



1
00:00:06,230 --> 00:00:03,669
welcome back to the partnership and

2
00:00:09,990 --> 00:00:06,240
participatory engagement session at the

3
00:00:11,910 --> 00:00:10,000
ideas synthesis workshop here in houston

4
00:00:15,589 --> 00:00:11,920
uh

5
00:00:17,830 --> 00:00:15,599
lewicki

6
00:00:20,950 --> 00:00:17,840
joining us through adobe connect and we

7
00:00:23,429 --> 00:00:20,960
will be pulling him in virtually

8
00:00:25,910 --> 00:00:23,439
so why don't we turn over to chris

9
00:00:29,109 --> 00:00:25,920
real quick before we do that

10
00:00:32,069 --> 00:00:29,119
asteroid partners to follow us

11
00:00:34,069 --> 00:00:32,079
online and submit your questions

12
00:00:36,470 --> 00:00:34,079
and one real thing quick thing for you

13
00:00:38,229 --> 00:00:36,480

chris if you wouldn't mind

14

00:00:40,869 --> 00:00:38,239

staying on

15

00:00:43,190 --> 00:00:40,879

after the presenters are all finished

16

00:00:45,670 --> 00:00:43,200

we'll have questions and i know folks

17

00:00:47,510 --> 00:00:45,680

would likely have some for you so if you

18

00:00:48,709 --> 00:00:47,520

wouldn't mind sticking around that would

19

00:00:50,389 --> 00:00:48,719

be awesome

20

00:00:51,189 --> 00:00:50,399

uh and with that absolutely i can do

21

00:00:52,389 --> 00:00:51,199

that

22

00:00:53,990 --> 00:00:52,399

great

23

00:00:58,310 --> 00:00:54,000

and with that i'll turn it over to you

24

00:01:00,790 --> 00:00:58,320

and uh your presentation thank you

25

00:01:02,709 --> 00:01:00,800

all right good morning everyone

26
00:01:05,030 --> 00:01:02,719
this morning i'm going to give you some

27
00:01:07,750 --> 00:01:05,040
of planetary resources thoughts on

28
00:01:09,910 --> 00:01:07,760
participatory engagement with nasa and

29
00:01:11,750 --> 00:01:09,920
the u.s government and private industry

30
00:01:13,750 --> 00:01:11,760
in meeting the goals of nasa's asteroid

31
00:01:16,149 --> 00:01:13,760
initiative

32
00:01:19,109 --> 00:01:16,159
to start with though i wanted to speak a

33
00:01:21,510 --> 00:01:19,119
little bit on why we explore

34
00:01:24,149 --> 00:01:21,520
today we've explored for scientific

35
00:01:26,630 --> 00:01:24,159
interest for meeting questions of our

36
00:01:27,990 --> 00:01:26,640
solar system how it began to form

37
00:01:30,469 --> 00:01:28,000
uh but that's really starting to

38
00:01:32,789 --> 00:01:30,479

transition we've learned a great deal in

39

00:01:35,270 --> 00:01:32,799

the last 50 years of space exploration

40

00:01:38,469 --> 00:01:35,280

and as the president said in the our own

41

00:01:40,310 --> 00:01:38,479

u.s national space policy in 2010

42

00:01:42,230 --> 00:01:40,320

which is on this page we're

43

00:01:44,870 --> 00:01:42,240

transitioning to a way of exploration

44

00:01:46,550 --> 00:01:44,880

that's ultimately more sustainable and

45

00:01:48,310 --> 00:01:46,560

even indefinite

46

00:01:51,030 --> 00:01:48,320

and in order for us to be able to do

47

00:01:53,109 --> 00:01:51,040

this we think one of the critical ways

48

00:01:54,469 --> 00:01:53,119

and things we need to leverage our

49

00:01:56,389 --> 00:01:54,479

resources

50

00:01:58,310 --> 00:01:56,399

the near-earth asteroids in the solar

51
00:01:59,990 --> 00:01:58,320
system really have a tremendous amount

52
00:02:03,190 --> 00:02:00,000
of resources that can be leveraged for

53
00:02:05,030 --> 00:02:03,200
this from water to precious metals

54
00:02:08,229 --> 00:02:05,040
and the structural materials that we'll

55
00:02:10,469 --> 00:02:08,239
need to build future structures in space

56
00:02:12,470 --> 00:02:10,479
and the asteroids themselves of course

57
00:02:13,830 --> 00:02:12,480
are extremely plentiful in these

58
00:02:14,710 --> 00:02:13,840
resources

59
00:02:17,510 --> 00:02:14,720
so

60
00:02:19,750 --> 00:02:17,520
over time we've been the benefit of an

61
00:02:22,229 --> 00:02:19,760
exploration program thus far between

62
00:02:25,510 --> 00:02:22,239
nasa and other space agencies that send

63
00:02:28,790 --> 00:02:25,520

a number of exploration spacecraft to

64

00:02:31,110 --> 00:02:28,800

solar small solar system bodies uh the

65

00:02:32,070 --> 00:02:31,120

near-earth asteroid rendezvous shoemaker

66

00:02:34,150 --> 00:02:32,080

mission

67

00:02:37,030 --> 00:02:34,160

to the first near-earth asteroid out to

68

00:02:39,270 --> 00:02:37,040

today's osiris-rex but these missions

69

00:02:41,670 --> 00:02:39,280

are becoming increasingly complex

70

00:02:44,869 --> 00:02:41,680

increasingly expensive as a result and

71

00:02:46,550 --> 00:02:44,879

unfortunately a bit less frequent and

72

00:02:48,790 --> 00:02:46,560

this is something that from a commercial

73

00:02:50,470 --> 00:02:48,800

standpoint we would like to see the pace

74

00:02:51,350 --> 00:02:50,480

quickened in this area

75

00:02:54,150 --> 00:02:51,360

and

76

00:02:57,030 --> 00:02:54,160

today we propose a way for a private

77

00:02:58,949 --> 00:02:57,040

public partnership to enable that

78

00:03:01,110 --> 00:02:58,959

so the idea is the creation of an

79

00:03:03,350 --> 00:03:01,120

incentive prize for the acquisition of

80

00:03:05,190 --> 00:03:03,360

asteroid data a private public

81

00:03:07,190 --> 00:03:05,200

partnership between the government and

82

00:03:09,589 --> 00:03:07,200

private industry and this is something

83

00:03:12,149 --> 00:03:09,599

that's already been done before nasa has

84

00:03:13,430 --> 00:03:12,159

one of these partnerships in place uh in

85

00:03:16,869 --> 00:03:13,440

the form of the innovative lunar

86

00:03:19,430 --> 00:03:16,879

demonstrations data baa and this is

87

00:03:21,509 --> 00:03:19,440

underway today uh six companies

88

00:03:23,990 --> 00:03:21,519

originally were selected for this it

89

00:03:25,910 --> 00:03:24,000

further was down selected to three and

90

00:03:27,670 --> 00:03:25,920

uh progress is underway for those teams

91

00:03:28,550 --> 00:03:27,680

who are competing for the google inner x

92

00:03:30,470 --> 00:03:28,560

prize

93

00:03:32,550 --> 00:03:30,480

as it relates to asteroid data this is

94

00:03:34,229 --> 00:03:32,560

something that can probably be achieved

95

00:03:37,430 --> 00:03:34,239

for less than the cost of a single

96

00:03:39,270 --> 00:03:37,440

discovery mission we would have uh maybe

97

00:03:41,670 --> 00:03:39,280

perhaps through the end of the decade to

98

00:03:42,309 --> 00:03:41,680

return data in line with road maps that

99

00:03:44,390 --> 00:03:42,319

are

100

00:03:46,309 --> 00:03:44,400

in place today and the award types would

101
00:03:49,910 --> 00:03:46,319
allow perhaps a half a dozen different

102
00:03:52,550 --> 00:03:49,920
companies to provide these types of data

103
00:03:54,949 --> 00:03:52,560
so just as a notional overview

104
00:03:57,030 --> 00:03:54,959
these are things that

105
00:03:59,110 --> 00:03:57,040
are gone through a selection process

106
00:04:02,070 --> 00:03:59,120
based on technical merit business merit

107
00:04:03,910 --> 00:04:02,080
and then ultimate value and you have a

108
00:04:05,830 --> 00:04:03,920
detailed set of things that the

109
00:04:07,830 --> 00:04:05,840
businesses need to do contract line

110
00:04:09,429 --> 00:04:07,840
items and this is drawing directly on

111
00:04:13,350 --> 00:04:09,439
the language and the structure that has

112
00:04:16,469 --> 00:04:13,360
been created for the lunar ild program

113
00:04:19,749 --> 00:04:16,479

uh a the process starts with a

114

00:04:22,230 --> 00:04:19,759

solicitation and an initial small award

115

00:04:23,830 --> 00:04:22,240

just to set things up and then increases

116

00:04:26,150 --> 00:04:23,840

through uh

117

00:04:28,629 --> 00:04:26,160

more and more productive dates initially

118

00:04:30,390 --> 00:04:28,639

activities might be done on earth or in

119

00:04:33,110 --> 00:04:30,400

proximity to earth

120

00:04:34,950 --> 00:04:33,120

follow-on milestones might include

121

00:04:36,710 --> 00:04:34,960

missions that go out to the vicinity of

122

00:04:39,350 --> 00:04:36,720

the asteroid or perhaps

123

00:04:41,110 --> 00:04:39,360

fly by earth-crossing asteroids but

124

00:04:43,350 --> 00:04:41,120

ultimately and what

125

00:04:44,550 --> 00:04:43,360

is most value both to private industry

126

00:04:46,550 --> 00:04:44,560

as well to the government are the

127

00:04:49,030 --> 00:04:46,560

rendezvous missions that help reduce the

128

00:04:52,390 --> 00:04:49,040

risk and characterize more and more of

129

00:04:55,030 --> 00:04:52,400

these small bodies in the solar system

130

00:04:57,670 --> 00:04:55,040

uh to give you one example uh going into

131

00:05:00,070 --> 00:04:57,680

the later stage activities uh we could

132

00:05:03,110 --> 00:05:00,080

look to the third tier of these

133

00:05:04,390 --> 00:05:03,120

activities uh and for example a an

134

00:05:06,629 --> 00:05:04,400

entire

135

00:05:07,749 --> 00:05:06,639

rendezvous mission could be conducted

136

00:05:09,670 --> 00:05:07,759

for a

137

00:05:11,350 --> 00:05:09,680

50 million dollar award this would be

138

00:05:13,430 --> 00:05:11,360

something that would be paid

139

00:05:15,749 --> 00:05:13,440

upon receipt of the data this is not a

140

00:05:17,670 --> 00:05:15,759

cost plus fixed fee program but

141

00:05:18,469 --> 00:05:17,680

something that would require businesses

142

00:05:21,510 --> 00:05:18,479

to

143

00:05:22,790 --> 00:05:21,520

essentially risk uh the mission and

144

00:05:25,110 --> 00:05:22,800

develop this

145

00:05:26,469 --> 00:05:25,120

but in doing so would know that

146

00:05:28,469 --> 00:05:26,479

in providing the data the government

147

00:05:30,790 --> 00:05:28,479

would be a customer for it

148

00:05:32,310 --> 00:05:30,800

so these milestones at the rendezvous

149

00:05:34,070 --> 00:05:32,320

point could mean touching down in the

150

00:05:36,310 --> 00:05:34,080

service of the asteroid perhaps for

151
00:05:38,469 --> 00:05:36,320
in-situ science the identification of

152
00:05:40,870 --> 00:05:38,479
potential human hazards perhaps

153
00:05:43,350 --> 00:05:40,880
simulating human appropriate approach

154
00:05:45,270 --> 00:05:43,360
and departure trajectories and of course

155
00:05:47,189 --> 00:05:45,280
the extended duration science that you

156
00:05:51,029 --> 00:05:47,199
can get where you can characterize the

157
00:05:53,590 --> 00:05:51,039
asteroids mass volume spin state surface

158
00:05:55,909 --> 00:05:53,600
morphology and perhaps even characterize

159
00:05:58,629 --> 00:05:55,919
other hazards like dust

160
00:06:00,870 --> 00:05:58,639
or if there are moons present in the

161
00:06:02,309 --> 00:06:00,880
asteroid system

162
00:06:03,830 --> 00:06:02,319
this is something that planetary

163
00:06:06,390 --> 00:06:03,840

resources is

164

00:06:08,390 --> 00:06:06,400

prepared to support starting

165

00:06:10,870 --> 00:06:08,400

with our own internal activities of

166

00:06:12,950 --> 00:06:10,880

launching our core technology next year

167

00:06:15,270 --> 00:06:12,960

and in the next several years we have an

168

00:06:17,430 --> 00:06:15,280

increasingly more capable set of

169

00:06:19,830 --> 00:06:17,440

demonstrations adding in those

170

00:06:22,070 --> 00:06:19,840

capabilities necessary to go into deep

171

00:06:24,550 --> 00:06:22,080

space which include propulsion the

172

00:06:26,629 --> 00:06:24,560

communications and then ultimately the

173

00:06:31,430 --> 00:06:26,639

capabilities that allow you to perform

174

00:06:34,790 --> 00:06:33,909

i want to leave with one other final

175

00:06:37,029 --> 00:06:34,800

point

176
00:06:39,270 --> 00:06:37,039
related to something that the government

177
00:06:41,510 --> 00:06:39,280
could start today perhaps with no funds

178
00:06:44,309 --> 00:06:41,520
at all and this is the opportunity for

179
00:06:47,110 --> 00:06:44,319
sponsored or ride-share access to solar

180
00:06:49,029 --> 00:06:47,120
orbit this is being done in low earth

181
00:06:51,110 --> 00:06:49,039
orbit actually was just recently done

182
00:06:53,589 --> 00:06:51,120
this week with a number of payloads on a

183
00:06:55,909 --> 00:06:53,599
variety of launch vehicles but we see a

184
00:06:58,390 --> 00:06:55,919
situation where there are several

185
00:07:01,110 --> 00:06:58,400
missions that are launching to mars or

186
00:07:03,270 --> 00:07:01,120
other destinations with excess capacity

187
00:07:05,189 --> 00:07:03,280
uh the insight marshlander is an example

188
00:07:08,390 --> 00:07:05,199

that's landing or launching with over a

189

00:07:10,469 --> 00:07:08,400

metric ton of excess capacity uh on the

190

00:07:13,110 --> 00:07:10,479

launch vehicle that it's currently on

191

00:07:15,990 --> 00:07:13,120

the uh sls demo flights that are coming

192

00:07:19,029 --> 00:07:16,000

up later this decade are an opportunity

193

00:07:21,270 --> 00:07:19,039

to get earth escape trajectory and get

194

00:07:22,950 --> 00:07:21,280

demonstration or test payloads on that

195

00:07:24,550 --> 00:07:22,960

and then even the department of defense

196

00:07:26,950 --> 00:07:24,560

has often

197

00:07:29,510 --> 00:07:26,960

had third stages which after delivering

198

00:07:32,710 --> 00:07:29,520

a spacecraft to geostationary orbit the

199

00:07:35,110 --> 00:07:32,720

third stages are disposed in solar orbit

200

00:07:36,870 --> 00:07:35,120

so all this excess capacity could be of

201
00:07:39,430 --> 00:07:36,880
great benefit for

202
00:07:42,230 --> 00:07:39,440
an innovative and supportive environment

203
00:07:43,990 --> 00:07:42,240
for commercial activity it helps to

204
00:07:45,589 --> 00:07:44,000
reduce the uncertainty associated with

205
00:07:48,150 --> 00:07:45,599
launch manifests and the schedules

206
00:07:50,390 --> 00:07:48,160
associated them the upfront costs with

207
00:07:52,469 --> 00:07:50,400
getting those manifest started and then

208
00:07:54,150 --> 00:07:52,479
of course with a timetable on when these

209
00:07:56,629 --> 00:07:54,160
launches exist

210
00:07:58,390 --> 00:07:56,639
there's certainly plenty of motivation

211
00:07:59,990 --> 00:07:58,400
to meet that schedule

212
00:08:02,070 --> 00:08:00,000
and to get the payload to that

213
00:08:04,790 --> 00:08:02,080

spacecraft so this is something we'd

214

00:08:07,589 --> 00:08:04,800

love to see explored to allow more and

215

00:08:09,589 --> 00:08:07,599

more experimentation and innovation

216

00:08:13,270 --> 00:08:09,599

that can ride on investments that the

217

00:08:15,749 --> 00:08:13,280

government is already making

218

00:08:16,869 --> 00:08:15,759

so planetary resources is ready to

219

00:08:19,029 --> 00:08:16,879

support

220

00:08:21,110 --> 00:08:19,039

nasa's objectives and goals with the

221

00:08:22,710 --> 00:08:21,120

asteroid initiative and we look forward

222

00:08:24,469 --> 00:08:22,720

to what these private and public

223

00:08:27,350 --> 00:08:24,479

partnerships might allow in the future

224

00:08:34,790 --> 00:08:27,360

so jen and jason thank you very much

225

00:08:38,310 --> 00:08:37,509

all right next up is scott sivicik from

226

00:08:45,110 --> 00:08:38,320

uh

227

00:08:48,310 --> 00:08:46,710

good morning scott selcheck from

228

00:08:50,550 --> 00:08:48,320

prospect dynamics and i'm going to take

229

00:08:52,710 --> 00:08:50,560

a few minutes here to talk about

230

00:08:54,230 --> 00:08:52,720

opportunities that nasa has to reduce

231

00:08:55,990 --> 00:08:54,240

the barriers to entry for small

232

00:08:59,430 --> 00:08:56,000

businesses as a means to increase

233

00:09:03,350 --> 00:09:01,269

unfortunately when it comes to early

234

00:09:05,670 --> 00:09:03,360

stage small businesses we spend way too

235

00:09:06,870 --> 00:09:05,680

much time figuring out how to pay our

236

00:09:08,389 --> 00:09:06,880

employees

237

00:09:09,829 --> 00:09:08,399

rather than focusing on the technical

238

00:09:11,910 --> 00:09:09,839

challenges where we really are

239

00:09:13,590 --> 00:09:11,920

interested and really want to

240

00:09:14,790 --> 00:09:13,600

spend our time

241

00:09:17,750 --> 00:09:14,800

there are two

242

00:09:20,389 --> 00:09:17,760

broad brush categories that nasa will

243

00:09:23,670 --> 00:09:20,399

have the opportunity to aid in the first

244

00:09:25,509 --> 00:09:23,680

being a direct funding means helping us

245

00:09:28,310 --> 00:09:25,519

reach the funding levels we need to move

246

00:09:30,230 --> 00:09:28,320

forward the second a more indirect means

247

00:09:33,590 --> 00:09:30,240

and that is through

248

00:09:34,550 --> 00:09:33,600

leveraging nasa's visibility to aid us

249

00:09:41,829 --> 00:09:34,560

in

250

00:09:43,750 --> 00:09:41,839

through other means

251
00:09:45,670 --> 00:09:43,760
on the direct funding side the

252
00:09:48,150 --> 00:09:45,680
intelligence agency

253
00:09:49,590 --> 00:09:48,160
built a model called inquitel that

254
00:09:51,110 --> 00:09:49,600
addresses a lot of the same challenges

255
00:09:52,790 --> 00:09:51,120
that exist for small businesses in the

256
00:09:54,710 --> 00:09:52,800
aerospace industry

257
00:09:56,790 --> 00:09:54,720
and that is to

258
00:09:57,990 --> 00:09:56,800
use federal funding

259
00:10:02,470 --> 00:09:58,000
to

260
00:10:04,389 --> 00:10:02,480
and find the technologies that are most

261
00:10:05,670 --> 00:10:04,399
significant most relevant to that

262
00:10:07,750 --> 00:10:05,680
customer

263
00:10:08,550 --> 00:10:07,760

and aid them in

264

00:10:10,870 --> 00:10:08,560

in

265

00:10:11,990 --> 00:10:10,880

speak

266

00:10:13,829 --> 00:10:12,000

with the

267

00:10:15,670 --> 00:10:13,839

the barriers to entry and aerospace the

268

00:10:17,910 --> 00:10:15,680

long timelines and the significant

269

00:10:18,630 --> 00:10:17,920

capital investments required this model

270

00:10:20,389 --> 00:10:18,640

is

271

00:10:24,949 --> 00:10:20,399

perhaps even more applicable and more

272

00:10:26,870 --> 00:10:24,959

valuable in the in this industry

273

00:10:29,190 --> 00:10:26,880

also opportunities for relevant contract

274

00:10:31,269 --> 00:10:29,200

work and now this would be specific to

275

00:10:33,829 --> 00:10:31,279

the grand challenge

276

00:10:35,829 --> 00:10:33,839

focusing sbir topics focusing other

277

00:10:38,069 --> 00:10:35,839

investment vehicles on the topics that

278

00:10:39,350 --> 00:10:38,079

are identified and needed for this grand

279

00:10:42,230 --> 00:10:39,360

challenge

280

00:10:45,110 --> 00:10:42,240

also looking at the paths to procurement

281

00:10:47,110 --> 00:10:45,120

and and understanding really where

282

00:10:49,350 --> 00:10:47,120

some of the waste occurs

283

00:10:52,150 --> 00:10:49,360

just as an example i've been looking at

284

00:10:52,949 --> 00:10:52,160

the naic solicitation that came out last

285

00:10:54,550 --> 00:10:52,959

week

286

00:10:56,630 --> 00:10:54,560

the first step in that is a three-page

287

00:10:58,550 --> 00:10:56,640

proposal to submit that three-page

288

00:11:01,110 --> 00:10:58,560

proposal i need to understand and comply

289

00:11:02,550 --> 00:11:01,120

with about 130 pages of guidance and

290

00:11:04,069 --> 00:11:02,560

register on four different government

291

00:11:06,470 --> 00:11:04,079

websites

292

00:11:09,269 --> 00:11:06,480

for a three-page proposal so

293

00:11:10,870 --> 00:11:09,279

there are opportunities there to

294

00:11:13,030 --> 00:11:10,880

to make it a little bit easier for a few

295

00:11:15,350 --> 00:11:13,040

more companies to

296

00:11:17,350 --> 00:11:15,360

get their ideas heard by nasa and really

297

00:11:19,590 --> 00:11:17,360

this rfi was a great example of

298

00:11:22,389 --> 00:11:19,600

something simple to allow us to

299

00:11:23,990 --> 00:11:22,399

to to get information out

300

00:11:26,150 --> 00:11:24,000

on the visibility side there are ideas

301
00:11:27,509 --> 00:11:26,160
that are even easier

302
00:11:29,350 --> 00:11:27,519
something that would be worth its weight

303
00:11:30,630 --> 00:11:29,360
in gold to me is a letter of intent for

304
00:11:32,550 --> 00:11:30,640
nasa

305
00:11:34,710 --> 00:11:32,560
this wouldn't have to be something that

306
00:11:37,750 --> 00:11:34,720
offers any real commitment just an

307
00:11:40,389 --> 00:11:37,760
opportunity for us to submit an idea for

308
00:11:43,430 --> 00:11:40,399
review and in the best of cases have

309
00:11:45,590 --> 00:11:43,440
nasa provide back a letter stating that

310
00:11:48,710 --> 00:11:45,600
we've looked at this idea the technology

311
00:11:51,110 --> 00:11:48,720
has merit this guy can make it work

312
00:11:54,949 --> 00:11:51,120
there might be a spot for it within the

313
00:11:59,590 --> 00:11:57,750

retweets even easier nasa has a massive

314

00:12:02,150 --> 00:11:59,600

social media following

315

00:12:05,430 --> 00:12:02,160

providing and publicizing a hashtag that

316

00:12:07,670 --> 00:12:05,440

would allow us to request a retweet

317

00:12:10,629 --> 00:12:07,680

would be a very very simple effort

318

00:12:11,590 --> 00:12:10,639

and from that nasa would simply need to

319

00:12:13,990 --> 00:12:11,600

review

320

00:12:17,030 --> 00:12:14,000

tweets tagged with this hashtag and make

321

00:12:18,790 --> 00:12:17,040

a decision as to which to bring forward

322

00:12:21,990 --> 00:12:18,800

and then the big idea

323

00:12:23,430 --> 00:12:22,000

would be coordinated demonstrations

324

00:12:25,750 --> 00:12:23,440

so talking about that specifically what

325

00:12:28,389 --> 00:12:25,760

i have in mind for coordinated

326

00:12:29,509 --> 00:12:28,399

demonstrations focuses around a demo day

327

00:12:32,949 --> 00:12:29,519

events

328

00:12:35,750 --> 00:12:32,959

as each of us goes through the normal

329

00:12:37,430 --> 00:12:35,760

development life cycle there are stages

330

00:12:40,470 --> 00:12:37,440

where we

331

00:12:42,310 --> 00:12:40,480

have natural demonstration points

332

00:12:43,590 --> 00:12:42,320

and in many cases those would be pretty

333

00:12:46,470 --> 00:12:43,600

uninteresting

334

00:12:49,269 --> 00:12:46,480

to anyone outside the organization

335

00:12:51,430 --> 00:12:49,279

but over time they get more interesting

336

00:12:53,430 --> 00:12:51,440

more complex and

337

00:12:54,870 --> 00:12:53,440

if we bring all of these ideas all of

338

00:12:56,150 --> 00:12:54,880

these little development efforts that

339

00:12:57,670 --> 00:12:56,160

are going on

340

00:13:00,710 --> 00:12:57,680

across the industry

341

00:13:02,310 --> 00:13:00,720

and bring them together we can leverage

342

00:13:04,470 --> 00:13:02,320

the economies of scale bring everybody

343

00:13:05,990 --> 00:13:04,480

into the same room and

344

00:13:06,949 --> 00:13:06,000

build a lot of network effects out of

345

00:13:08,310 --> 00:13:06,959

that

346

00:13:10,150 --> 00:13:08,320

it would start with technology road

347

00:13:12,230 --> 00:13:10,160

mapping and not the high level

348

00:13:14,389 --> 00:13:12,240

technology road mapping that is done and

349

00:13:16,949 --> 00:13:14,399

done very well at the strategic level

350

00:13:19,750 --> 00:13:16,959

but the the more tactical detailed

351
00:13:22,629 --> 00:13:19,760
technical road mapping within a specific

352
00:13:24,150 --> 00:13:22,639
area so planetary defense for example

353
00:13:26,230 --> 00:13:24,160
what are the architectures that are

354
00:13:28,550 --> 00:13:26,240
being considered for a planetary defense

355
00:13:30,389 --> 00:13:28,560
architecture and what is the trade space

356
00:13:31,590 --> 00:13:30,399
that branches back from those different

357
00:13:33,190 --> 00:13:31,600
architectures

358
00:13:34,389 --> 00:13:33,200
looking back through that trade space

359
00:13:35,590 --> 00:13:34,399
what are the functionalities and

360
00:13:37,430 --> 00:13:35,600
capabilities that need to be

361
00:13:39,350 --> 00:13:37,440
demonstrated by certain technologies

362
00:13:41,829 --> 00:13:39,360
that need to be developed

363
00:13:43,910 --> 00:13:41,839

developing this lower level map would

364

00:13:46,629 --> 00:13:43,920

provide a go-to source for college

365

00:13:48,550 --> 00:13:46,639

students looking for ideas on relevant

366

00:13:51,350 --> 00:13:48,560

relevant projects it would provide an

367

00:13:52,870 --> 00:13:51,360

opportunity for businesses to go out and

368

00:13:53,750 --> 00:13:52,880

look and understand

369

00:13:56,310 --> 00:13:53,760

where

370

00:13:58,150 --> 00:13:56,320

they can best leverage their resources

371

00:14:00,470 --> 00:13:58,160

for the most bang for their buck

372

00:14:02,230 --> 00:14:00,480

and it would provide nasa a scorecard as

373

00:14:03,269 --> 00:14:02,240

we develop through this technology

374

00:14:06,310 --> 00:14:03,279

roadmap

375

00:14:08,310 --> 00:14:06,320

nasa can see where and how we are

376

00:14:09,910 --> 00:14:08,320

developing into which architectures

377

00:14:13,110 --> 00:14:09,920

identify if there are gaps potential

378

00:14:14,870 --> 00:14:13,120

areas that need to be incentivized

379

00:14:16,949 --> 00:14:14,880

from this road mapping come the demo day

380

00:14:19,110 --> 00:14:16,959

events themselves bring a lot of people

381

00:14:21,430 --> 00:14:19,120

together into a room into a convention

382

00:14:22,790 --> 00:14:21,440

center potentially going through a

383

00:14:24,150 --> 00:14:22,800

number of demonstrations of the

384

00:14:25,509 --> 00:14:24,160

technologies

385

00:14:26,790 --> 00:14:25,519

that that they are developing

386

00:14:28,150 --> 00:14:26,800

individually

387

00:14:31,030 --> 00:14:28,160

coordinating for scale you bring a lot

388

00:14:33,189 --> 00:14:31,040

of people together that

389

00:14:35,110 --> 00:14:33,199

then are enable nasa to show the

390

00:14:36,870 --> 00:14:35,120

momentum that is being built

391

00:14:38,389 --> 00:14:36,880

it provides opportunities for people to

392

00:14:39,750 --> 00:14:38,399

see what else is going on in industry

393

00:14:41,829 --> 00:14:39,760

and potentially find

394

00:14:43,350 --> 00:14:41,839

complementary demonstrations

395

00:14:46,150 --> 00:14:43,360

and it allows

396

00:14:49,750 --> 00:14:48,150

really investors and large businesses to

397

00:14:52,470 --> 00:14:49,760

come and see what's going on as a

398

00:14:54,949 --> 00:14:52,480

potential a shopping spree for for

399

00:14:56,389 --> 00:14:54,959

acquisitions

400

00:14:57,829 --> 00:14:56,399

and then the big piece is a headline

401
00:15:00,470 --> 00:14:57,839
event so

402
00:15:02,310 --> 00:15:00,480
right now we have four five six events a

403
00:15:03,269 --> 00:15:02,320
year that aren't these small

404
00:15:05,430 --> 00:15:03,279
demonstrations they're big

405
00:15:07,910 --> 00:15:05,440
demonstrations newsworthy on their own

406
00:15:10,389 --> 00:15:07,920
and if we coordinate these smaller demos

407
00:15:13,350 --> 00:15:10,399
these consolidated demos with the

408
00:15:15,590 --> 00:15:13,360
headline events then we essentially have

409
00:15:17,670 --> 00:15:15,600
the opportunity to take turns within

410
00:15:20,069 --> 00:15:17,680
industry providing the coattails for

411
00:15:22,150 --> 00:15:20,079
everyone else

412
00:15:24,629 --> 00:15:22,160
so how would prospect dynamics

413
00:15:27,110 --> 00:15:24,639

leverage this structure

414

00:15:28,790 --> 00:15:27,120

one of our focuses would i

415

00:15:30,710 --> 00:15:28,800

would certainly be within that roadmap

416

00:15:32,870 --> 00:15:30,720

as a key point and that is anchoring or

417

00:15:34,629 --> 00:15:32,880

attachment technology

418

00:15:37,110 --> 00:15:34,639

as we progress through the development

419

00:15:39,910 --> 00:15:37,120

we participate in demo days with

420

00:15:41,990 --> 00:15:39,920

different interesting and engaging

421

00:15:44,230 --> 00:15:42,000

attempts at showing how the technology

422

00:15:45,829 --> 00:15:44,240

is progressing

423

00:15:47,509 --> 00:15:45,839

in time we would be ready for a low

424

00:15:49,670 --> 00:15:47,519

earth orbit attachment demonstration

425

00:15:52,470 --> 00:15:49,680

which could serve as a headline marquee

426

00:15:53,910 --> 00:15:52,480

demo for a demo day

427

00:15:56,150 --> 00:15:53,920

i'll talk more about this slide in

428

00:15:57,670 --> 00:15:56,160

context 350 this afternoon in the

429

00:16:00,470 --> 00:15:57,680

asteroid deflection demonstration

430

00:16:02,230 --> 00:16:00,480

session but it is relevant here as well

431

00:16:05,110 --> 00:16:02,240

what we would do for a demonstration of

432

00:16:07,189 --> 00:16:05,120

attachment technology is demonstrate in

433

00:16:08,550 --> 00:16:07,199

low earth orbit rather than going to an

434

00:16:10,310 --> 00:16:08,560

ashtray

435

00:16:12,230 --> 00:16:10,320

we would

436

00:16:14,150 --> 00:16:12,240

lift

437

00:16:16,470 --> 00:16:14,160

potentially a handful of cubesats

438

00:16:18,069 --> 00:16:16,480

enabled with an attachment capability

439

00:16:20,230 --> 00:16:18,079

and then use space debris as an asteroid

440

00:16:21,110 --> 00:16:20,240

analog attached to the space debris

441

00:16:22,710 --> 00:16:21,120

object

442

00:16:24,069 --> 00:16:22,720

characterize its motion and then change

443

00:16:25,670 --> 00:16:24,079

its orbit

444

00:16:28,389 --> 00:16:25,680

this proves out the attachment

445

00:16:30,550 --> 00:16:28,399

capability in a

446

00:16:32,310 --> 00:16:30,560

potentially bold and very visible manner

447

00:16:34,629 --> 00:16:32,320

and it also highlights a number of

448

00:16:36,389 --> 00:16:34,639

applications that a single technology

449

00:16:37,829 --> 00:16:36,399

can be used for from the planetary

450

00:16:40,230 --> 00:16:37,839

defense application they'll talk about

451
00:16:42,949 --> 00:16:40,240
this afternoon to

452
00:16:44,629 --> 00:16:42,959
space debris mitigation if the altered

453
00:16:46,790 --> 00:16:44,639
orbit is to deorbit

454
00:16:49,670 --> 00:16:46,800
potential applications for

455
00:16:51,189 --> 00:16:49,680
on-orbit servicing as well

456
00:16:52,230 --> 00:16:51,199
so that is how we would engage the

457
00:16:55,509 --> 00:16:52,240
process

458
00:16:58,790 --> 00:16:55,519
but back to the overall

459
00:17:01,350 --> 00:16:58,800
concept in reducing barriers to entry

460
00:17:02,470 --> 00:17:01,360
funding via investments or simplified

461
00:17:04,949 --> 00:17:02,480
contracting

462
00:17:07,270 --> 00:17:04,959
and visibility being a means to indirect

463
00:17:09,029 --> 00:17:07,280

funding allowing us to go out into

464

00:17:11,829 --> 00:17:09,039

the investor community with the

465

00:17:13,590 --> 00:17:11,839

credibility of nasa behind us and then

466

00:17:16,549 --> 00:17:13,600

this overall idea of coordinated

467

00:17:19,029 --> 00:17:16,559

demonstrations to allow for

468

00:17:21,110 --> 00:17:19,039

leveraging the economies of scale

469

00:17:22,710 --> 00:17:21,120

establishing the technology roadmap so

470

00:17:24,630 --> 00:17:22,720

we know where we're going together in a

471

00:17:26,150 --> 00:17:24,640

coordinated fashion and then providing

472

00:17:28,309 --> 00:17:26,160

this opportunity

473

00:17:30,950 --> 00:17:28,319

of bringing so many people together in

474

00:17:41,510 --> 00:17:32,470

thank you

475

00:17:55,350 --> 00:17:41,520

next up we have david gump from deep

476

00:17:55,360 --> 00:18:01,669

and rick tumlinson to help

477

00:18:04,230 --> 00:18:03,270

okay ready

478

00:18:05,990 --> 00:18:04,240

please

479

00:18:08,230 --> 00:18:06,000

i was going to start this with hello

480

00:18:09,430 --> 00:18:08,240

sharks but david won't let me do that

481

00:18:11,909 --> 00:18:09,440

pitch so

482

00:18:13,750 --> 00:18:11,919

um i believe uh first of all

483

00:18:15,029 --> 00:18:13,760

there are three banners with a lot of a

484

00:18:17,750 --> 00:18:15,039

lot of great banners here there should

485

00:18:20,390 --> 00:18:17,760

probably be two more one that says um

486

00:18:21,830 --> 00:18:20,400

harvest and i know that says utilize

487

00:18:23,909 --> 00:18:21,840

but they wouldn't have the meatball on

488

00:18:25,430 --> 00:18:23,919

them they would just be here as part of

489

00:18:26,549 --> 00:18:25,440

the flow

490

00:18:28,630 --> 00:18:26,559

uh because that's the kind of thing

491

00:18:31,029 --> 00:18:28,640

we're talking about here

492

00:18:33,110 --> 00:18:31,039

we have to

493

00:18:35,590 --> 00:18:33,120

be able to create something that is a

494

00:18:39,110 --> 00:18:35,600

sustainable program that shows returns

495

00:18:42,789 --> 00:18:39,120

both economic uh educational national

496

00:18:44,710 --> 00:18:42,799

in terms of defense of the planet um

497

00:18:48,470 --> 00:18:44,720

and um

498

00:18:49,430 --> 00:18:48,480

that kind of program is one that

499

00:18:52,310 --> 00:18:49,440

would

500

00:18:53,350 --> 00:18:52,320

be able to stand up to these uh

501
00:18:55,669 --> 00:18:53,360
uh

502
00:18:57,029 --> 00:18:55,679
you know activities a lot better and

503
00:18:58,630 --> 00:18:57,039
it's something that it has to be

504
00:19:00,230 --> 00:18:58,640
sellable on all these different levels

505
00:19:02,150 --> 00:19:00,240
and it has to as somebody said in one of

506
00:19:03,669 --> 00:19:02,160
the earlier presentations that has to be

507
00:19:06,150 --> 00:19:03,679
kept sold

508
00:19:08,070 --> 00:19:06,160
and um certain programs that are being

509
00:19:10,150 --> 00:19:08,080
put out and ideas that are being put out

510
00:19:11,990 --> 00:19:10,160
just don't fit that so the overall

511
00:19:14,310 --> 00:19:12,000
broader partnerships that we can create

512
00:19:16,549 --> 00:19:14,320
the ones that show both economic and

513
00:19:18,230 --> 00:19:16,559

cultural uh returns

514

00:19:20,789 --> 00:19:18,240

are the ones that are going to be the

515

00:19:22,630 --> 00:19:20,799

ones that succeed in the long run and if

516

00:19:24,950 --> 00:19:22,640

we don't pay attention we will end up in

517

00:19:26,150 --> 00:19:24,960

the the special rocket ship garbage can

518

00:19:28,630 --> 00:19:26,160

of congress

519

00:19:30,150 --> 00:19:28,640

um because they need to see these things

520

00:19:33,830 --> 00:19:30,160

and white houses need to see these

521

00:19:35,990 --> 00:19:33,840

things and they need to go beyond the

522

00:19:38,710 --> 00:19:36,000

time-based parochial interests

523

00:19:40,470 --> 00:19:38,720

of of you know every administration that

524

00:19:42,310 --> 00:19:40,480

comes in redefines space

525

00:19:44,150 --> 00:19:42,320

one administration it's the moon one

526

00:19:46,549 --> 00:19:44,160

says it's mars one says it's asteroids

527

00:19:48,070 --> 00:19:46,559

been there to the moon etc etc so there

528

00:19:49,909 --> 00:19:48,080

needs to be an overarching goal that

529

00:19:51,590 --> 00:19:49,919

goes beyond all of those and the

530

00:19:54,549 --> 00:19:51,600

constituencies need to be broad enough

531

00:19:57,110 --> 00:19:54,559

to keep the activity going through those

532

00:19:59,909 --> 00:19:57,120

seismic shifts that occur

533

00:20:01,669 --> 00:19:59,919

now nasa needs to do certain things it

534

00:20:04,390 --> 00:20:01,679

has a mandate to do certain things

535

00:20:06,390 --> 00:20:04,400

including data science space exploration

536

00:20:08,470 --> 00:20:06,400

operations and planetary defense

537

00:20:10,789 --> 00:20:08,480

and obviously

538

00:20:11,990 --> 00:20:10,799

anybody in uh on the inside or any even

539

00:20:13,750 --> 00:20:12,000

close to the inside knows that that's

540

00:20:15,830 --> 00:20:13,760

the ultimate goal is going to mars

541

00:20:17,110 --> 00:20:15,840

whether nasa gets there first or musk

542

00:20:19,830 --> 00:20:17,120

gets their first

543

00:20:22,070 --> 00:20:19,840

we're going to mars and there are a lot

544

00:20:24,710 --> 00:20:22,080

of uh activities that are considered by

545

00:20:27,350 --> 00:20:24,720

some to be dog legs from that um i i'm

546

00:20:28,870 --> 00:20:27,360

not interested in ripping a

547

00:20:30,710 --> 00:20:28,880

leg off a dog i don't know where that

548

00:20:32,470 --> 00:20:30,720

analogy came from but i wouldn't mind

549

00:20:34,950 --> 00:20:32,480

hitching extra dogs to the sled to take

550

00:20:35,830 --> 00:20:34,960

us into the into the unknown

551
00:20:38,070 --> 00:20:35,840
um

552
00:20:41,029 --> 00:20:38,080
and we believe that ineos served that by

553
00:20:42,710 --> 00:20:41,039
helping us do different things in space

554
00:20:44,630 --> 00:20:42,720
keep in mind to get to any of these

555
00:20:46,549 --> 00:20:44,640
destinations you have to cross the ocean

556
00:20:49,029 --> 00:20:46,559
of space you have to go through what we

557
00:20:50,870 --> 00:20:49,039
call free space to get there and on the

558
00:20:52,870 --> 00:20:50,880
way it would be nice to be able to

559
00:20:55,830 --> 00:20:52,880
utilize what you can find there those

560
00:20:58,390 --> 00:20:55,840
resources to build your habitats uh find

561
00:20:59,590 --> 00:20:58,400
your fuel propellant

562
00:21:01,029 --> 00:20:59,600
and

563
00:21:04,149 --> 00:21:01,039

in the meantime we can be doing other

564

00:21:05,830 --> 00:21:04,159

activities such as helping

565

00:21:06,870 --> 00:21:05,840

communication satellites extend their

566

00:21:08,230 --> 00:21:06,880

life

567

00:21:10,390 --> 00:21:08,240

things like that so there's a lot of

568

00:21:12,630 --> 00:21:10,400

possibilities and if we can learn to

569

00:21:13,590 --> 00:21:12,640

live off the land it's absolutely the

570

00:21:15,110 --> 00:21:13,600

key

571

00:21:16,710 --> 00:21:15,120

we're working the transportation

572

00:21:18,070 --> 00:21:16,720

equation right now we're getting a

573

00:21:19,830 --> 00:21:18,080

government there are three legs to

574

00:21:21,750 --> 00:21:19,840

opening up frontier having a government

575

00:21:23,669 --> 00:21:21,760

that's not in your way or at least at

576
00:21:25,510 --> 00:21:23,679
least not your way and probably helping

577
00:21:27,270 --> 00:21:25,520
getting cheap to a transportation to and

578
00:21:28,470 --> 00:21:27,280
from the frontier and learning to live

579
00:21:29,430 --> 00:21:28,480
off the land and that's what we're all

580
00:21:32,310 --> 00:21:29,440
about

581
00:21:34,549 --> 00:21:32,320
someone hand this over to david

582
00:21:37,110 --> 00:21:34,559
so of the three locations for space

583
00:21:39,510 --> 00:21:37,120
based resources two of them are at the

584
00:21:41,270 --> 00:21:39,520
bottom of gravity wells

585
00:21:43,270 --> 00:21:41,280
and therefore when you do resources on

586
00:21:45,590 --> 00:21:43,280
the moon it primarily serves lunar

587
00:21:47,590 --> 00:21:45,600
activities same for mars that primarily

588
00:21:49,590 --> 00:21:47,600

serves martian activities but when you

589

00:21:52,149 --> 00:21:49,600

get your resources in free space you

590

00:21:53,029 --> 00:21:52,159

serve all those destinations plus earth

591

00:21:56,070 --> 00:21:53,039

orbit

592

00:21:59,430 --> 00:21:56,080

and we tend to envision the the asteroid

593

00:22:01,510 --> 00:21:59,440

initiative as an enabler for lots of

594

00:22:03,990 --> 00:22:01,520

space activities rather than as a

595

00:22:05,830 --> 00:22:04,000

destination

596

00:22:08,230 --> 00:22:05,840

and so we propose an initiative for

597

00:22:10,630 --> 00:22:08,240

commercial asteroid development that

598

00:22:13,190 --> 00:22:10,640

joins what nasa needs with what industry

599

00:22:15,669 --> 00:22:13,200

can get from from asteroids pooling the

600

00:22:18,149 --> 00:22:15,679

goals and technologies and being able to

601
00:22:19,190 --> 00:22:18,159
develop a more robust space exploration

602
00:22:21,110 --> 00:22:19,200
system

603
00:22:23,029 --> 00:22:21,120
and also in the in the process as i'll

604
00:22:25,590 --> 00:22:23,039
talk about later really enhancing

605
00:22:27,990 --> 00:22:25,600
planetary defense

606
00:22:31,110 --> 00:22:28,000
so what we propose is the the i can be

607
00:22:32,310 --> 00:22:31,120
modeled primarily on cots and the ild

608
00:22:35,590 --> 00:22:32,320
that

609
00:22:38,549 --> 00:22:35,600
chris lewicky talked about the idea is

610
00:22:41,270 --> 00:22:38,559
that you go with a fixed price approach

611
00:22:43,110 --> 00:22:41,280
and a below-cost approach to ensure that

612
00:22:45,270 --> 00:22:43,120
there's private investment

613
00:22:47,590 --> 00:22:45,280

you get paid on milestones

614

00:22:48,950 --> 00:22:47,600

rather than a monthly uh cost plus

615

00:22:52,630 --> 00:22:48,960

invoice

616

00:22:54,950 --> 00:22:52,640

nasa decides to buy what what it needs

617

00:22:58,149 --> 00:22:54,960

and then industry will fund additional

618

00:23:00,310 --> 00:22:58,159

capabilities to serve commercial markets

619

00:23:03,510 --> 00:23:00,320

just like with cots nasa specified we

620

00:23:06,230 --> 00:23:03,520

need this much tonnage and potentially

621

00:23:08,549 --> 00:23:06,240

these crew replacements done

622

00:23:11,350 --> 00:23:08,559

and spacex and orbital sciences could

623

00:23:14,149 --> 00:23:11,360

come up with a vehicle that did that

624

00:23:16,470 --> 00:23:14,159

plus what was necessary to make it an

625

00:23:18,390 --> 00:23:16,480

attractive commercial activity

626
00:23:19,750 --> 00:23:18,400
and the benefit of taking this approach

627
00:23:22,630 --> 00:23:19,760
is that

628
00:23:25,350 --> 00:23:22,640
it's sustainable those activities like

629
00:23:28,310 --> 00:23:25,360
falco falcon 9 will continue to operate

630
00:23:31,909 --> 00:23:28,320
even if it if the space station

631
00:23:34,149 --> 00:23:31,919
contract eventually goes away

632
00:23:34,950 --> 00:23:34,159
so you know the agency specifies its

633
00:23:37,750 --> 00:23:34,960
need

634
00:23:39,669 --> 00:23:37,760
provides tech dev and purchases data and

635
00:23:41,269 --> 00:23:39,679
the private sector both develops

636
00:23:43,430 --> 00:23:41,279
technologies and chooses which

637
00:23:45,190 --> 00:23:43,440
technologies need to be developed it

638
00:23:47,110 --> 00:23:45,200

shapes the operation

639

00:23:50,390 --> 00:23:47,120

and if there are multiple multiple

640

00:23:52,549 --> 00:23:50,400

suppliers nasa gets a competitive base

641

00:23:53,830 --> 00:23:52,559

to buy its needs from

642

00:23:56,390 --> 00:23:53,840

this

643

00:23:58,149 --> 00:23:56,400

produces lower costs as spacex showed

644

00:24:01,350 --> 00:23:58,159

not only was the total cost of getting

645

00:24:04,070 --> 00:24:01,360

it falcon 9 created lower than

646

00:24:06,390 --> 00:24:04,080

possible under standard contracting

647

00:24:07,830 --> 00:24:06,400

industry participated in paying that

648

00:24:10,630 --> 00:24:07,840

lower cost

649

00:24:12,870 --> 00:24:10,640

as as rick mentioned if if you have a

650

00:24:14,470 --> 00:24:12,880

commercial asteroid initiative you can

651
00:24:16,870 --> 00:24:14,480
cut off the dog leg

652
00:24:19,669 --> 00:24:16,880
hand it to industry and keep nasa

653
00:24:22,070 --> 00:24:19,679
focused on going to the moon and mars

654
00:24:25,029 --> 00:24:22,080
and it also results in in resources for

655
00:24:27,430 --> 00:24:25,039
a frontier uh living off the land and

656
00:24:28,870 --> 00:24:27,440
being able to stay in space once you get

657
00:24:30,870 --> 00:24:28,880
there

658
00:24:32,549 --> 00:24:30,880
we like to emphasize that

659
00:24:34,390 --> 00:24:32,559
first do no harm

660
00:24:37,029 --> 00:24:34,400
nasa ought to

661
00:24:40,230 --> 00:24:37,039
focus on having scouting missions

662
00:24:42,070 --> 00:24:40,240
for uh for industry

663
00:24:44,950 --> 00:24:42,080

and that should be the first action

664

00:24:48,710 --> 00:24:44,960

under a commercial asteroid development

665

00:24:50,149 --> 00:24:48,720

initiative and these small vehicles also

666

00:24:51,269 --> 00:24:50,159

in the next phase could do sample

667

00:24:53,029 --> 00:24:51,279

returns

668

00:24:54,789 --> 00:24:53,039

to reduce the great levels of

669

00:24:56,470 --> 00:24:54,799

uncertainty that exist

670

00:24:58,149 --> 00:24:56,480

with what

671

00:25:00,070 --> 00:24:58,159

anyone will find when you try to go to

672

00:25:04,230 --> 00:25:00,080

an asteroid for returning large

673

00:25:08,870 --> 00:25:05,990

and this i think might be one of the

674

00:25:11,029 --> 00:25:08,880

most important points for selling

675

00:25:12,789 --> 00:25:11,039

asteroid activity to congress and the

676
00:25:14,950 --> 00:25:12,799
general public

677
00:25:17,750 --> 00:25:14,960
you know your planetary defense can be

678
00:25:21,269 --> 00:25:20,149
it becomes a profit center learning how

679
00:25:23,510 --> 00:25:21,279
to

680
00:25:25,669 --> 00:25:23,520
inspect intercept and manage asteroids

681
00:25:29,350 --> 00:25:25,679
because the asteroid industry needs to

682
00:25:31,269 --> 00:25:29,360
do that in its normal course of business

683
00:25:33,029 --> 00:25:31,279
if you have a robust industry doing

684
00:25:35,909 --> 00:25:33,039
asteroid recovery

685
00:25:38,630 --> 00:25:35,919
activities you'll have the hardware and

686
00:25:39,750 --> 00:25:38,640
the people already in space for faster

687
00:25:41,669 --> 00:25:39,760
response

688
00:25:43,669 --> 00:25:41,679

you'll you'll have lots of bruce willis

689

00:25:46,149 --> 00:25:43,679

is already working in space

690

00:25:48,789 --> 00:25:46,159

you won't have to have a crash program

691

00:25:51,669 --> 00:25:48,799

to suddenly develop them and launch them

692

00:25:53,669 --> 00:25:51,679

so i think when you position

693

00:25:55,909 --> 00:25:53,679

asteroid activity politically

694

00:26:00,070 --> 00:25:55,919

we really need to focus on you get

695

00:26:04,390 --> 00:26:01,909

the other benefits are much broader

696

00:26:06,390 --> 00:26:04,400

science you know as on earth the

697

00:26:08,230 --> 00:26:06,400

resource industry

698

00:26:10,710 --> 00:26:08,240

coal and oil and gas

699

00:26:13,430 --> 00:26:10,720

has learned so much about the structure

700

00:26:15,350 --> 00:26:13,440

of the earth's crust that is paid for by

701
00:26:17,750 --> 00:26:15,360
commercial activities

702
00:26:19,190 --> 00:26:17,760
and if these things are done on an

703
00:26:21,510 --> 00:26:19,200
energy basis

704
00:26:24,390 --> 00:26:21,520
we can do things that nasa cannot

705
00:26:27,269 --> 00:26:24,400
charlie's done a great thing to take

706
00:26:30,070 --> 00:26:27,279
over the the exploitation rights

707
00:26:31,830 --> 00:26:30,080
of the solar sail project

708
00:26:34,070 --> 00:26:31,840
with an industry-led project though the

709
00:26:35,029 --> 00:26:34,080
actual activities themselves can be

710
00:26:36,870 --> 00:26:35,039
tweaked

711
00:26:39,269 --> 00:26:36,880
new things can be added to to the

712
00:26:41,510 --> 00:26:39,279
baseline mission that support public

713
00:26:44,470 --> 00:26:41,520

engage engagement

714

00:26:45,269 --> 00:26:44,480

so in summary we think that it ought to

715

00:26:46,870 --> 00:26:45,279

be

716

00:26:48,870 --> 00:26:46,880

a program that starts with buying

717

00:26:51,750 --> 00:26:48,880

scouting data

718

00:26:53,830 --> 00:26:51,760

and in parallel put out a baa for

719

00:26:55,669 --> 00:26:53,840

industry ideas and how nasa and the

720

00:26:58,149 --> 00:26:55,679

private sector could actually carry out

721

00:27:01,190 --> 00:26:58,159

the asteroid redirection mission

722

00:27:02,789 --> 00:27:01,200

and soon move into a phase where we you

723

00:27:05,830 --> 00:27:02,799

seek competitive

724

00:27:08,390 --> 00:27:05,840

bids to be able to bring back asteroids

725

00:27:11,029 --> 00:27:08,400

in a manner that serves nasa's needs and

726
00:27:12,230 --> 00:27:11,039
also provides a continuing resource in

727
00:27:14,549 --> 00:27:12,240
earth orbit

728
00:27:17,269 --> 00:27:14,559
that can be turned into useful products

729
00:27:18,630 --> 00:27:17,279
for expanding the frontier

730
00:27:21,350 --> 00:27:18,640
you'll notice nowhere in there do we

731
00:27:23,269 --> 00:27:21,360
talk about abandon in place surplus or

732
00:27:26,230 --> 00:27:23,279
prizes

733
00:27:29,909 --> 00:27:26,240
we are talking about

734
00:27:32,549 --> 00:27:29,919
analogies the ild and the cots

735
00:27:34,310 --> 00:27:32,559
approach a partnership

736
00:27:36,149 --> 00:27:34,320
this is the big plan this is the big

737
00:27:38,710 --> 00:27:36,159
goal and yes there are two asteroids

738
00:27:40,870 --> 00:27:38,720

rotating around that big red planet um

739

00:27:42,070 --> 00:27:40,880

but that's that's the big goal that's

740

00:27:45,510 --> 00:27:42,080

where i think

741

00:27:47,590 --> 00:27:45,520

most of uh nasa and and a lot of the

742

00:27:48,710 --> 00:27:47,600

those you know citizens of the country

743

00:27:51,029 --> 00:27:48,720

want to go

744

00:27:53,269 --> 00:27:51,039

um we have our plans and uh you know

745

00:27:56,070 --> 00:27:53,279

some of us are free spacers we believe

746

00:27:57,510 --> 00:27:56,080

that uh if we can get together we can do

747

00:27:59,510 --> 00:27:57,520

what we need to do

748

00:28:00,950 --> 00:27:59,520

and you know our merchant marine can

749

00:28:04,230 --> 00:28:00,960

help support

750

00:28:07,110 --> 00:28:04,240

uh the opening i won't say conquest

751

00:28:08,630 --> 00:28:07,120

of the of of mars but um i think it can

752

00:28:11,110 --> 00:28:08,640

be a joint partnership and i think

753

00:28:13,590 --> 00:28:11,120

there's a lot uh to be said for all of

754

00:28:15,190 --> 00:28:13,600

us working together in these ways thank

755

00:28:22,789 --> 00:28:15,200

you

756

00:28:27,830 --> 00:28:25,510

and next we should have eric mum from

757

00:28:33,990 --> 00:28:27,840

honeybee robotics joining us virtually

758

00:28:34,000 --> 00:28:37,669

okay

759

00:28:42,230 --> 00:28:39,750

so i wanted to

760

00:28:44,470 --> 00:28:42,240

focus today

761

00:28:48,549 --> 00:28:44,480

on robotic technology development

762

00:28:51,269 --> 00:28:48,559

and and maturation of the robotic

763

00:28:52,789 --> 00:28:51,279

systems and tasks that would be required

764

00:28:53,990 --> 00:28:52,799

for

765

00:28:55,750 --> 00:28:54,000

um

766

00:28:56,630 --> 00:28:55,760

a bold mission like this and and talk

767

00:28:59,909 --> 00:28:56,640

about

768

00:29:01,029 --> 00:28:59,919

uh how you know some of the facilities

769

00:29:03,190 --> 00:29:01,039

and

770

00:29:06,630 --> 00:29:03,200

capabilities that honeybee brings to the

771

00:29:09,430 --> 00:29:06,640

table and how that dovetails well with

772

00:29:11,750 --> 00:29:09,440

some great facilities and

773

00:29:13,029 --> 00:29:11,760

capabilities personnel at

774

00:29:16,310 --> 00:29:13,039

nasa

775

00:29:19,430 --> 00:29:16,320

and how we can mutually

776

00:29:21,830 --> 00:29:19,440

work how we can work together to

777

00:29:24,830 --> 00:29:21,840

to develop jointly develop a

778

00:29:27,510 --> 00:29:24,840

not only a robotic system that

779

00:29:29,750 --> 00:29:27,520

can be successful

780

00:29:31,110 --> 00:29:29,760

but also a ground test bed that we can

781

00:29:33,190 --> 00:29:31,120

use to validate

782

00:29:35,110 --> 00:29:33,200

these technologies so the first thing

783

00:29:37,430 --> 00:29:35,120

i'm going to uh

784

00:29:39,909 --> 00:29:37,440

focus on

785

00:29:41,190 --> 00:29:39,919

are some of the the relevant honeybee

786

00:29:42,630 --> 00:29:41,200

technologies

787

00:29:48,389 --> 00:29:42,640

that

788

00:29:51,190 --> 00:29:48,399

developed

789

00:29:53,909 --> 00:29:51,200

has has been developing end of robotic

790

00:29:55,430 --> 00:29:53,919

systems end effectors sampling systems

791

00:29:57,029 --> 00:29:55,440

for

792

00:29:59,110 --> 00:29:57,039

the mars program

793

00:30:01,269 --> 00:29:59,120

lunar exploration and

794

00:30:04,070 --> 00:30:01,279

even

795

00:30:05,750 --> 00:30:04,080

asteroids and common sampling so we've

796

00:30:07,029 --> 00:30:05,760

been on every landed mission

797

00:30:09,190 --> 00:30:07,039

since mer

798

00:30:11,350 --> 00:30:09,200

mer we provided a

799

00:30:13,669 --> 00:30:11,360

rock abrasion tool or a grinding tool

800

00:30:15,430 --> 00:30:13,679

that's featured in this slide

801
00:30:17,029 --> 00:30:15,440
we provide two mechanisms for mars

802
00:30:19,909 --> 00:30:17,039
phoenix lander and then we've got two

803
00:30:21,590 --> 00:30:19,919
systems on curiosity right now

804
00:30:23,830 --> 00:30:21,600
so we've got a pretty good history of

805
00:30:25,830 --> 00:30:23,840
working with nasa on developing robotic

806
00:30:27,430 --> 00:30:25,840
systems and and performing great

807
00:30:29,190 --> 00:30:27,440
institute science

808
00:30:30,870 --> 00:30:29,200
um

809
00:30:32,710 --> 00:30:30,880
so i've got kind of a generalized slide

810
00:30:35,110 --> 00:30:32,720
deck because we've got uh

811
00:30:37,430 --> 00:30:35,120
presentations across multiple topics and

812
00:30:39,110 --> 00:30:37,440
this is the one that we had authorized

813
00:30:40,149 --> 00:30:39,120

to release so i'm going to skip through

814

00:30:42,870 --> 00:30:40,159

this

815

00:30:44,230 --> 00:30:42,880

pretty quickly and again just highlight

816

00:30:47,190 --> 00:30:44,240

some of the

817

00:30:49,750 --> 00:30:47,200

relevant technologies that

818

00:30:52,950 --> 00:30:49,760

honeybee brings to the table so we've

819

00:30:55,750 --> 00:30:52,960

been developing uh robotic uh drills

820

00:30:58,310 --> 00:30:55,760

planetary drills for for sampling uh

821

00:31:00,710 --> 00:30:58,320

powders and and taking cores

822

00:31:01,830 --> 00:31:00,720

uh for mars moon asteroids and comets

823

00:31:02,789 --> 00:31:01,840

we've got

824

00:31:06,549 --> 00:31:02,799

um

825

00:31:09,269 --> 00:31:06,559

probably a collection of 10 or so

826
00:31:13,430 --> 00:31:09,279
prototype drills and sampling systems in

827
00:31:17,750 --> 00:31:15,909
those are our systems that are available

828
00:31:19,830 --> 00:31:17,760
for continued technology development and

829
00:31:22,310 --> 00:31:19,840
demonstration

830
00:31:24,549 --> 00:31:22,320
for not only performing some in-situ

831
00:31:27,029 --> 00:31:24,559
science on an asteroid but but perhaps

832
00:31:30,389 --> 00:31:27,039
even placing anchors

833
00:31:34,710 --> 00:31:32,230
you know taking samples to perform

834
00:31:36,389 --> 00:31:34,720
institute science and and and um placing

835
00:31:37,669 --> 00:31:36,399
anchors in an asteroid

836
00:31:40,549 --> 00:31:37,679
um

837
00:31:42,149 --> 00:31:40,559
to minimize the eva activity uh you know

838
00:31:43,350 --> 00:31:42,159

once in lunar orbit

839

00:31:47,590 --> 00:31:43,360

um

840

00:31:50,070 --> 00:31:47,600

utility for robotic systems that could

841

00:31:51,990 --> 00:31:50,080

offload from the human aspect of

842

00:31:54,789 --> 00:31:52,000

characterizing and

843

00:31:56,470 --> 00:31:54,799

exploring an asteroid so

844

00:31:58,310 --> 00:31:56,480

we've got

845

00:32:00,710 --> 00:31:58,320

a great facility and a great set of

846

00:32:02,389 --> 00:32:00,720

prototype hardware pretty high trl

847

00:32:05,430 --> 00:32:02,399

hardware available

848

00:32:06,549 --> 00:32:05,440

to perform near-term demonstrations

849

00:32:12,389 --> 00:32:06,559

and and

850

00:32:16,630 --> 00:32:14,789

pneumatic sampling techniques so

851
00:32:19,750 --> 00:32:16,640
we've also developed some

852
00:32:23,190 --> 00:32:19,760
capturing mechanisms docking mechanisms

853
00:32:27,509 --> 00:32:24,710
satellite servicing

854
00:32:29,830 --> 00:32:27,519
but these can be applied to

855
00:32:31,830 --> 00:32:29,840
this mission context as well and so far

856
00:32:36,230 --> 00:32:31,840
as

857
00:32:38,070 --> 00:32:36,240
system can be used to capture boulders

858
00:32:40,070 --> 00:32:38,080
or or capture

859
00:32:42,710 --> 00:32:40,080
samples on an asteroid and pull it back

860
00:32:47,029 --> 00:32:42,720
to the to the spacecraft whereby we can

861
00:32:50,470 --> 00:32:49,269
this could even be scaled up to

862
00:32:54,070 --> 00:32:50,480
capture the

863
00:32:55,029 --> 00:32:54,080

the asteroid in its entirety

864

00:32:56,789 --> 00:32:55,039

and so

865

00:32:59,350 --> 00:32:56,799

you know those are a couple of the um

866

00:33:02,710 --> 00:32:59,360

top-level you know key technologies that

867

00:33:04,389 --> 00:33:02,720

that we see as as relevant um in in this

868

00:33:06,710 --> 00:33:04,399

mission concept

869

00:33:07,669 --> 00:33:06,720

uh or context

870

00:33:11,190 --> 00:33:07,679

um

871

00:33:14,870 --> 00:33:11,200

and and with regard to uh

872

00:33:16,230 --> 00:33:14,880

participatory engagement um first

873

00:33:17,190 --> 00:33:16,240

we maintain

874

00:33:19,350 --> 00:33:17,200

uh

875

00:33:22,230 --> 00:33:19,360

a nice facility out in pasadena

876

00:33:25,430 --> 00:33:23,110

where

877

00:33:27,269 --> 00:33:25,440

you know as i alluded to earlier

878

00:33:30,070 --> 00:33:27,279

we're developing various planetary

879

00:33:32,389 --> 00:33:30,080

drills and sampling technologies

880

00:33:33,430 --> 00:33:32,399

and the associated environmental test

881

00:33:35,190 --> 00:33:33,440

chambers

882

00:33:36,389 --> 00:33:35,200

required to

883

00:33:38,070 --> 00:33:36,399

um

884

00:33:40,870 --> 00:33:38,080

to validate uh some of these

885

00:33:43,590 --> 00:33:40,880

technologies uh in in a relevant

886

00:33:45,430 --> 00:33:43,600

environment and so we maintain you know

887

00:33:47,590 --> 00:33:45,440

three chambers you can see one very

888

00:33:49,590 --> 00:33:47,600

large chamber here on the left side of

889

00:33:51,590 --> 00:33:49,600

the screen that we um

890

00:33:53,990 --> 00:33:51,600

we use for some of our deep drilling

891

00:33:55,350 --> 00:33:54,000

demonstrations in a again in a relevant

892

00:33:57,830 --> 00:33:55,360

environment

893

00:33:59,269 --> 00:33:57,840

and the facility also uh has an

894

00:34:00,230 --> 00:33:59,279

extensive

895

00:34:02,789 --> 00:34:00,240

uh

896

00:34:04,950 --> 00:34:02,799

materials analog or analog materials

897

00:34:09,030 --> 00:34:04,960

library so we've got planetary

898

00:34:12,710 --> 00:34:09,040

stimulants such as jsc1 fjs1 grc1

899

00:34:15,270 --> 00:34:12,720

and many um targets or rocks that are

900

00:34:17,030 --> 00:34:15,280

good analogs to what we might encounter

901
00:34:19,510 --> 00:34:17,040
on the surface of an asteroid so we

902
00:34:21,510 --> 00:34:19,520
maintain this capability within

903
00:34:24,389 --> 00:34:21,520
um you know the

904
00:34:27,190 --> 00:34:24,399
the the honeybee umbrella and i'm

905
00:34:30,790 --> 00:34:27,200
pleased to report that

906
00:34:34,550 --> 00:34:30,800
we have has recently started

907
00:34:36,389 --> 00:34:34,560
engaging on the government side

908
00:34:37,430 --> 00:34:36,399
the satellite servicing capabilities

909
00:34:40,550 --> 00:34:37,440
office

910
00:34:41,589 --> 00:34:40,560
at goddard space flight center

911
00:34:44,790 --> 00:34:41,599
and

912
00:34:47,829 --> 00:34:44,800
i know both spoke earlier

913
00:34:50,550 --> 00:34:47,839

but they maintain a wonderful facility

914

00:34:52,790 --> 00:34:50,560

there at goddard

915

00:34:54,950 --> 00:34:52,800

whereby you know we can not only

916

00:34:56,710 --> 00:34:54,960

validate

917

00:34:58,069 --> 00:34:56,720

certain robotic

918

00:34:59,990 --> 00:34:58,079

technologies

919

00:35:00,829 --> 00:35:00,000

such as

920

00:35:02,950 --> 00:35:00,839

you know

921

00:35:05,829 --> 00:35:02,960

grasping or

922

00:35:08,230 --> 00:35:05,839

capturing a boulder or capturing

923

00:35:10,069 --> 00:35:08,240

a large object but also manipulating

924

00:35:14,150 --> 00:35:10,079

that large object so maybe we place

925

00:35:20,069 --> 00:35:17,589

we drill and sample uh and and and so we

926

00:35:22,310 --> 00:35:20,079

see a a nice um

927

00:35:23,349 --> 00:35:22,320

culmination of of capabilities here

928

00:35:25,750 --> 00:35:23,359

between

929

00:35:27,589 --> 00:35:25,760

uh honeybee and our you know government

930

00:35:29,910 --> 00:35:27,599

counterpart in this case goddard space

931

00:35:33,589 --> 00:35:29,920

flight center and leveraging their vast

932

00:35:36,150 --> 00:35:33,599

vast expertise and robotic servicing

933

00:35:37,750 --> 00:35:36,160

and their amazing test beds along with

934

00:35:42,310 --> 00:35:37,760

our expertise and

935

00:35:45,030 --> 00:35:42,320

and robotic drills robotic end effectors

936

00:35:46,870 --> 00:35:45,040

and again some of the uh the sampling

937

00:35:49,670 --> 00:35:46,880

techniques and the anchoring techniques

938

00:35:51,270 --> 00:35:49,680

and and the geotechnical uh expertise

939

00:35:52,790 --> 00:35:51,280

that will be required when interacting

940

00:35:55,670 --> 00:35:52,800

with an asteroid

941

00:35:56,550 --> 00:35:55,680

um and so you know this is one of the

942

00:35:59,190 --> 00:35:56,560

this is

943

00:35:59,990 --> 00:35:59,200

we feel a fine example of a nice you

944

00:36:02,550 --> 00:36:00,000

know

945

00:36:04,150 --> 00:36:02,560

private and government

946

00:36:07,349 --> 00:36:04,160

collaboration

947

00:36:09,430 --> 00:36:07,359

uh that should absolutely be exploited

948

00:36:11,510 --> 00:36:09,440

um you know to buy

949

00:36:13,109 --> 00:36:11,520

excuse me to buy down risk and to

950

00:36:15,190 --> 00:36:13,119

demonstrate

951
00:36:17,190 --> 00:36:15,200
technology into mature technologies that

952
00:36:20,150 --> 00:36:17,200
will be necessary

953
00:36:24,390 --> 00:36:20,160
to pull off a bold mission such as

954
00:36:28,710 --> 00:36:26,550
that i think uh about wraps it up about

955
00:36:30,069 --> 00:36:28,720
my ten minute time limit so uh that's

956
00:36:31,990 --> 00:36:30,079
that's all i have i thank you for your

957
00:36:34,710 --> 00:36:32,000
time and attention

958
00:36:36,470 --> 00:36:34,720
thank you eric

959
00:36:38,550 --> 00:36:36,480
and ask that you would

960
00:36:40,470 --> 00:36:38,560
stay online uh

961
00:36:43,109 --> 00:36:40,480
as we now move into our question phase

962
00:36:44,790 --> 00:36:43,119
for this group um

963
00:36:47,109 --> 00:36:44,800

let me throw it out to joe do we have

964

00:36:53,510 --> 00:36:47,119

anything coming in yeah

965

00:36:58,390 --> 00:36:54,790

thanks

966

00:37:00,390 --> 00:36:58,400

um so this one is um actually to chris

967

00:37:03,030 --> 00:37:00,400

uh planetary resources it's from uh

968

00:37:04,870 --> 00:37:03,040

clinton clark online um the question is

969

00:37:07,270 --> 00:37:04,880

if nasa focuses on

970

00:37:09,430 --> 00:37:07,280

prize money for funding of

971

00:37:10,710 --> 00:37:09,440

an asteroid study capture

972

00:37:13,030 --> 00:37:10,720

how would that affect your business

973

00:37:18,230 --> 00:37:13,040

model or your competition uh or your

974

00:37:22,870 --> 00:37:19,430

all right thanks for the question

975

00:37:28,230 --> 00:37:24,870

uh

976

00:37:31,270 --> 00:37:28,240

the availability of nasa's interest in

977

00:37:31,990 --> 00:37:31,280

prospecting missions and to provide a

978

00:37:48,950 --> 00:37:32,000

a

979

00:37:50,870 --> 00:37:48,960

explicit line of business

980

00:37:53,589 --> 00:37:50,880

without something like that uh we're

981

00:37:55,510 --> 00:37:53,599

kind of left wondering uh what nasa's

982

00:37:57,510 --> 00:37:55,520

objectives are and whether they may

983

00:38:00,470 --> 00:37:57,520

choose to meet them themselves

984

00:38:02,390 --> 00:38:00,480

or if uh in this example that i laid out

985

00:38:05,030 --> 00:38:02,400

and uh it was laid out in other

986

00:38:07,430 --> 00:38:05,040

presentations this morning can allow

987

00:38:08,870 --> 00:38:07,440

some well-defined collaboration with

988

00:38:13,190 --> 00:38:08,880

commercial capabilities that's coming

989

00:38:13,200 --> 00:38:23,430

thank you

990

00:38:27,910 --> 00:38:25,190

i think we should look

991

00:38:30,310 --> 00:38:27,920

at prizes in terms of the track record

992

00:38:33,430 --> 00:38:30,320

so far

993

00:38:37,670 --> 00:38:33,440

if you contrast that with cots

994

00:38:40,069 --> 00:38:37,680

nasa paid spacex roughly 90

995

00:38:41,349 --> 00:38:40,079

of the cots contract before their first

996

00:38:43,990 --> 00:38:41,359

launch

997

00:38:46,069 --> 00:38:44,000

and they now have a successful rocket

998

00:38:48,870 --> 00:38:46,079

if you look at the google lunar x prize

999

00:38:50,630 --> 00:38:48,880

uh which pays in

1000

00:38:52,390 --> 00:38:50,640

initially zero

1001
00:38:55,670 --> 00:38:52,400
prior to success

1002
00:38:58,069 --> 00:38:55,680
and the ild companion contract that nasa

1003
00:39:00,950 --> 00:38:58,079
came up with it was perhaps 10 percent

1004
00:39:03,030 --> 00:39:00,960
prior to launch none of the google lunar

1005
00:39:04,150 --> 00:39:03,040
x prize teams are in particularly good

1006
00:39:06,069 --> 00:39:04,160
shape

1007
00:39:08,150 --> 00:39:06,079
and there's great doubt as to whether

1008
00:39:10,310 --> 00:39:08,160
any of them will actually be able to get

1009
00:39:12,390 --> 00:39:10,320
to the moon by the deadline

1010
00:39:15,270 --> 00:39:12,400
so i think in terms of asteroids we

1011
00:39:23,589 --> 00:39:15,280
ought to lean towards the cots approach

1012
00:39:30,630 --> 00:39:25,990
i i maybe this is for david and rick or

1013
00:39:32,790 --> 00:39:30,640

for chris um i i was wondering if

1014

00:39:35,750 --> 00:39:32,800

if you thought that partnering with nasa

1015

00:39:37,589 --> 00:39:35,760

or help and help from nasa

1016

00:39:39,190 --> 00:39:37,599

with issues that may be related to the

1017

00:39:40,710 --> 00:39:39,200

outer space treaty

1018

00:39:43,349 --> 00:39:40,720

in the long run

1019

00:39:52,550 --> 00:39:43,359

is important or is that not important to

1020

00:39:55,990 --> 00:39:54,390

i can address that question

1021

00:39:57,990 --> 00:39:56,000

so with regards to the outer space

1022

00:39:58,950 --> 00:39:58,000

treaty and the peaceful uses of outer

1023

00:40:01,589 --> 00:39:58,960

space

1024

00:40:04,390 --> 00:40:01,599

the issue is often frequently one of

1025

00:40:05,510 --> 00:40:04,400

rights of extraction and mineral rights

1026
00:40:08,470 --> 00:40:05,520
and

1027
00:40:09,990 --> 00:40:08,480
we of course have seen that used by many

1028
00:40:11,910 --> 00:40:10,000
different nations including the united

1029
00:40:14,870 --> 00:40:11,920
states in the collecting and returning

1030
00:40:17,030 --> 00:40:14,880
of samples for scientific use

1031
00:40:18,870 --> 00:40:17,040
in partnering with nasa for

1032
00:40:20,630 --> 00:40:18,880
obtaining those materials

1033
00:40:23,190 --> 00:40:20,640
perhaps eventually for science use but

1034
00:40:24,950 --> 00:40:23,200
as a result of a business transaction

1035
00:40:26,950 --> 00:40:24,960
this is an area where we can really

1036
00:40:29,910 --> 00:40:26,960
clarify this area of the outer space

1037
00:40:32,470 --> 00:40:29,920
treaty and continue to set precedent

1038
00:40:35,430 --> 00:40:32,480

in how it outlines and defines and

1039

00:40:36,550 --> 00:40:35,440

allows this type of peaceful activity in

1040

00:40:42,790 --> 00:40:36,560

space

1041

00:40:47,510 --> 00:40:45,829

i think we could use nasa's help in

1042

00:40:50,150 --> 00:40:47,520

making sure that the

1043

00:40:51,190 --> 00:40:50,160

space lawyer community

1044

00:40:53,829 --> 00:40:51,200

is

1045

00:40:56,870 --> 00:40:53,839

following practice rather than declaring

1046

00:40:58,790 --> 00:40:56,880

what practice should be

1047

00:41:01,190 --> 00:40:58,800

you know chris in the past has has made

1048

00:41:03,349 --> 00:41:01,200

the analogy to fishing in international

1049

00:41:05,030 --> 00:41:03,359

waters those fish are the common

1050

00:41:06,870 --> 00:41:05,040

heritage of all mankind but once they're

1051

00:41:08,470 --> 00:41:06,880

in the hold of your ship they're

1052

00:41:09,670 --> 00:41:08,480

obviously yours you can bring them back

1053

00:41:11,910 --> 00:41:09,680

to port

1054

00:41:14,390 --> 00:41:11,920

i'd like to try that approach for

1055

00:41:17,270 --> 00:41:14,400

asteroid resources to start

1056

00:41:20,870 --> 00:41:17,280

i guess my greatest fear is a a space

1057

00:41:23,030 --> 00:41:20,880

lawyer tsunami cranking up with lots of

1058

00:41:36,390 --> 00:41:23,040

bright ideas of how to structure

1059

00:41:39,829 --> 00:41:37,910

i just want to weigh in on that as well

1060

00:41:41,190 --> 00:41:39,839

i think that

1061

00:41:42,950 --> 00:41:41,200

several of those treaties the early

1062

00:41:43,910 --> 00:41:42,960

treaties were written in terms of nation

1063

00:41:47,030 --> 00:41:43,920

states

1064

00:41:48,630 --> 00:41:47,040
as opposed to private companies

1065

00:41:49,990 --> 00:41:48,640
nobody even thought that private

1066

00:41:51,750 --> 00:41:50,000
companies would be

1067

00:41:52,950 --> 00:41:51,760
engaging in space activities at that

1068

00:41:55,030 --> 00:41:52,960
point and

1069

00:41:57,510 --> 00:41:55,040
we need to be cautious

1070

00:41:59,670 --> 00:41:57,520
um in the sense that if if a nation

1071

00:42:01,510 --> 00:41:59,680
state the form of nasa is undertaking

1072

00:42:03,910 --> 00:42:01,520
certain activities that it doesn't

1073

00:42:06,069 --> 00:42:03,920
trigger reactions that then trickle down

1074

00:42:08,309 --> 00:42:06,079
and inhibit the private sector from

1075

00:42:10,069 --> 00:42:08,319
doing what we want to do there are

1076

00:42:11,670 --> 00:42:10,079

people and i i

1077

00:42:12,630 --> 00:42:11,680

shared a thing in london recently we had

1078

00:42:14,790 --> 00:42:12,640

somebody

1079

00:42:16,950 --> 00:42:14,800

pop up and say well

1080

00:42:19,190 --> 00:42:16,960

we are in i think it was pakistan and he

1081

00:42:21,510 --> 00:42:19,200

said uh it was an interesting refrain

1082

00:42:22,790 --> 00:42:21,520

from the from the 60s and 70s he said

1083

00:42:24,950 --> 00:42:22,800

basically uh

1084

00:42:26,069 --> 00:42:24,960

um you know we deserve a piece of the

1085

00:42:27,190 --> 00:42:26,079

wealth that you're going to create in

1086

00:42:28,150 --> 00:42:27,200

space

1087

00:42:29,990 --> 00:42:28,160

uh

1088

00:42:31,349 --> 00:42:30,000

i guess just because we're human beings

1089

00:42:32,470 --> 00:42:31,359

on the planet with you

1090

00:42:34,950 --> 00:42:32,480

um

1091

00:42:36,870 --> 00:42:34,960

i think that that can be handled

1092

00:42:38,230 --> 00:42:36,880

more in a in a private sector realm by

1093

00:42:40,550 --> 00:42:38,240

the fact that

1094

00:42:42,150 --> 00:42:40,560

the obvious best way to distribute

1095

00:42:44,390 --> 00:42:42,160

wealth on the planet that seems to be

1096

00:42:46,710 --> 00:42:44,400

working most effectively

1097

00:42:48,870 --> 00:42:46,720

is the free enterprise economic system

1098

00:42:50,390 --> 00:42:48,880

and many of the foes and the people that

1099

00:42:51,670 --> 00:42:50,400

were in the quote-unquote non-aligned

1100

00:42:54,390 --> 00:42:51,680

movement

1101

00:42:56,870 --> 00:42:54,400

in the uh 60s and the early in the 70s

1102

00:42:59,670 --> 00:42:56,880

where these treaties were drawn up

1103

00:43:01,270 --> 00:42:59,680

now find themselves for example china

1104

00:43:02,870 --> 00:43:01,280

and the entrepreneurs in china on the

1105

00:43:04,630 --> 00:43:02,880

other side of things

1106

00:43:06,230 --> 00:43:04,640

so there are different ways to look at

1107

00:43:07,430 --> 00:43:06,240

it now than were originally intended by

1108

00:43:10,309 --> 00:43:07,440

those treaties

1109

00:43:12,550 --> 00:43:10,319

and i think nasa can encourage a

1110

00:43:13,589 --> 00:43:12,560

conversation but make sure that it

1111

00:43:16,309 --> 00:43:13,599

itself

1112

00:43:18,150 --> 00:43:16,319

does not become the point of the

1113

00:43:28,150 --> 00:43:18,160

argument by being a national entity

1114

00:43:32,550 --> 00:43:29,430

um

1115

00:43:35,910 --> 00:43:32,560

so i guess i i i applaud you guys in the

1116

00:43:37,910 --> 00:43:35,920

effort to open this new industry i i can

1117

00:43:40,390 --> 00:43:37,920

clearly see the parallels between what

1118

00:43:42,309 --> 00:43:40,400

nasa is doing in terms of scouting and

1119

00:43:45,190 --> 00:43:42,319

why scouting is important for you guys

1120

00:43:47,910 --> 00:43:45,200

and why you would like to

1121

00:43:51,750 --> 00:43:47,920

play a role in nasa's efforts to do that

1122

00:43:56,950 --> 00:43:53,990

opening a new mine is a very expensive

1123

00:43:58,790 --> 00:43:56,960

thing and and opening new industry is

1124

00:44:00,069 --> 00:43:58,800

very expensive it requires a lot of

1125

00:44:01,109 --> 00:44:00,079

investment

1126

00:44:02,550 --> 00:44:01,119

and

1127

00:44:04,230 --> 00:44:02,560

you know i think we'd like to believe

1128

00:44:07,030 --> 00:44:04,240

that there's potential private

1129

00:44:10,870 --> 00:44:07,040

investment to open this new industry

1130

00:44:14,550 --> 00:44:10,880

my question really is what can we do now

1131

00:44:17,109 --> 00:44:14,560

to make investors more likely

1132

00:44:19,270 --> 00:44:17,119

to help to help you and open that

1133

00:44:21,510 --> 00:44:19,280

industry what what needs to happen

1134

00:44:23,430 --> 00:44:21,520

before those investments investors will

1135

00:44:25,910 --> 00:44:23,440

come on board do we need to prove mining

1136

00:44:28,390 --> 00:44:25,920

technology do we need to find a thousand

1137

00:44:30,630 --> 00:44:28,400

rocks we can bring back what what is the

1138

00:44:39,109 --> 00:44:30,640

key thing that that needs to happen now

1139

00:44:42,710 --> 00:44:40,069

i think

1140

00:44:44,470 --> 00:44:42,720

investors look primarily at will you

1141

00:44:45,990 --> 00:44:44,480

have a market

1142

00:44:47,910 --> 00:44:46,000

for what you're doing

1143

00:44:49,589 --> 00:44:47,920

they have some faith that if there is a

1144

00:44:52,630 --> 00:44:49,599

market you'll find that technical

1145

00:44:55,190 --> 00:44:52,640

solution to serve that market

1146

00:44:56,470 --> 00:44:55,200

so in terms of nasa

1147

00:45:00,710 --> 00:44:56,480

in the past

1148

00:45:03,750 --> 00:45:00,720

when nasa's been planning mars missions

1149

00:45:06,630 --> 00:45:03,760

isru you know in space ircu has played a

1150

00:45:08,390 --> 00:45:06,640

relatively minor part because it's it's

1151
00:45:09,750 --> 00:45:08,400
not yet proven

1152
00:45:12,550 --> 00:45:09,760
and so instead

1153
00:45:15,349 --> 00:45:12,560
there's envisioned you know 10 giant

1154
00:45:16,630 --> 00:45:15,359
launch vehicles to get one mars mission

1155
00:45:20,150 --> 00:45:16,640
done

1156
00:45:22,470 --> 00:45:20,160
if if nasa could officially declare

1157
00:45:25,829 --> 00:45:22,480
and acknowledge we're not going to mars

1158
00:45:28,150 --> 00:45:25,839
unless we get resources in space

1159
00:45:31,910 --> 00:45:28,160
because there's no way we can afford 10

1160
00:45:35,510 --> 00:45:31,920
sls in in one year to do a mars mission

1161
00:45:38,150 --> 00:45:35,520
that provides one more marker for there

1162
00:45:41,270 --> 00:45:38,160
is a customer in addition to comsats in

1163
00:45:43,829 --> 00:45:41,280

addition to bigelow aerospace for large

1164

00:45:49,190 --> 00:45:43,839

quantities of space resources i think

1165

00:45:53,270 --> 00:45:50,790

do you want to comment on this as well

1166

00:45:55,190 --> 00:45:53,280

this is an excellent question uh in

1167

00:45:56,630 --> 00:45:55,200

terms of what government spending

1168

00:45:58,309 --> 00:45:56,640

ultimately can do

1169

00:46:00,069 --> 00:45:58,319

uh in

1170

00:46:02,710 --> 00:46:00,079

creating a foundation and an

1171

00:46:05,109 --> 00:46:02,720

infrastructure um which

1172

00:46:07,190 --> 00:46:05,119

helps overall sustainable exploration of

1173

00:46:08,630 --> 00:46:07,200

space and uh indefinite presence in

1174

00:46:09,990 --> 00:46:08,640

space

1175

00:46:12,710 --> 00:46:10,000

all mining of course starts with

1176
00:46:14,309 --> 00:46:12,720
prospecting and whether that prospecting

1177
00:46:16,710 --> 00:46:14,319
has been done by nasa scientific

1178
00:46:18,150 --> 00:46:16,720
missions or if it has been done by

1179
00:46:20,950 --> 00:46:18,160
commercial missions

1180
00:46:24,150 --> 00:46:20,960
that information helped connect the vast

1181
00:46:27,510 --> 00:46:24,160
meteorite database we have on earth with

1182
00:46:30,870 --> 00:46:27,520
specific bodies out in the solar system

1183
00:46:32,630 --> 00:46:30,880
nasa increasing uh its efforts and uh

1184
00:46:36,550 --> 00:46:32,640
doing as it has been done

1185
00:46:39,190 --> 00:46:36,560
uh with the neowise restart uh the

1186
00:46:41,510 --> 00:46:39,200
considering of repurposing kepler

1187
00:46:44,630 --> 00:46:41,520
for asteroid surveys and uh the funding

1188
00:46:47,030 --> 00:46:44,640

of new technology like neocam and spacex

1189

00:46:48,150 --> 00:46:47,040

agreements with groups like b612 and the

1190

00:46:50,309 --> 00:46:48,160

sentinel

1191

00:46:52,790 --> 00:46:50,319

to increase the rate of discovery we've

1192

00:46:54,309 --> 00:46:52,800

only found less than a percent of all

1193

00:46:56,550 --> 00:46:54,319

these objects

1194

00:46:59,190 --> 00:46:56,560

but perhaps the most important thing uh

1195

00:47:01,030 --> 00:46:59,200

that could be done with the way that we

1196

00:47:02,950 --> 00:47:01,040

are laying out an infrastructure in our

1197

00:47:04,950 --> 00:47:02,960

exploration of space is an

1198

00:47:07,190 --> 00:47:04,960

infrastructure that leverages those

1199

00:47:09,589 --> 00:47:07,200

resources that are already out in space

1200

00:47:11,430 --> 00:47:09,599

uh creating an architecture that uses

1201

00:47:14,069 --> 00:47:11,440

field depots that develops that

1202

00:47:15,510 --> 00:47:14,079

technology that creates a network

1203

00:47:16,870 --> 00:47:15,520

between here and mars and other

1204

00:47:18,550 --> 00:47:16,880

destinations

1205

00:47:20,309 --> 00:47:18,560

where those resources can be sourced

1206

00:47:22,069 --> 00:47:20,319

from where it makes the most sense maybe

1207

00:47:24,549 --> 00:47:22,079

from the surface of the earth maybe from

1208

00:47:27,990 --> 00:47:24,559

the moon maybe from the asteroids

1209

00:47:30,390 --> 00:47:28,000

and as we've seen in the past uh it is

1210

00:47:33,109 --> 00:47:30,400

some parts government some parts private

1211

00:47:35,270 --> 00:47:33,119

industry and i think in this particular

1212

00:47:39,430 --> 00:47:35,280

case and developing the solar system

1213

00:47:41,510 --> 00:47:39,440

economy it'll be no different

1214

00:47:42,870 --> 00:47:41,520

just to weigh in on that with chris and

1215

00:47:46,390 --> 00:47:42,880

and i think

1216

00:47:49,109 --> 00:47:46,400

as an industry of two companies now

1217

00:47:51,349 --> 00:47:49,119

um we share a lot of the same opinions

1218

00:47:53,109 --> 00:47:51,359

the questions uh really get into this is

1219

00:47:54,710 --> 00:47:53,119

an organic dance

1220

00:47:57,109 --> 00:47:54,720

that we can engage with in the

1221

00:47:58,790 --> 00:47:57,119

government and it is really

1222

00:48:00,069 --> 00:47:58,800

uh making sure that we all know where

1223

00:48:02,710 --> 00:48:00,079

we're supposed to put our feet so we

1224

00:48:04,549 --> 00:48:02,720

don't step on each other um in the dance

1225

00:48:07,589 --> 00:48:04,559

and um

1226

00:48:09,670 --> 00:48:07,599

enter in terms of an arm nasa developing

1227

00:48:12,150 --> 00:48:09,680

as we saw last night the ability through

1228

00:48:13,910 --> 00:48:12,160

jpl and others the ability to go out and

1229

00:48:15,829 --> 00:48:13,920

grab things in bags and stuff like that

1230

00:48:17,829 --> 00:48:15,839

that's that's an appropriate government

1231

00:48:19,750 --> 00:48:17,839

role as far as i could see that that's

1232

00:48:21,910 --> 00:48:19,760

great research development

1233

00:48:23,910 --> 00:48:21,920

that helps lead the way

1234

00:48:25,430 --> 00:48:23,920

i won't get too far into the subject of

1235

00:48:27,190 --> 00:48:25,440

whether i believe nasa should be the one

1236

00:48:28,390 --> 00:48:27,200

going out to grab the asteroid on the

1237

00:48:30,549 --> 00:48:28,400

other hand

1238

00:48:32,470 --> 00:48:30,559

because pricing and pricing as set by the

1239

00:48:34,150 --> 00:48:32,480

government is going to be different than

1240

00:48:36,710 --> 00:48:34,160

that that's going to be set by the

1241

00:48:39,750 --> 00:48:36,720

private sector however if nasa can play

1242

00:48:41,349 --> 00:48:39,760

the customer role and determine that in

1243

00:48:43,270 --> 00:48:41,359

advance it's going to be a customer kind

1244

00:48:45,990 --> 00:48:43,280

of emphasizing what both chris and david

1245

00:48:47,670 --> 00:48:46,000

said if we look at for example

1246

00:48:49,990 --> 00:48:47,680

during the era of the space shuttle

1247

00:48:52,549 --> 00:48:50,000

great vehicle that it was amazing uh

1248

00:48:54,309 --> 00:48:52,559

system that it was

1249

00:48:56,549 --> 00:48:54,319

the government was providing an

1250

00:48:57,430 --> 00:48:56,559

operational industrial transportation

1251

00:48:59,030 --> 00:48:57,440

role

1252

00:49:00,710 --> 00:48:59,040

with the space shuttle out of the

1253

00:49:02,710 --> 00:49:00,720

picture and it now being clear that the

1254

00:49:05,190 --> 00:49:02,720

government's going to buy its payloads

1255

00:49:07,910 --> 00:49:05,200

and services from the commercial sector

1256

00:49:10,790 --> 00:49:07,920

the commercial sector can go out and and

1257

00:49:12,790 --> 00:49:10,800

build in that direction and both parties

1258

00:49:15,030 --> 00:49:12,800

win the government in the end will have

1259

00:49:17,670 --> 00:49:15,040

lower cost and more reliable

1260

00:49:19,109 --> 00:49:17,680

multi-source transportation systems

1261

00:49:21,349 --> 00:49:19,119

and the private sector will have a

1262

00:49:23,670 --> 00:49:21,359

market that it can go out to and

1263

00:49:26,870 --> 00:49:23,680

leverage the investment that it gets by

1264

00:49:28,630 --> 00:49:26,880

the same token if nasa downstream

1265

00:49:31,270 --> 00:49:28,640

does declare as david mentioned that it

1266

00:49:33,430 --> 00:49:31,280

is going to be buying resources buying

1267

00:49:34,710 --> 00:49:33,440

data buying these things and the lines

1268

00:49:36,630 --> 00:49:34,720

are clear

1269

00:49:38,790 --> 00:49:36,640

that that's going to be there then we

1270

00:49:40,710 --> 00:49:38,800

can go back to investors and say look

1271

00:49:42,470 --> 00:49:40,720

there are customers in the form of

1272

00:49:44,870 --> 00:49:42,480

government downstream

1273

00:49:46,710 --> 00:49:44,880

the government in turn can look at its

1274

00:49:48,549 --> 00:49:46,720

budget estimates and say you know what

1275

00:49:49,349 --> 00:49:48,559

we're going to be able to save x amount

1276

00:49:52,069 --> 00:49:49,359

because these are going to be

1277

00:49:54,230 --> 00:49:52,079

commercially provided services as in the

1278

00:49:56,549 --> 00:49:54,240

the case of commercial transportation to

1279

00:49:59,349 --> 00:49:56,559

and from orbit so it really is a dance

1280

00:50:01,510 --> 00:49:59,359

that goes on between both sectors if we

1281

00:50:03,030 --> 00:50:01,520

can basically agree on the music the

1282

00:50:07,670 --> 00:50:03,040

tempo and the base

1283

00:50:07,680 --> 00:50:11,349

anything joe

1284

00:50:11,359 --> 00:50:14,870

okay

1285

00:50:18,950 --> 00:50:17,270

any other questions we're coming up uh

1286

00:50:22,069 --> 00:50:18,960

at the top of the hour for our next

1287

00:50:27,030 --> 00:50:24,309

all right why don't we hold it there

1288

00:50:29,510 --> 00:50:27,040

i will take another uh 10 minutes

1289

00:50:32,549 --> 00:50:29,520

uh and be back with our our third and

1290

00:50:35,190 --> 00:50:32,559

last uh group of panelists

1291

00:50:36,630 --> 00:50:35,200

uh and then open it up to discussion so

1292

00:50:37,910 --> 00:50:36,640

thank you everybody