



- 1  
00:00:00,000 --> 00:00:00,996  
Sound effects.
- 2  
00:00:00,997 --> 00:00:01,000  
up full with sfx timed to logo.
- 3  
00:00:11,167 --> 00:00:17,963  
Music.
- 4  
00:00:17,998 --> 00:00:18,779  
Music under narration.
- 5  
00:00:18,814 --> 00:00:20,043  
Getting tomorrow's
- 6  
00:00:20,078 --> 00:00:20,795  
technology ready
- 7  
00:00:20,830 --> 00:00:21,372  
for the future is the
- 8  
00:00:21,531 --> 00:00:22,347  
purpose of the Technology
- 9  
00:00:22,491 --> 00:00:23,339  
Demonstration Missions
- 10  
00:00:24,027 --> 00:00:26,074  
Program. Taking today's
- 11  
00:00:26,268 --> 00:00:27,499  
most promising exploration
- 12  
00:00:27,948 --> 00:00:28,986  
technology and raising it
- 13  
00:00:29,756 --> 00:00:30,410

to the level of maturity

14

00:00:30,716 --> 00:00:31,914

that mission planners

15

00:00:31,949 --> 00:00:33,291

require, means that TDM puts

16

00:00:33,404 --> 00:00:35,226

the technology to the

17

00:00:35,261 --> 00:00:38,011

test. The projects include

18

00:00:38,046 --> 00:00:39,515

communication, materials,

19

00:00:39,550 --> 00:00:41,547

propulsion and robotics.

20

00:00:41,582 --> 00:00:44,154

Key to any exploration

21

00:00:44,189 --> 00:00:46,026

program is effective

22

00:00:46,061 --> 00:00:47,722

communication. Current

23

00:00:47,757 --> 00:00:49,402

technology is hitting a bandwidth

24

00:00:49,437 --> 00:00:51,483

and wavelength ceiling.

25

00:00:51,518 --> 00:00:52,987

Tomorrow's missions will

26  
00:00:53,022 --> 00:00:55,355  
need a new technology. NASA

27  
00:00:55,390 --> 00:00:57,179  
is leading the effort to

28  
00:00:57,214 --> 00:00:58,810  
make laser light reinforce

29  
00:00:58,845 --> 00:01:01,050  
the current radio or RF

30  
00:01:01,085 --> 00:01:02,954  
based communications. The

31  
00:01:02,989 --> 00:01:04,795  
Laser Communications Relay

32  
00:01:04,830 --> 00:01:06,458  
Demonstration or "Laser

33  
00:01:06,493 --> 00:01:08,523  
Comm" project will provide

34  
00:01:08,558 --> 00:01:10,442  
an orbital test-bed for a

35  
00:01:10,477 --> 00:01:11,915  
wide variety of scenarios

36  
00:01:11,950 --> 00:01:13,691  
to simulate future

37  
00:01:13,726 --> 00:01:15,579  
missions. In the near future

38  
00:01:15,614 --> 00:01:17,019

laser communications could

39

00:01:17,054 --> 00:01:18,442

increase the amount of

40

00:01:18,477 --> 00:01:20,122

information to tens of

41

00:01:20,157 --> 00:01:22,634

gigabits per second. This

42

00:01:22,669 --> 00:01:24,106

would be an improvement of

43

00:01:24,141 --> 00:01:26,827

data rates of between 10-100

44

00:01:26,862 --> 00:01:29,451

times. The project will

45

00:01:29,486 --> 00:01:31,227

use laser light transmitted

46

00:01:31,262 --> 00:01:32,859

to a satellite payload and

47

00:01:32,894 --> 00:01:34,746

back to an earth station

48

00:01:34,781 --> 00:01:36,186

to simulate and test a

49

00:01:36,221 --> 00:01:38,091

large number of possible

50

00:01:38,126 --> 00:01:39,930

mission scenarios. Another

51  
00:01:39,965 --> 00:01:42,314  
foundational technology being

52  
00:01:42,349 --> 00:01:44,699  
improved by the TDM Program

53  
00:01:44,734 --> 00:01:46,139  
involves a basic component

54  
00:01:46,174 --> 00:01:48,523  
of all exploration missions■

55  
00:01:48,558 --> 00:01:50,907  
time. The Deep Space

56  
00:01:50,942 --> 00:01:53,098  
Atomic Clock project promises

57  
00:01:53,133 --> 00:01:54,842  
to reduce cost, improve

58  
00:01:54,877 --> 00:01:56,954  
space navigation, data

59  
00:01:56,989 --> 00:01:58,746  
quality and the next GPS

60  
00:01:58,781 --> 00:02:01,274  
system. To test this

61  
00:02:01,309 --> 00:02:02,954  
concept, the project will fly

62  
00:02:02,989 --> 00:02:05,179  
the deep space atomic clock

63  
00:02:05,214 --> 00:02:07,451

along with a GPS receiver

64

00:02:07,486 --> 00:02:08,938  
on a commercial communication

65

00:02:08,973 --> 00:02:11,034  
satellite. Ground

66

00:02:11,069 --> 00:02:12,522  
based systems require

67

00:02:12,557 --> 00:02:14,394  
two-way communication, with an

68

00:02:14,429 --> 00:02:15,962  
onboard atomic clock

69

00:02:15,997 --> 00:02:17,754  
DSAC allows for 1 way

70

00:02:17,789 --> 00:02:20,539  
navigation-using NASA's Deep

71

00:02:20,574 --> 00:02:22,635  
Space Network more efficiently!

72

00:02:22,670 --> 00:02:24,315  
Eventually this will

73

00:02:24,350 --> 00:02:25,994  
enable deep space autonomous

74

00:02:26,029 --> 00:02:28,506  
navigation. Communications

75

00:02:28,541 --> 00:02:30,378  
and science payloads

76

00:02:30,413 --> 00:02:31,786

need advanced warning of

77

00:02:31,821 --> 00:02:33,658

Solar Flares. One way to

78

00:02:33,693 --> 00:02:35,114

do that includes

79

00:02:35,149 --> 00:02:36,827

station-keeping capabilities like

80

00:02:36,862 --> 00:02:38,363

the current NOAA solar

81

00:02:38,398 --> 00:02:40,363

activity warning instrument.

82

00:02:40,398 --> 00:02:42,507

The TDM Solar Sail project

83

00:02:42,542 --> 00:02:44,028

takes a previously tested

84

00:02:44,063 --> 00:02:46,362

propulsion technology and

85

00:02:46,397 --> 00:02:47,610

infuses it into an even

86

00:02:47,645 --> 00:02:48,954

better warning system 2

87

00:02:48,989 --> 00:02:51,642

times closer to the sun. The

88

00:02:51,677 --> 00:02:53,371

## Solar Sail project

89

00:02:53,406 --> 00:02:54,843

pushes the technology to a

90

00:02:54,878 --> 00:02:56,507

practical application while

91

00:02:56,542 --> 00:02:58,059

simultaneously maturing the

92

00:02:58,094 --> 00:02:59,772

system so that future

93

00:02:59,807 --> 00:03:01,451

mission planners can chose it

94

00:03:01,486 --> 00:03:03,098

for a whole range of missions.

95

00:03:03,133 --> 00:03:05,738

All of NASA's Technology

96

00:03:05,773 --> 00:03:07,211

Demonstration Missions are

97

00:03:07,246 --> 00:03:09,051

infusing mature technology

98

00:03:09,086 --> 00:03:10,683

from the realm of tested

99

00:03:10,718 --> 00:03:12,122

to ready and proven,

100

00:03:12,157 --> 00:03:13,499

but one of those

101  
00:03:13,534 --> 00:03:14,731  
demonstrations tests the very

102  
00:03:14,766 --> 00:03:16,171  
materials that are used for

103  
00:03:16,206 --> 00:03:18,267  
space craft construction.

104  
00:03:18,302 --> 00:03:19,740  
That project is a continuation

105  
00:03:19,775 --> 00:03:21,610  
of a heritage project

106  
00:03:21,645 --> 00:03:23,146  
called MISSE; Materials

107  
00:03:23,181 --> 00:03:24,458  
International Space Station

108  
00:03:24,493 --> 00:03:26,202  
Experiment. Building on

109  
00:03:26,237 --> 00:03:27,419  
the previous missions,

110  
00:03:27,454 --> 00:03:28,986  
MISSE-X seeks to provide

111  
00:03:29,021 --> 00:03:30,395  
low-cost access to space

112  
00:03:30,430 --> 00:03:31,983  
technology experiments

113  
00:03:32,018 --> 00:03:33,796

using robotically installed

114

00:03:33,831 --> 00:03:35,796

"plug and play" features.

115

00:03:35,831 --> 00:03:37,442

MISSE-X plans to monitor the

116

00:03:37,477 --> 00:03:38,995

payloads by collecting

117

00:03:39,030 --> 00:03:41,621

data and photographic images

118

00:03:41,656 --> 00:03:42,610

in near real-time. This

119

00:03:42,645 --> 00:03:43,731

allows for faster testing

120

00:03:43,766 --> 00:03:45,155

of materials and greater

121

00:03:45,190 --> 00:03:46,963

opportunities for educators

122

00:03:46,998 --> 00:03:48,274

to have easy access to

123

00:03:48,309 --> 00:03:50,131

the ISS as an experimental

124

00:03:50,166 --> 00:03:52,498

platform. Maturing materials

125

00:03:52,533 --> 00:03:54,516

and technology continues

126  
00:03:54,551 --> 00:03:55,730  
to be an objective of

127  
00:03:55,765 --> 00:03:57,730  
the TDM Program. Sometimes

128  
00:03:57,765 --> 00:03:59,106  
that means putting instruments

129  
00:03:59,141 --> 00:04:00,401  
on the spacecraft of

130  
00:04:00,436 --> 00:04:01,970  
other NASA Missions to further

131  
00:04:02,005 --> 00:04:03,746  
our collective knowledge.

132  
00:04:03,781 --> 00:04:05,665  
One project that does that is

133  
00:04:05,700 --> 00:04:07,602  
MEDLI. MEDLI stands for Mars

134  
00:04:07,637 --> 00:04:10,546  
Science Laboratory Entry Descent

135  
00:04:10,581 --> 00:04:12,425  
and Landing Instrumentation.

136  
00:04:12,460 --> 00:04:13,784  
MEDLI is an instrumentation

137  
00:04:13,819 --> 00:04:15,193  
suite embedded in and behind the

138  
00:04:15,228 --> 00:04:17,720

heat shield of the Mars Science

139

00:04:17,755 --> 00:04:19,433

Laboratory now on its way to a

140

00:04:19,468 --> 00:04:21,673

Martian landing this summer.

141

00:04:21,708 --> 00:04:22,985

The instruments gather real-time

142

00:04:23,020 --> 00:04:24,713

data on the atmosphere, thermal

143

00:04:24,748 --> 00:04:26,345

protection system, or heat

144

00:04:26,380 --> 00:04:29,177

shield, and aerodynamics during

145

00:04:29,212 --> 00:04:31,736

entry and descent. The MEDLI

146

00:04:31,771 --> 00:04:33,383

data will improve modeling and

147

00:04:33,418 --> 00:04:35,047

predictive capabilities for future

148

00:04:35,082 --> 00:04:37,576

missions, ensuring safer and

149

00:04:37,611 --> 00:04:39,096

less expensive missions to a

150

00:04:39,131 --> 00:04:41,368

larger variety of destinations.

151

00:04:41,403 --> 00:04:47,767

Along with the MEDLI data, NASA

152

00:04:47,802 --> 00:04:49,415

will see the fruits of research

153

00:04:49,450 --> 00:04:51,637

into entry in low density

154

00:04:51,672 --> 00:04:53,493

atmospheres like Mar's with the

155

00:04:53,528 --> 00:04:55,204

Low Density Supersonic Decelerator

156

00:04:55,239 --> 00:04:59,573

or LDSD project. On Mars for

157

00:04:59,608 --> 00:05:01,684

example, increasingly massive

158

00:05:01,719 --> 00:05:03,221

payloads and eventually human

159

00:05:03,256 --> 00:05:05,683

missions will require new ways to

160

00:05:05,718 --> 00:05:08,292

slow down to subsonic speeds, high

161

00:05:08,327 --> 00:05:10,676

in the thin Martian Atmosphere,

162

00:05:10,711 --> 00:05:12,467

allowing more landing site

163

00:05:12,502 --> 00:05:14,964

options. These heavier spacecraft

164

00:05:14,999 --> 00:05:16,931  
will need large drag generating

165

00:05:16,966 --> 00:05:19,332  
devices and the LDSO project

166

00:05:19,367 --> 00:05:21,555  
will test 3 of them. Two of the

167

00:05:21,590 --> 00:05:27,300  
test articles will be inflatable

168

00:05:27,335 --> 00:05:28,387  
inner tube type devices that

169

00:05:28,422 --> 00:05:29,411  
surround the entry capsule.

170

00:05:29,446 --> 00:05:30,691  
These 6 and 9 meter devices will

171

00:05:30,726 --> 00:05:31,954  
be flown at supersonic speeds

172

00:05:31,989 --> 00:05:34,705  
high in the earth's atmosphere.

173

00:05:34,740 --> 00:05:36,083  
The third device will be a

174

00:05:36,118 --> 00:05:38,163  
large 30 meter parachute tested

175

00:05:38,198 --> 00:05:39,778  
several times to collect data

176  
00:05:39,813 --> 00:05:42,610  
for future exploration missions.

177  
00:05:42,645 --> 00:05:44,561  
All the previous exploration

178  
00:05:44,596 --> 00:05:46,370  
enabling technologies will be

179  
00:05:46,405 --> 00:05:47,330  
dependent on propulsion to get

180  
00:05:47,365 --> 00:05:49,265  
to their destination. Long

181  
00:05:49,300 --> 00:05:51,298  
duration missions require special

182  
00:05:51,333 --> 00:05:53,009  
considerations for the cryogenic

183  
00:05:53,044 --> 00:05:54,881  
propellant likely to be used

184  
00:05:54,916 --> 00:05:57,553  
for human exploration missions.

185  
00:05:57,588 --> 00:05:59,393  
On short missions, the natural

186  
00:05:59,428 --> 00:06:01,011  
boiling off of cryogenic fluids

187  
00:06:01,046 --> 00:06:03,098  
is not as serious a concern,

188  
00:06:03,133 --> 00:06:04,177

but on long missions it

189

00:06:04,212 --> 00:06:05,761

becomes critically important.

190

00:06:05,796 --> 00:06:08,426

Propellants are heavy and expensive

191

00:06:08,461 --> 00:06:10,473

to lift to orbit and therefore

192

00:06:10,508 --> 00:06:12,535

too precious to lose. Anything

193

00:06:12,570 --> 00:06:14,152

we can learn to minimize this

194

00:06:14,187 --> 00:06:17,416

pays back huge dividends! There

195

00:06:17,451 --> 00:06:19,064

are a variety of approaches to

196

00:06:19,099 --> 00:06:21,304

meet this challenge including

197

00:06:21,339 --> 00:06:23,064

passive systems like insulation

198

00:06:23,099 --> 00:06:25,704

and active ones like refrigeration.

199

00:06:25,739 --> 00:06:27,768

Another important part

200

00:06:27,803 --> 00:06:29,192

of this research is lossless

201  
00:06:29,227 --> 00:06:32,263  
transfer of cryogenic fluids and

202  
00:06:32,298 --> 00:06:33,703  
accurate measurement. Once

203  
00:06:33,738 --> 00:06:35,591  
completed, the flight demonstration

204  
00:06:35,626 --> 00:06:38,790  
technology projects will be

205  
00:06:38,825 --> 00:06:39,847  
extremely valuable, enabling

206  
00:06:39,882 --> 00:06:40,758  
us to reach our exploration

207  
00:06:40,793 --> 00:06:44,119  
goals■ beyond Earth orbit. As we

208  
00:06:44,154 --> 00:06:46,487  
begin to land even more ambitious

209  
00:06:46,522 --> 00:06:48,837  
crewed and robotic missions,

210  
00:06:48,872 --> 00:06:50,709  
one of the most challenging

211  
00:06:50,744 --> 00:06:52,341  
aspects of those missions will be

212  
00:06:52,376 --> 00:06:53,749  
landing in a large variety

213  
00:06:53,784 --> 00:06:55,301

of conditions. The Autonomous

214

00:06:55,336 --> 00:06:56,949

Landing and Hazard Avoidance

215

00:06:56,984 --> 00:06:59,797

Technology■ ALHAT, uses sensors to

216

00:06:59,832 --> 00:07:02,148

rapidly map the ground in 3D,

217

00:07:02,183 --> 00:07:04,148

and measure range and velocity far

218

00:07:04,183 --> 00:07:06,020

more accurately than existing

219

00:07:06,055 --> 00:07:08,916

radar systems. ALHAT has already

220

00:07:08,951 --> 00:07:10,356

made tremendous strides in

221

00:07:10,391 --> 00:07:11,860

meeting the challenge of safely

222

00:07:11,895 --> 00:07:13,972

landing in some very difficult

223

00:07:14,007 --> 00:07:16,051

terrain. In the near future ALHAT

224

00:07:16,086 --> 00:07:17,844

will be integrated with a

225

00:07:17,879 --> 00:07:19,346

vertical test bed named Morpheus

226  
00:07:19,381 --> 00:07:22,130  
to test and demonstrate advanced

227  
00:07:22,165 --> 00:07:24,306  
propulsion and safe landing

228  
00:07:24,341 --> 00:07:26,338  
techniques; critical for future

229  
00:07:26,373 --> 00:07:28,232  
missions. Some of those future

230  
00:07:28,267 --> 00:07:30,361  
missions will include humans,

231  
00:07:30,396 --> 00:07:32,873  
other robots, and some will

232  
00:07:32,908 --> 00:07:34,843  
be a symbiotic combination of

233  
00:07:34,878 --> 00:07:37,433  
both. The Telerobotics project

234  
00:07:37,468 --> 00:07:39,898  
is working onboard the International

235  
00:07:39,933 --> 00:07:41,497  
Space Station, integrating

236  
00:07:41,532 --> 00:07:43,322  
robotics seamlessly into the

237  
00:07:43,357 --> 00:07:45,576  
nation's space exploration

238  
00:07:45,611 --> 00:07:47,465

goals. From measuring environmental

239

00:07:47,500 --> 00:07:49,801

conditions on the ISS with

240

00:07:49,836 --> 00:07:51,801

free-flying robots called "Smart

241

00:07:51,836 --> 00:07:54,377

Spheres" to dexterous two armed

242

00:07:54,412 --> 00:07:57,096

humanoid robots like "Robonaut2,"

243

00:07:57,131 --> 00:07:58,825

NASA sees a growing role for

244

00:07:58,860 --> 00:08:01,192

intelligent robotic devices.

245

00:08:01,227 --> 00:08:04,088

TeleRobots can also save precious

246

00:08:04,123 --> 00:08:05,416

resources by doing Extra-vehicular

247

00:08:05,451 --> 00:08:07,529

activities. Working before

248

00:08:07,564 --> 00:08:10,518

and after humans. Each of these

249

00:08:10,553 --> 00:08:12,359

programs has been carefully

250

00:08:12,394 --> 00:08:14,263

chosen because they contribute

251

00:08:14,298 --> 00:08:15,878

critical technology and functional

252

00:08:15,913 --> 00:08:17,478

knowledge to our nation's

253

00:08:17,513 --> 00:08:20,342

exploration objectives. They improve

254

00:08:20,377 --> 00:08:23,190

safety and reduce cost. The

255

00:08:23,225 --> 00:08:25,302

Technology Demonstration Missions

256

00:08:25,337 --> 00:08:27,431

Program provides new knowledge

257

00:08:27,466 --> 00:08:29,863

and capabilities needed to enable