Control Centers
What do the consoles do?
### A Long Way

#### Control Panel

<table>
<thead>
<tr>
<th>Function</th>
<th>Status</th>
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<tbody>
<tr>
<td>F/N</td>
<td>13/699</td>
</tr>
<tr>
<td>Site TDR CI</td>
<td>108</td>
</tr>
<tr>
<td>U/D Rate</td>
<td>1</td>
</tr>
<tr>
<td>SCIU</td>
<td>16:17</td>
</tr>
<tr>
<td>MSB</td>
<td>10:19</td>
</tr>
<tr>
<td>MPC</td>
<td>20:21</td>
</tr>
<tr>
<td>DPC</td>
<td>22:23</td>
</tr>
<tr>
<td>LCKA</td>
<td>24:15</td>
</tr>
<tr>
<td>FSS</td>
<td>2:15</td>
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<tr>
<td>LCKR</td>
<td>1:26</td>
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<tr>
<td>PCU</td>
<td>5</td>
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<tr>
<td>FMDM</td>
<td>0.95</td>
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<td>FMDM Box A</td>
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#### Configurations

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<th>Mechanism</th>
<th>Selection</th>
<th>Configuration</th>
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<tbody>
<tr>
<td>BEAR LAT</td>
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<td>SCIU A</td>
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<td>17</td>
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<tr>
<td>UMB MAIN</td>
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<td>SCIU B</td>
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<td>17</td>
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<td>RET LAT KEEL</td>
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<td>17</td>
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<td>PLAT LOCK</td>
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<td>17</td>
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<tr>
<td>DESELECT</td>
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<td>16</td>
<td>17</td>
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#### Override

<table>
<thead>
<tr>
<th>Enable</th>
<th>Disable</th>
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<tbody>
<tr>
<td>14</td>
<td>15</td>
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#### Resume

<table>
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<tr>
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<td>SM</td>
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<td>3</td>
<td>QNCB</td>
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<tr>
<td>4</td>
<td>QNCB</td>
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</tbody>
</table>

#### Diagram

The diagram shows a spacecraft on the surface, with various sensors and controls visible. The interface includes data displays and control panels.
Mental Models - Displays, Applications, Objects

from Gemini to Shuttle

Displays
- Monochrome Alpha-Numeric
  - Channel 1
  - Channel 73

MCT to WARP

Objects, Models, Views
- Composition
  - View
- View
- View
- View

The Thing (Model)

Shuttle to ISS, Robotic Missions

Telemetry
- Plot Application
- Alpha-Numerics Application
- Timeline Editor
- Procedure Editor
- Trajectory

from Gemini to Shuttle

Shuttle to ISS, Robotic Missions

MCT to WARP

Objects, Models, Views
- Composition
  - View
  - View
  - View
  - View

The Thing (Model)
Resource Prospector

Commands

Round Trip Command to Telemetry Receipt ~6 seconds

Telemetry/Data
Physical Co-Location

• Why co-location?
• Gestures
• Face to face
Mission Operations

1. Monitor health & status
2. Examine science data
3. Examine other data
4. Decide what to do next
5. Command spacecraft

* Intermediaries (such as satellites and ground stations) omitted for simplicity.
Multi-Disciplinary Operations

**Operations**
Flight directors, planners, and decision-makers who conduct the mission.

**Engineering**
Specialists monitoring the health and status of subsystems, instruments.

**Science**
Experts in areas pertinent to the science goals of the mission.

Personnel from many different areas of expertise collaborate and contribute toward achieving mission goals. Effective communication is essential!
Multi-Disciplinary Communication
Mission Tools

Operations personnel use a broad variety of tools to work with a broad variety of data.

- Telemetry visualization
  - Plots
  - Alphanumerics
  - Dense displays
- Telemetry dictionaries
- Data product viewers
  - Imagery
  - Spectra
- Procedures
  - Viewers, editors
  - Executors
- Planning tools
  - Timeline-based
  - Traverse-based
- Clocks, timers
- Session management
- Commanding
  - Issue commands
  - Sequencers
- Text editors
- Version control systems
- Webcams
- Console logs
- Simulators
Mission Requirements

New missions do new things. The hardware, software, and human processes that worked for one mission may not be appropriate for another.
History

- The early Mercury Control Centers were distributed around the world
- Centralization became possible only with advances in communications and tracking networks