22,320
it's the same thing you you balance your

1053
00:37:25,910 --> 00:37:24,880
risk through a portfolio approach and

1054
00:37:28,710 --> 00:37:25,920
that's what we're going to do in the

1055
00:37:30,630 --> 00:37:28,720
space technology program

1056
00:37:31,910 --> 00:37:30,640
uh so here's kind of my view of how this

1057
00:37:34,390 --> 00:37:31,920
is going to work

1058
00:37:35,589 --> 00:37:34,400
we're going to start with uh visions of

1059
00:37:36,790 --> 00:37:35,599
the future

1060
00:37:38,950 --> 00:37:36,800
thousands

1061
00:37:40,950 --> 00:37:38,960
of visions of the future these will come

1062
00:37:43,270 --> 00:37:40,960
from all over they'll come from within

1063
00:37:45,109 --> 00:37:43,280

nasa and from outside of nasa

1064
00:37:47,910 --> 00:37:45,119
uh there'll be paper studies systems

1065
00:37:50,390 --> 00:37:47,920
analyses technology assessments cost

1066
00:37:52,230 --> 00:37:50,400
benefit studies all right

1067
00:37:54,950 --> 00:37:52,240
they'll all have this little piece of

1068
00:37:57,430 --> 00:37:54,960
physics that needs to get proven before

1069
00:38:00,470 --> 00:37:57,440
we can really accept them as science

1070
00:38:02,550 --> 00:38:00,480
fact as opposed to science fiction right

1071
00:38:03,910 --> 00:38:02,560
in this part of the program that's what

1072
00:38:05,670 --> 00:38:03,920
we'll focus on we'll use our

1073
00:38:07,990 --> 00:38:05,680
laboratories we'll use ground-based

1074
00:38:10,230 --> 00:38:08,000
testing we'll use uh you know whatever

1075
00:38:13,430 --> 00:38:10,240
we need to prove that that fundamental

1076
00:38:15,270 --> 00:38:13,440
physics works and when it does

1077
00:38:18,150 --> 00:38:15,280
we'll be over here and we'll take some

1078
00:38:19,430 --> 00:38:18,160
of those to flight readiness we'll take

1079
00:38:21,270 --> 00:38:19,440
them to low earth orbit we'll do

1080
00:38:23,670 --> 00:38:21,280
atmospheric flight testing whatever it

1081
00:38:27,430 --> 00:38:23,680
takes for that particular technology to

1082
00:38:29,670 --> 00:38:27,440
be at trl6 so that a mission uh would be

1083
00:38:32,390 --> 00:38:29,680
willing to adopt it and we'll then

1084
00:38:34,390 --> 00:38:32,400
infuse those technologies in our future

1085
00:38:36,230 --> 00:38:34,400
science and exploration missions but

1086
00:38:38,390 --> 00:38:36,240
we'll also infuse them in other

1087
00:38:42,230 --> 00:38:38,400
government agency missions and we'll

1088
00:38:44,470 --> 00:38:42,240

infuse them into industry

1089
00:38:45,349 --> 00:38:44,480
through this approach

1090
00:38:47,349 --> 00:38:45,359
now

1091
00:38:48,470 --> 00:38:47,359
i can't just put out a call right it's

1092
00:38:51,190 --> 00:38:48,480
going to this program by the way is

1093
00:38:52,630 --> 00:38:51,200
going to be largely competitive unlike

1094
00:38:54,150 --> 00:38:52,640
the approaches in the mission

1095
00:38:55,829 --> 00:38:54,160
directorates right this is another

1096
00:38:57,990 --> 00:38:55,839
difference between the space technology

1097
00:38:59,670 --> 00:38:58,000
program which by the way you know office

1098
00:39:01,270 --> 00:38:59,680
of chief technologist is not a mission

1099
00:39:02,310 --> 00:39:01,280
directorate it's set up that way on

1100
00:39:04,630 --> 00:39:02,320
purpose

1101
00:39:08,630 --> 00:39:05,990
this will be done largely in a

1102
00:39:10,870 --> 00:39:08,640
competitive way be open to all best

1103
00:39:13,190 --> 00:39:10,880
ideas from wherever they may come but i

1104
00:39:15,270 --> 00:39:13,200
can't just put out a call and say hey

1105
00:39:16,470 --> 00:39:15,280
technology bring it on

1106
00:39:18,710 --> 00:39:16,480
what do you got you know any

1107
00:39:20,630 --> 00:39:18,720
technologies so instead what we're going

1108
00:39:23,109 --> 00:39:20,640
to do is uh what you might call a grand

1109
00:39:23,829 --> 00:39:23,119
challenge kind of approach and there is

1110
00:39:33,750 --> 00:39:23,839
a

1111
00:39:35,589 --> 00:39:33,760
just got stood up

1112
00:39:37,430 --> 00:39:35,599
does this kind of approach now by the

1113
00:39:39,750 --> 00:39:37,440

way don't read too much into these words

1114
00:39:41,270 --> 00:39:39,760
here we're still working on this slide

1115
00:39:42,950 --> 00:39:41,280
this is i just wanted to put this up

1116
00:39:45,109 --> 00:39:42,960
here so you know i could talk to it and

1117
00:39:46,790 --> 00:39:45,119
give you an idea of what we're thinking

1118
00:39:48,230 --> 00:39:46,800
but we're going to come out with the

1119
00:39:49,910 --> 00:39:48,240
office of the chief technologist is

1120
00:39:50,950 --> 00:39:49,920
going to come out with a set of grand

1121
00:39:52,550 --> 00:39:50,960
challenges

1122
00:39:54,710 --> 00:39:52,560
we're not going to talk about

1123
00:39:56,950 --> 00:39:54,720
technological solutions we're going to

1124
00:39:59,990 --> 00:39:56,960
talk at the capability level

1125
00:40:02,150 --> 00:40:00,000
we want this capability by this date and

1126
00:40:04,630 --> 00:40:02,160
then we're going to put that out and

1127
00:40:08,150 --> 00:40:04,640
nasa centers or academia or industry

1128
00:40:10,150 --> 00:40:08,160
will respond with a variety i believe of

1129
00:40:12,550 --> 00:40:10,160
technological solutions to provide that

1130
00:40:15,190 --> 00:40:12,560
capability and we will fund several of

1131
00:40:17,829 --> 00:40:15,200
those for each grand challenge going

1132
00:40:19,589 --> 00:40:17,839
forward to a point that we can make an

1133
00:40:21,670 --> 00:40:19,599
informed decision

1134
00:40:24,150 --> 00:40:21,680
about which is the best technology to

1135
00:40:25,910 --> 00:40:24,160
take all the way to flight

1136
00:40:28,390 --> 00:40:25,920
i think i'll skip that one

1137
00:40:30,069 --> 00:40:28,400
uh here's a just an artist picture of

1138
00:40:31,829 --> 00:40:30,079

some of the kinds of things that might

1139
00:40:33,510 --> 00:40:31,839
come out of this program

1140
00:40:35,190 --> 00:40:33,520
uh you know these are the kinds of

1141
00:40:37,109 --> 00:40:35,200
technologies by the way that whether

1142
00:40:38,470 --> 00:40:37,119
you've been doing science missions or

1143
00:40:41,349 --> 00:40:38,480
whether you've been focused on human

1144
00:40:42,870 --> 00:40:41,359
exploration you know you have wanted

1145
00:40:44,790 --> 00:40:42,880
if you're an engineer

1146
00:40:46,150 --> 00:40:44,800
you know you have wanted these systems

1147
00:40:48,950 --> 00:40:46,160
for a long time

1148
00:40:50,630 --> 00:40:48,960
right and we never seem to be able to

1149
00:40:52,790 --> 00:40:50,640
get over the hump

1150
00:40:54,790 --> 00:40:52,800
of uh funding these to the point that

1151
00:40:56,710 --> 00:40:54,800
they're at a at a technology readiness

1152
00:40:58,390 --> 00:40:56,720
level that the mission directorates will

1153
00:41:00,550 --> 00:40:58,400
pick them up or that some other

1154
00:41:03,109 --> 00:41:00,560
government agency will pick them up

1155
00:41:06,069 --> 00:41:03,119
uh through the space technology program

1156
00:41:07,750 --> 00:41:06,079
uh we have a means for doing so in fact

1157
00:41:09,430 --> 00:41:07,760
we have a means to take things all the

1158
00:41:10,870 --> 00:41:09,440
way from concept

1159
00:41:12,309 --> 00:41:10,880
to flight

1160
00:41:14,550 --> 00:41:12,319
which is something we've never had at

1161
00:41:17,109 --> 00:41:14,560
nasa before on the technology side of

1162
00:41:23,030 --> 00:41:20,630
okay so just to kind of sum things up

1163
00:41:24,630 --> 00:41:23,040

in my view

1164
00:41:26,470 --> 00:41:24,640
and it is by the way this is you know

1165
00:41:28,550 --> 00:41:26,480
everyone has a different opinion on this

1166
00:41:29,670 --> 00:41:28,560
subject and i'll be the first to admit

1167
00:41:31,750 --> 00:41:29,680
that

1168
00:41:33,030 --> 00:41:31,760
but what the obama administration is

1169
00:41:36,390 --> 00:41:33,040
really saying

1170
00:41:38,230 --> 00:41:36,400
in its fy 11 budget requests for nasa

1171
00:41:39,510 --> 00:41:38,240
is bigger than what the newspapers are

1172
00:41:41,589 --> 00:41:39,520
reporting

1173
00:41:43,829 --> 00:41:41,599
okay what the obama administration is

1174
00:41:46,470 --> 00:41:43,839
really saying is that we're committed

1175
00:41:48,710 --> 00:41:46,480
to research technology and innovation

1176
00:41:50,790 --> 00:41:48,720
for the nation

1177
00:41:52,710 --> 00:41:50,800
as a means of stimulating the economy

1178
00:41:54,550 --> 00:41:52,720
that's really what they care about right

1179
00:41:57,190 --> 00:41:54,560
they care about the economy and they

1180
00:42:00,390 --> 00:41:57,200
care about preparing america to compete

1181
00:42:02,230 --> 00:42:00,400
on the global stage technologically

1182
00:42:03,910 --> 00:42:02,240
and they're allowing nasa by the way

1183
00:42:05,430 --> 00:42:03,920
it's a great privilege

1184
00:42:07,910 --> 00:42:05,440
you really need to think about this it's

1185
00:42:11,270 --> 00:42:07,920
a great privilege they're allowing nasa

1186
00:42:13,589 --> 00:42:11,280
to be part of this national strategy

1187
00:42:16,069 --> 00:42:13,599
nasa's not always part of the nation

1188
00:42:19,030 --> 00:42:16,079

strategy sometimes it's kind of you know

1189
00:42:20,630 --> 00:42:19,040
off on the side doing its own thing

1190
00:42:23,109 --> 00:42:20,640
this administration the obama

1191
00:42:24,950 --> 00:42:23,119
administration is cl by giving nasa a

1192
00:42:26,870 --> 00:42:24,960
budget increase and

1193
00:42:29,270 --> 00:42:26,880
turning it towards more of a research

1194
00:42:31,589 --> 00:42:29,280
and technology focused is saying that

1195
00:42:32,870 --> 00:42:31,599
nasa you're a part of this national

1196
00:42:34,950 --> 00:42:32,880
initiative

1197
00:42:37,750 --> 00:42:34,960
so the nasa budget request is really

1198
00:42:39,510 --> 00:42:37,760
aligned with this national strategy

1199
00:42:41,829 --> 00:42:39,520
right and once again the renewed

1200
00:42:43,829 --> 00:42:41,839
emphasis on technology

1201
00:42:45,829 --> 00:42:43,839
uh by the way which has been suggested

1202
00:42:47,190 --> 00:42:45,839
over and over again by a number of

1203
00:42:49,990 --> 00:42:47,200
external groups

1204
00:42:52,150 --> 00:42:50,000
is really in my view a rebalancing of

1205
00:42:53,990 --> 00:42:52,160
nasa's three fundamental core

1206
00:42:56,309 --> 00:42:54,000
competencies that have really always

1207
00:42:57,750 --> 00:42:56,319
been in existence

1208
00:43:00,069 --> 00:42:57,760
uh now

1209
00:43:01,510 --> 00:43:00,079
what this will do for nasa in my view is

1210
00:43:03,510 --> 00:43:01,520
it will provide

1211
00:43:06,550 --> 00:43:03,520
uh a much more

1212
00:43:09,190 --> 00:43:06,560
likely set and a much more exciting set

1213
00:43:11,270 --> 00:43:09,200

of potential futures for our science and

1214
00:43:13,910 --> 00:43:11,280
exploration missions okay it'll