Kennedy Space Center, Space Shuttle Processing, and International Space Station Program Overview

Scott Higginbotham
Mission Manager
International Space Station and Spacecraft Processing Directorate
NASA – John F. Kennedy Space Center
SPACE SHUTTLE GROUND OPERATIONS

OPF Operations
SPACE SHUTTLE GROUND OPERATIONS

SRB Recovery and Refurbishment
SPACE SHUTTLE GROUND OPERATIONS

VAB Operations
SPACE SHUTTLE GROUND OPERATIONS

External Tank
SPACE SHUTTLE GROUND OPERATIONS

Launch Pad
SPACE SHUTTLE GROUND OPERATIONS

Space Shuttle Launch
LIVING & WORKING IN SPACE

International Space Station - an overview

www.nasa.gov
Vision

A human outpost in space bringing nations together for the benefit of life on Earth ... and beyond.

We will make revolutionary discoveries and establish a permanent international presence of humans in space, to advance the exploration of the solar system and enable commerce in space.
Mission

Safely build, operate, and utilize a continuously inhabited orbital research facility through a partnership of governments, industries, and academia.
ISS Today

**dimensions:**
240 ft. long, 291 ft. wide, 45 ft. high, 29,560 cubic feet of living space.

**weight:**
815,520 lbs.

**science capabilities:**
laboratories from four international space agencies – U.S., Russia, Europe, and Japan.

**orbital inclination/path:**
51.6 degrees, covering 90% of the world’s population.

**altitude:**
approximately 220 miles above the Earth.

**speed:**
17,500 miles per hour, orbiting the Earth 16 times a day.

The International Space Station is more powerful, and 4 times larger than any human space craft ever built.
ISS Today

Multi-dimensional challenges:

- Integrating International Partners
- Engineering Excellence
- Prioritizing Science
- 24/7 Space Operations
- Organization, Budget, and People
Ten years of continued human presence...
Five international partners
Elements are constructed around the world
and come together in space with hairline tolerance.
110 flights to the ISS so far (11/98 - 4/11)

**35 shuttle flights**
- * crew member exchange
- STS-88 - U.S. Node
- STS-96 - Logistics
- STS-101 - Logistics
- STS-106 - Logistics
- STS-92 - Z-1 Truss
- STS-97 - Solar Array
- STS-98 - Destiny Lab
- STS-102 - MPLM
- STS-100 - Canadarm2
- STS-104 - U.S. Airlock
- STS-105* - MPLM
- STS-108* - Expedition 4
- STS-110 - S0 Truss
- STS-111* - Science, Expedition 5
- STS-112 - S1 Starboard Truss
- STS-113* - P1 Port Truss, Expedition 6
- STS-114 - Logistics
- STS-121 - Logistics
- STS-115 - P3/P4 Truss
- STS-116* - P5 Integrated Truss, Expedition 14
- STS-117* - S3/S4 Truss, Expedition 15
- STS-118 - S5 Truss
- STS-120* - Harmony module
- STS-122* - Columbus module
- STS-123* - "Kibo" module, "Dextre" robotic arm
- STS-124* - second "Kibo" module
- STS-126 - Logistics
- STS-119* - S6 Truss Solar Array
- STS-127* - "Kibo" platforms
- STS-128* - MPLM
- STS-129* - spare hardware on 2 logistics pallets
- STS-130 - Node 3/Cupola
- STS-131 - MPLM
- STS-132 - MRM1, spare antenna
- STS-133 – PMM “Leonardo”, 1 logistics pallet

**71 Russian flights**
- 2 Proton, (FGB, Service Module)
- 2 Unmanned Soyuz (Pirs and Poisk docking compartments)
- 26 Soyuz crew vehicles
- 41 Progress re-supply ships

**2 European flights**
- 2 ATV re-supply ship

**2 Japanese flights**
- 2 HTV re-supply ship
Present ISS launch vehicles

Shuttle
Proton
Soyuz
Ariane
HIIB
NASA and international partner control centers

MSS Control
St. Hubert, Canada

Columbus Control Center
Oberpfaffenhofen, Germany

ISS Mission Control
Moscow, Russia

JEM/HTV Control
Center - Tsukuba, Japan

ATV Control Center
Toulouse, France

H-IIB Launch Control
Tanegashima, Japan

Shuttle Launch Control
KSC, Florida

ISS Mission Control
Houston, TX

Soyuz Launch Control
Baikonur, Kazakstan

Ariane Launch Control
Kourou, French Guiana

POC
Huntsville, AL
Payload Operations Centers

From laptop, to ISS, to the world
"Zvezda", or the Service Module, serves as the Station's crew quarters, providing a place for the astronauts to eat, live, rest, exercise, and conduct science experiments.
The Russian built Zarya, or functional cargo block (FGB) was the initial building block, control center, and propulsive power of the Station.
With six docking ports, “Unity” (Node1) is the nexus of the Station’s U.S. segment connecting the lab, airlock, and solar array structures.
Destiny

The Station's main U.S. science facility is the home of four different types of racks, where ongoing experiments are performed and monitored by the crew.
Node 2, or “Harmony”, acts as a hub connecting the U.S. science lab “Destiny” to Europe’s “Columbus” lab and Japan’s “Kibo”.

Harmony
Europe’s research laboratory was launched with five science experiment racks and has room for five more.
"Kibo" ("Hope"), is Japan's state of the art science lab consisting of two modules providing room to house ten racks - it also has its own robotic arm (JRMS) outside the station.
The European built Node 3, named “Tranquility”, is the final connecting module to be added to the Station. Attached to the node is the Cupola, a robotic control station with seven windows providing a panoramic view of Earth, celestial objects, and visiting space craft.
Astronauts exit the Station using the Joint Airlock "Quest".
The Russian built “Poisk” (MRM2), along with functioning as a mini research module, also serves as an extra airlock for spacewalkers, and a docking port for re-supply ships.
Leonardo is one of the three Multi-Purpose Logistics Modules (MPLM) built by the European Space Agency to ferry supplies, equipment and other cargo to and from the Station via the shuttle’s payload bay. Later this year space shuttle Discovery will deliver the modified module one last time (STS-133), after which it will serve as a permanent pressurized storage facility for the crew.
The Russian built MRM1 (Mini Research Module) is primarily used for cargo storage and payload operations. It also provides a fourth docking port on the Russian operation segment of the station, and on its shell carries outfitting equipment for a future Russian lab module (MLM scheduled to launch in 2012).
Once docked to the Zvezda module the MLM (Multipurpose Laboratory Module) will become Russia’s primary research module. It will also add to the Station an additional docking port/airlock and provide backup attitude control. It is scheduled for launch aboard a Russian Proton rocket in 2012.
ISS today

Supplies and fuel are brought to the Station by the Russian Progress vehicle, which also boosts the Station’s orbit when needed.
The Soyuz, replaced every six months, provides crew rotation and emergency evacuation.
During space walks astronauts are able to maneuver and assemble the Station's massive elements with the help of the Canadian robotic arm system.
"Dextre", or the Special Purpose Dexterous Manipulator, is the final element of the Station’s Mobile Servicing System. It works with the Station’s robotic arm (Canadarm2) for Station maintenance and service.
In Earth orbit, the most practical and main source of power for the Station is sunlight, converted by the Solar Array panels. During the shadow phase, the Space Station relies on banks of nickel-hydrogen rechargeable batteries to provide a continuous power source.
The four U.S. Solar Arrays provide up to 120 kW of power for life support, battery charging, and other power management use, enough to power 40 average homes.
Thermal control subsystem

The Station's outstretched radiators are made of honeycomb aluminum panels, each providing 6 by 10 feet of ammonia tubing filled heat exchange area.
Guidance, navigation, and control

Electrical powered attitude control provided by four U.S. Control Moment Gyros.

Service Module (“Zvezda”) jets can also be used.

CMGs

The Shuttle and the Progress are used to boost the Station when docked.
Command data and handling

The Space Station systems are controlled by over 4 million lines of software code, about half provided by the U.S. in core computers (MDMS) and laptops, and the balance from the other international partners.
Canadarm2 represents next-generation robotics. By flipping end-over-end between anchor points it can move around the ISS like an inchworm. With its seven joints, Canadarm2 is more maneuverable than its predecessor on the shuttle and even more agile than a human arm.
Dextre, or Special Purpose Dexterous Manipulator, is the final element of the station's Mobile Servicing System. Designed for station maintenance and service, it has two arms and four cameras and is able to work from the end of Canadarm2 or the station’s Mobile Base System.
The JEM Remote Manipulator System (JEMRMS) is a robotic arm developed for supporting experiment and maintenance activities on the exposed areas of the "Kibo" science lab.
Robotics

Mobile Base System

Crew Equipment and Translation Aid Cart (CETA)
Human and robotic integration

The ISS is advancing human and robotic space operations to new heights experimenting with tools and equipment in the challenging environment of space.
Additional modes of re-supply

The European Space Agency’s three Italian built Multi-Purpose Logistics Modules (MPLM) - Leonardo, Rafællo, and Donatello - are brought to the Station in the shuttle’s payload bay. ESA has also successfully docked and undocked their first unmanned Automated Transfer Vehicle (ATV).

Japan has also built, launched and docked the unmanned HII Transfer Vehicle (HTV), that will perform additional logistics and re-supply functions in the future.
A springboard for many futures

Science Leads the Way
Space Engineering
Exploration of the Universe
Space Commerce test bed
Inspiring the Next Generation
See the ISS fly over your town at:

www.jsc.nasa.gov/sightings/