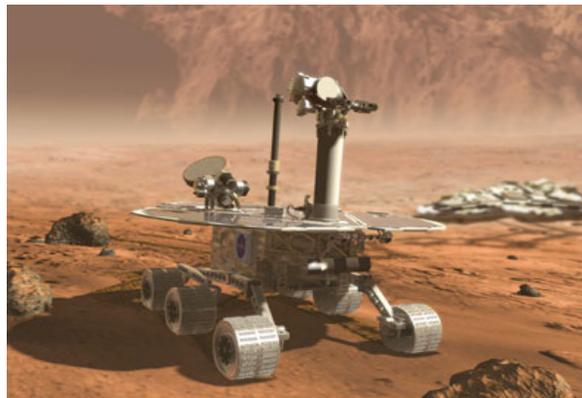
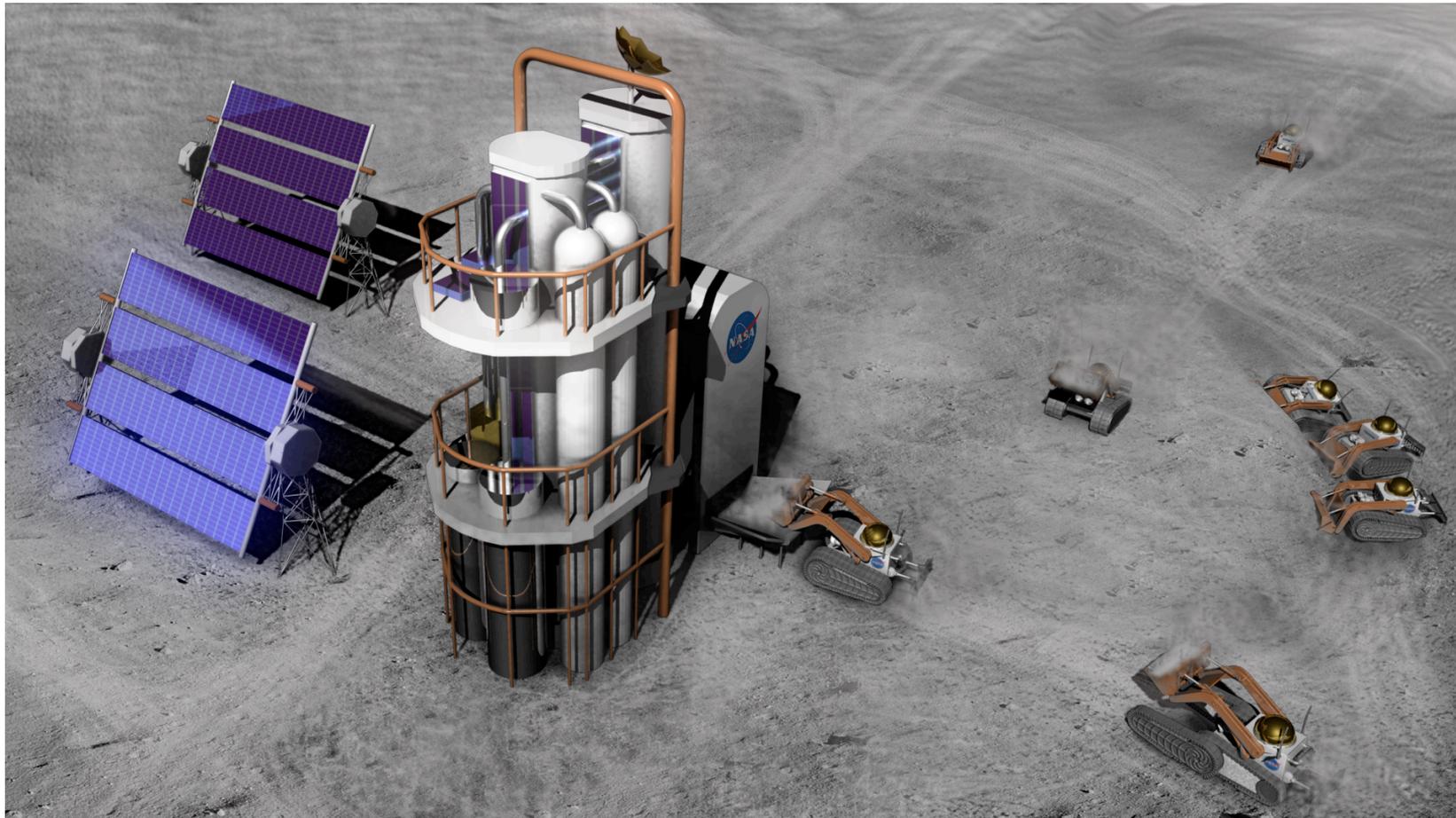

A Proposal for the Creation of a Diagnostics and Power Port Standard

Thomas Willeke

QSS Group / NASA Ames Research Center



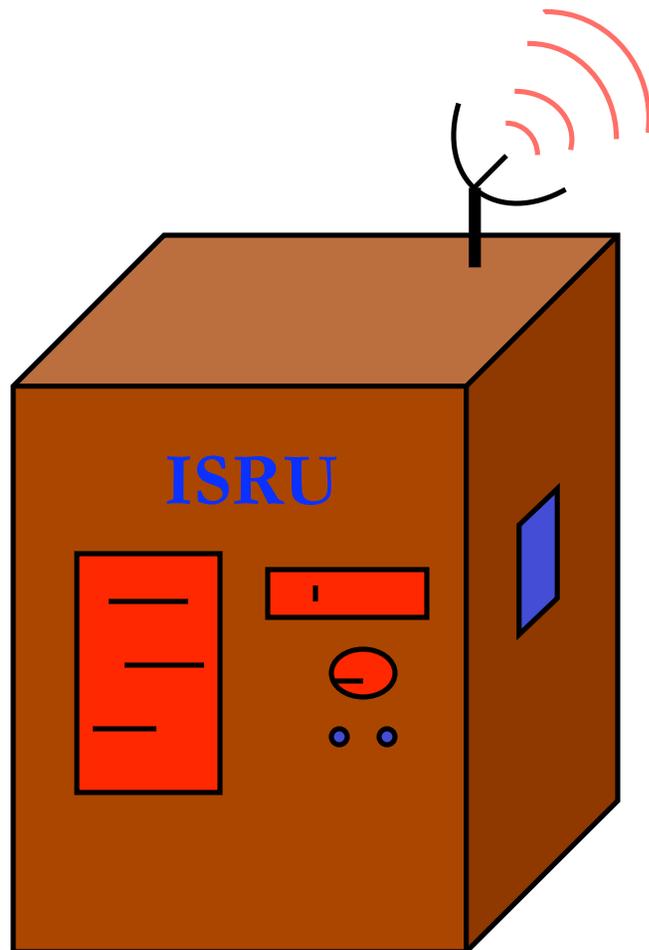
Robotic Lunar Precursor



- Establish infrastructure before humans arrive.
- How to increase system reliability?



ISRU lands on the Moon

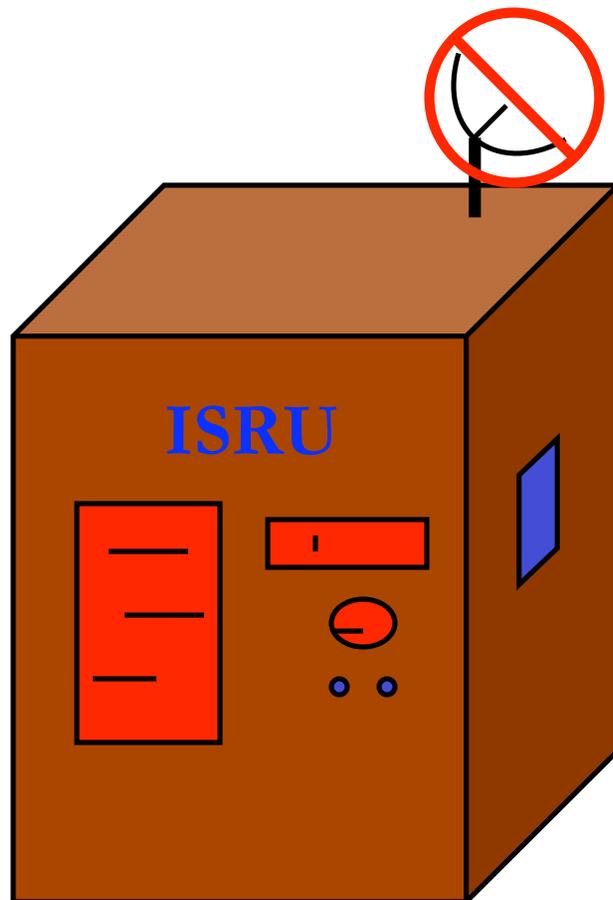




But It fails to communicate



This is often the first symptom of a large class of failures.

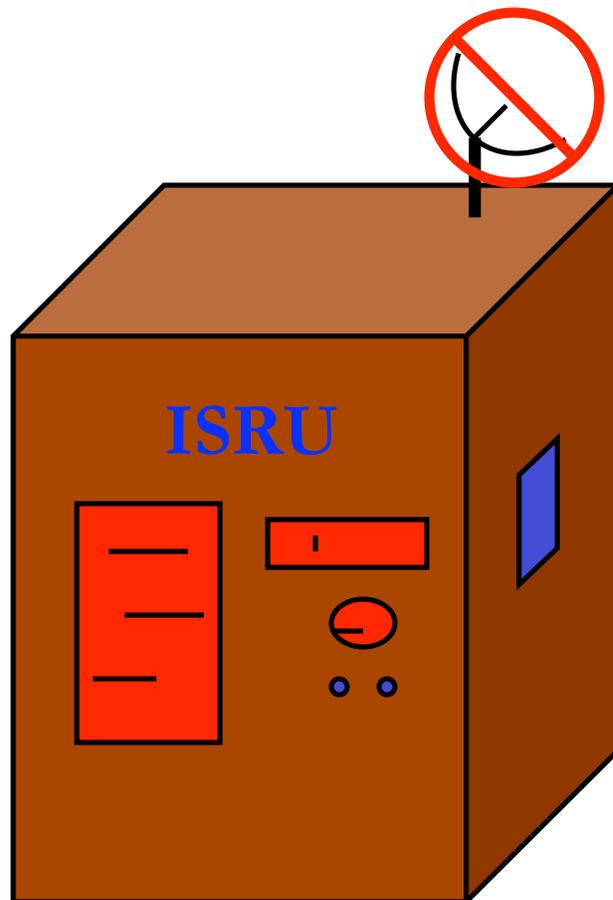




But It fails to communicate



This is often the first symptom of a large class of failures.



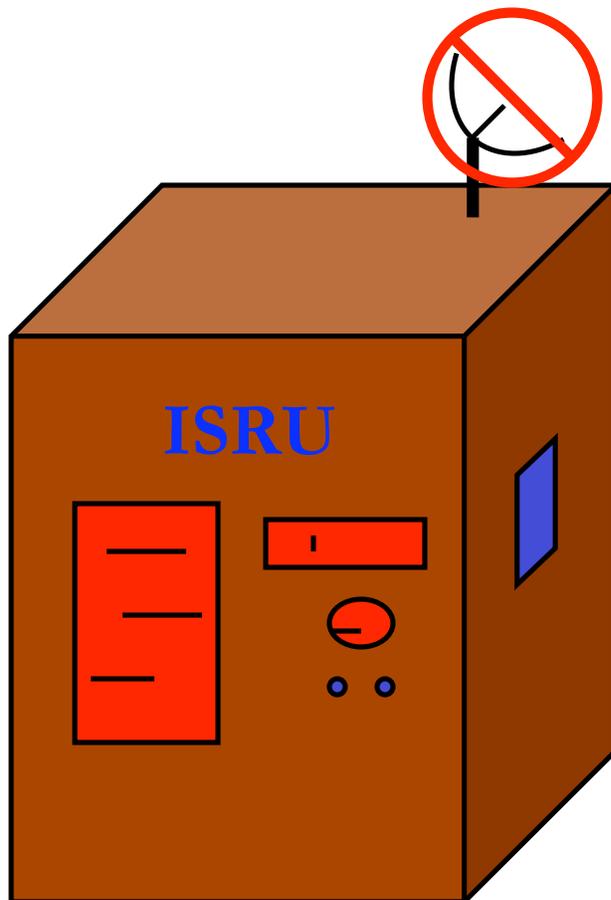
Goes into Safe Mode

Tries rebooting

Still no communication

Causes of Comm. Failure

This is often the first symptom of a large class of failures.

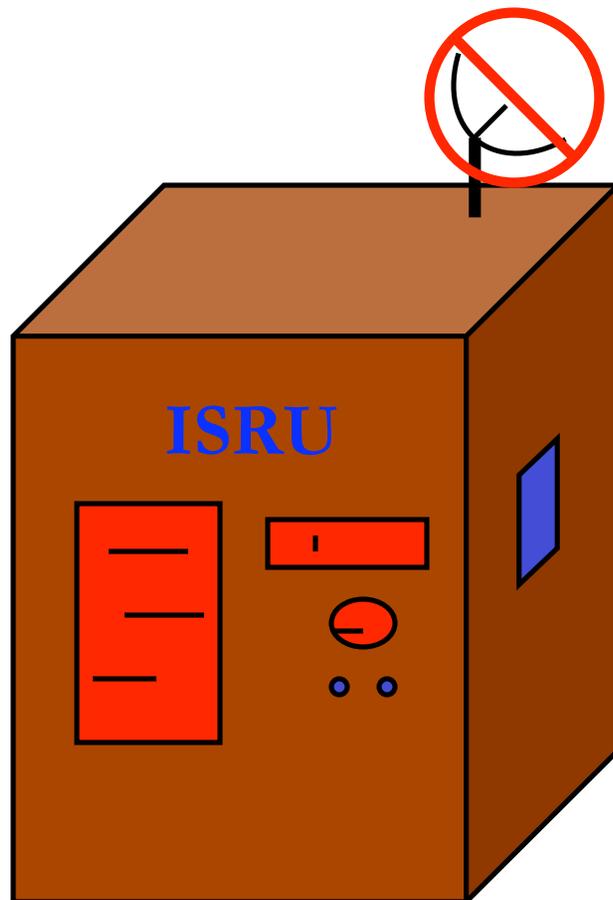


- Communication Failure
 - Antennae stuck
 - Hardware/software failure
- OS Crash
 - Spirit (Flash memory)
- Control Software failure
 - Race condition, etc...
- Bug in FPGA design or Bad Gate
- Failure in Power System
- Physical damage
- Other Component or mechanical failure

Causes of Comm. Failure



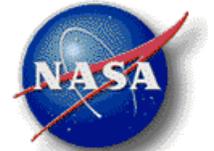
This is often the first symptom of a large class of failures.



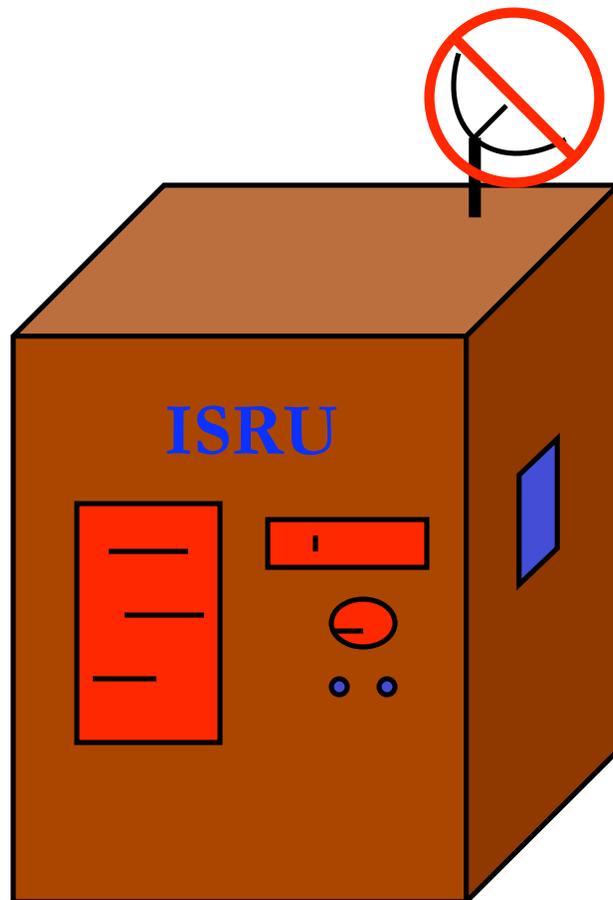
- Communication Failure
 - Antennae stuck
 - **Hardware/software failure**
- **OS Crash**
 - **Spirit (Flash memory)**
- **Control Software failure**
 - **Race condition, etc...**
- **Bug in FPGA design or Bad Gate**
- Failure in Power System
- Physical damage
- Other Component or mechanical failure

**Might be able to fix if you could
just establish communication**

Causes of Comm. Failure



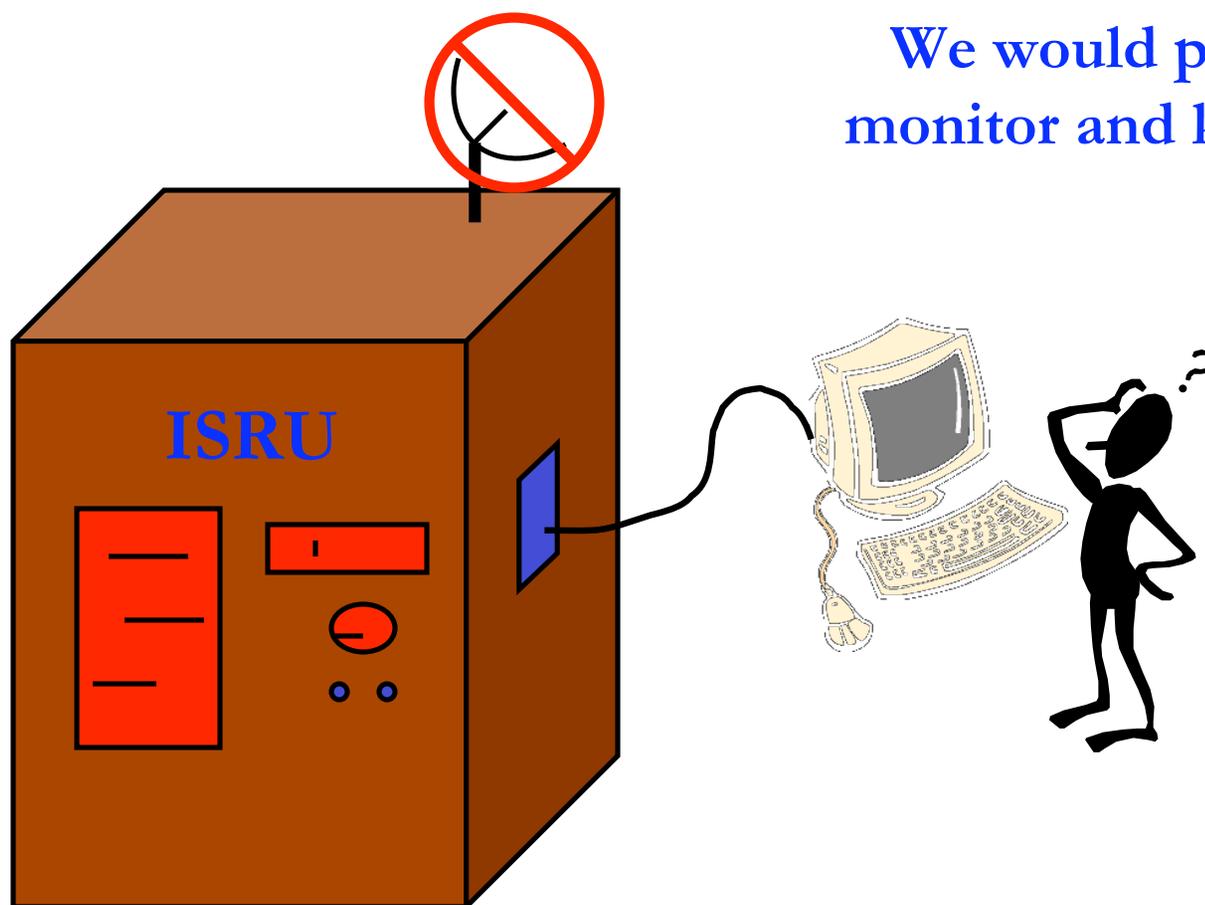
This is often the first symptom of a large class of failures.



- **Communication Failure**
 - **Antennae stuck**
 - Hardware/software failure
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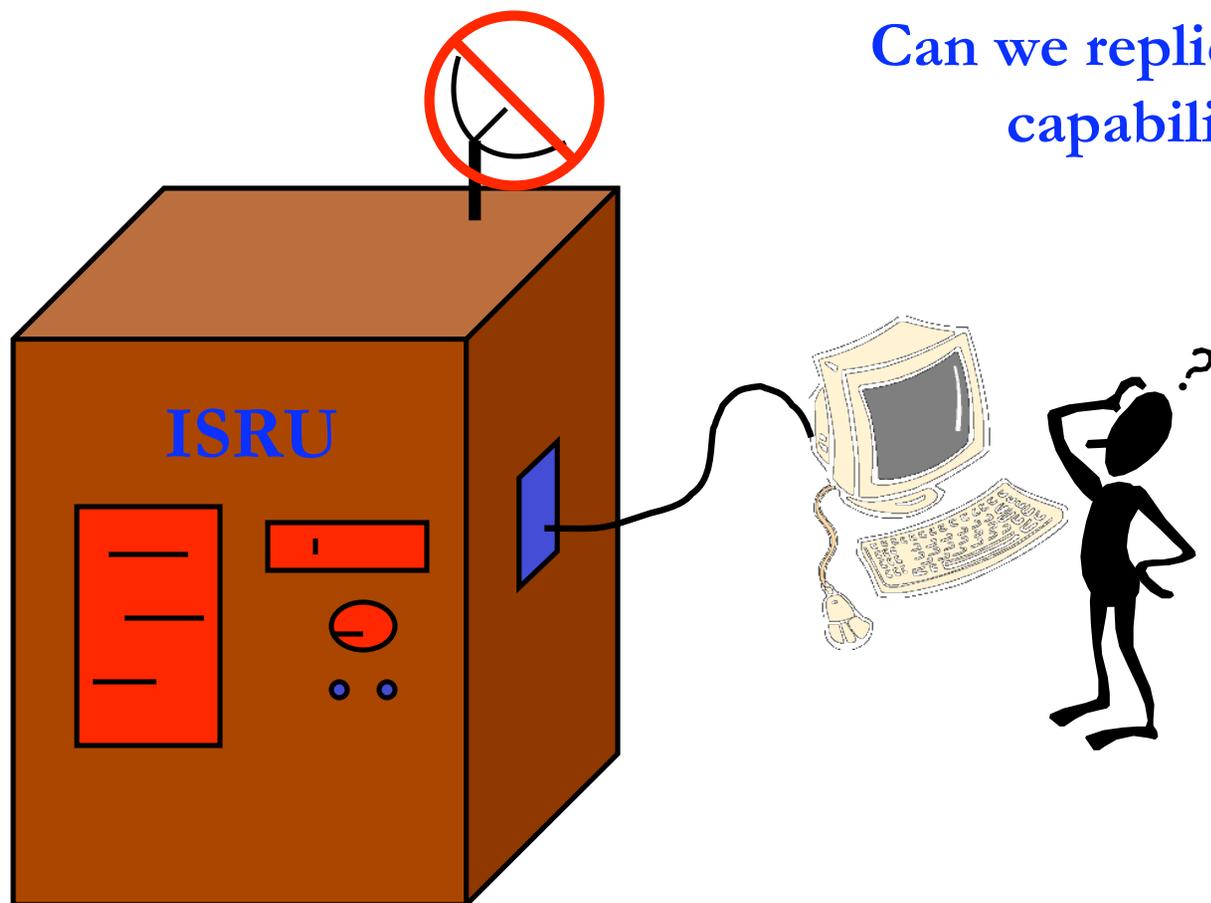
**Would like to know the cause
of the failure.**

On Earth.....

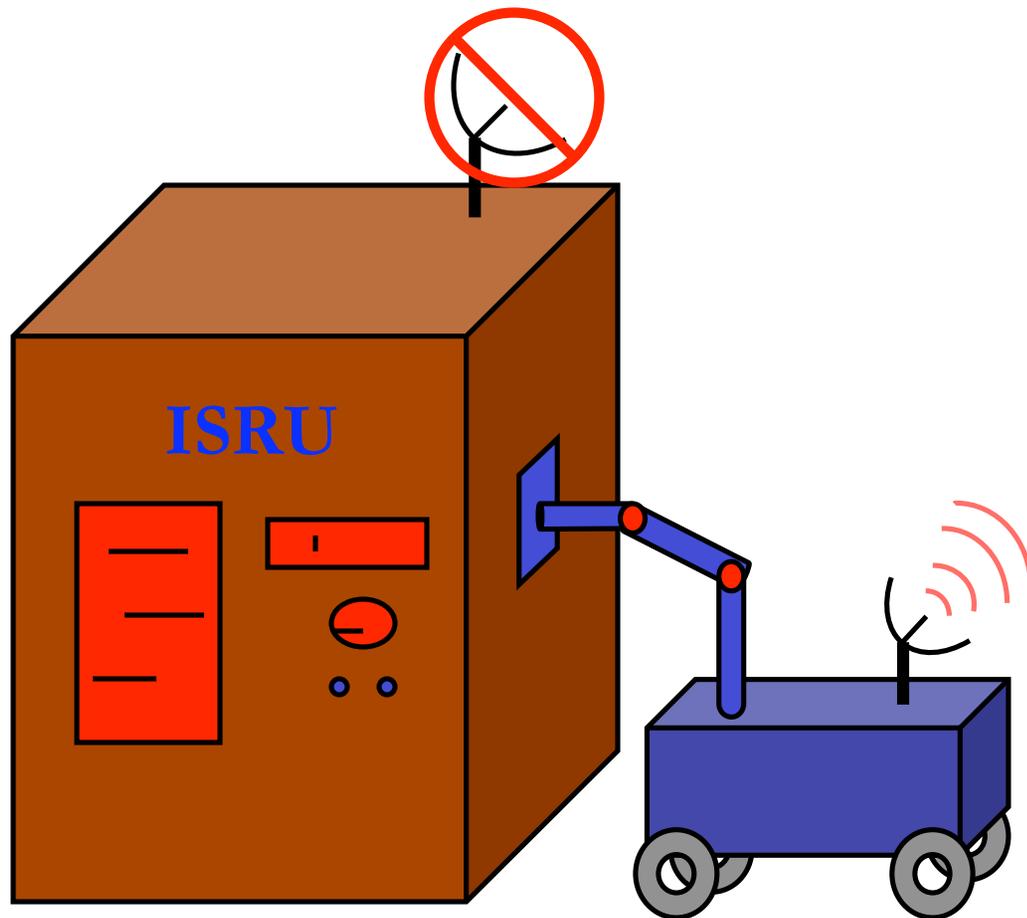


We would plug in a
monitor and keyboard.

On The Moon....



On The Moon....

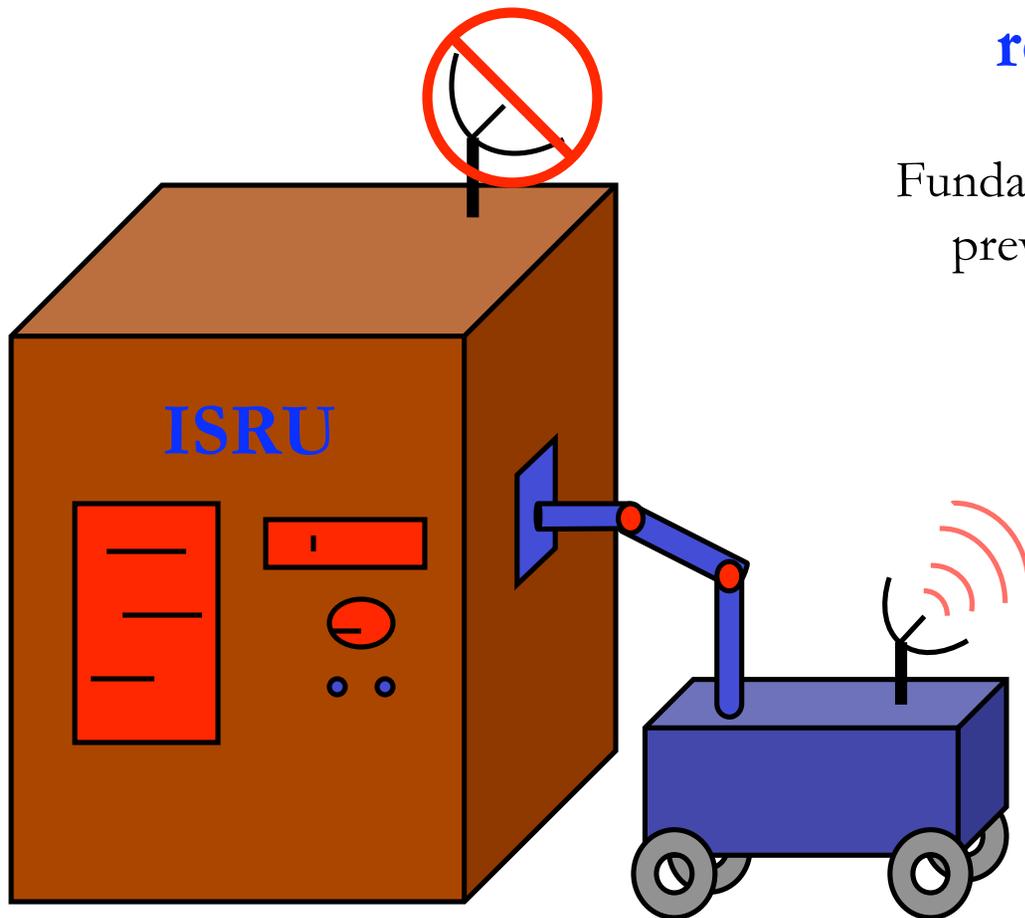


YES!!!

Assumptions

**At least one mobile
robot in area.**

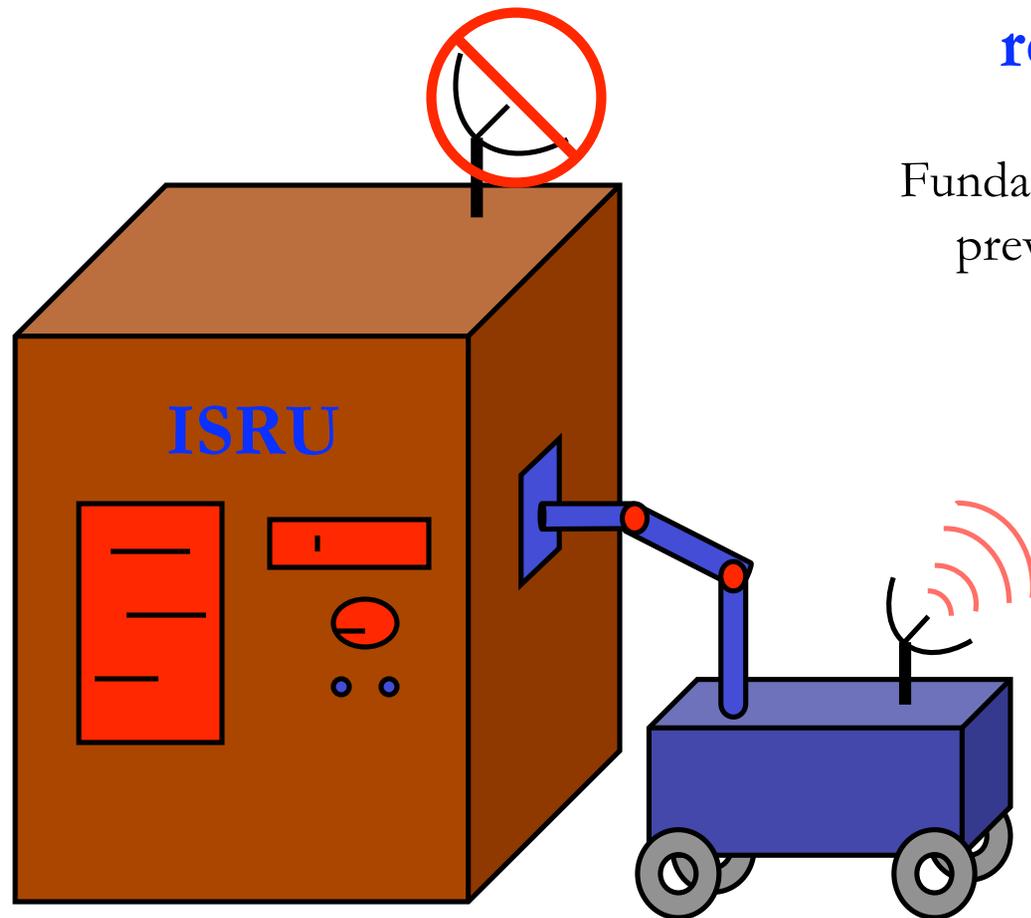
Fundamental change from all
previous space missions!



Assumptions

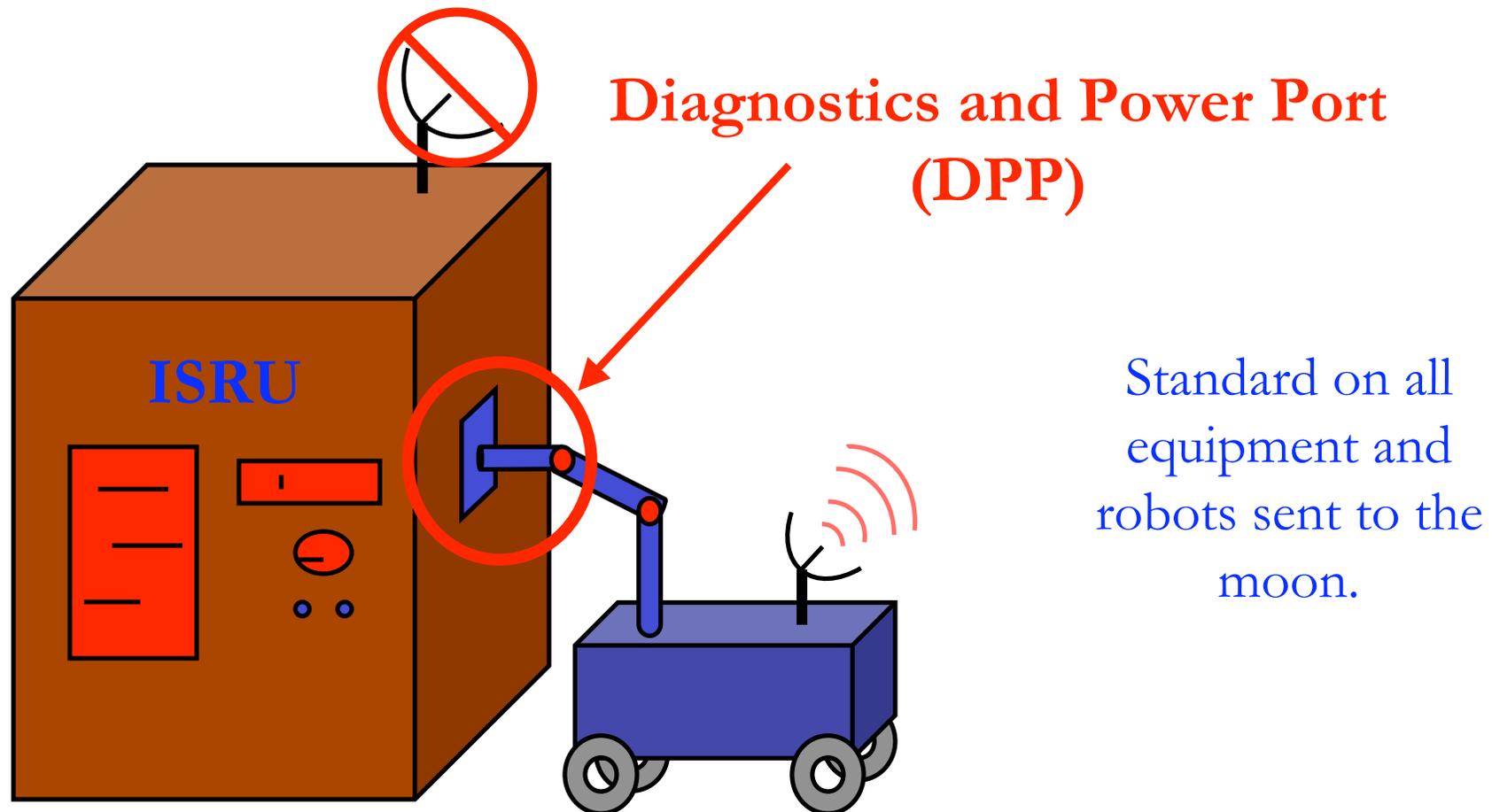
**At least one mobile
robot in area.**

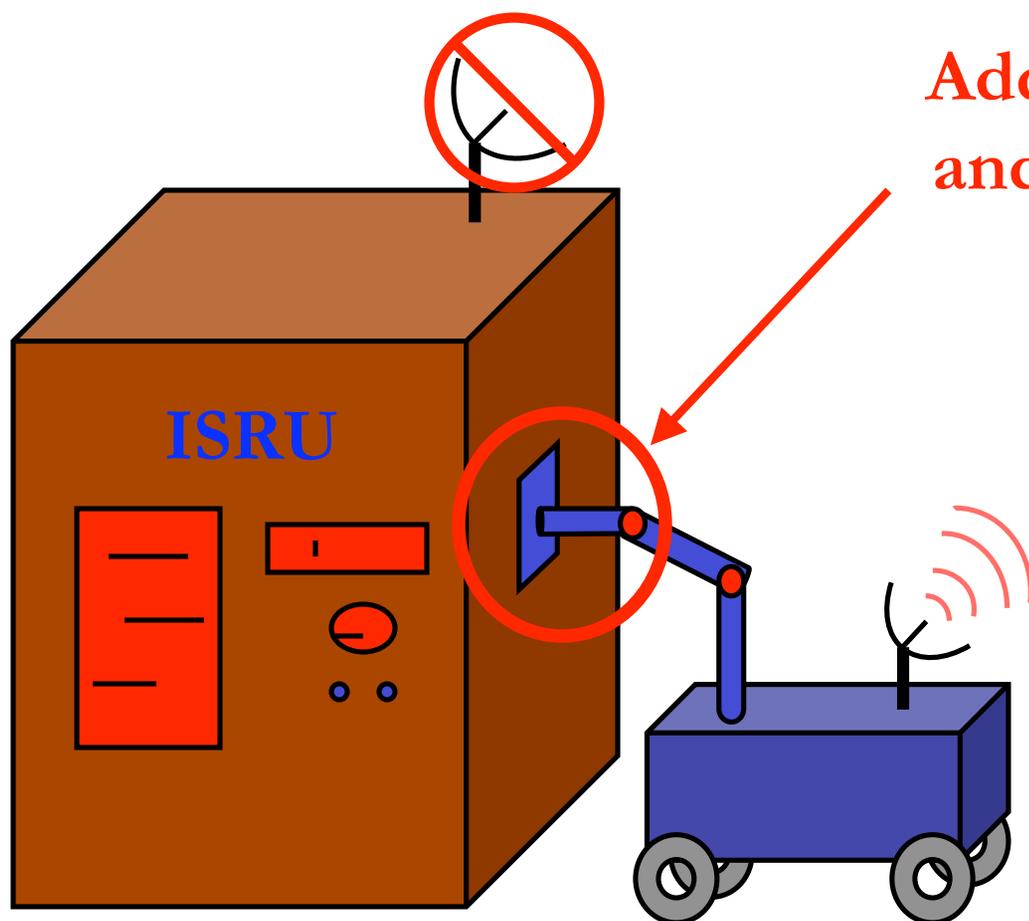
Fundamental change from all
previous space missions!



**Reliability of System
can be greater than
reliability of
individual
components!**

Assumptions 2



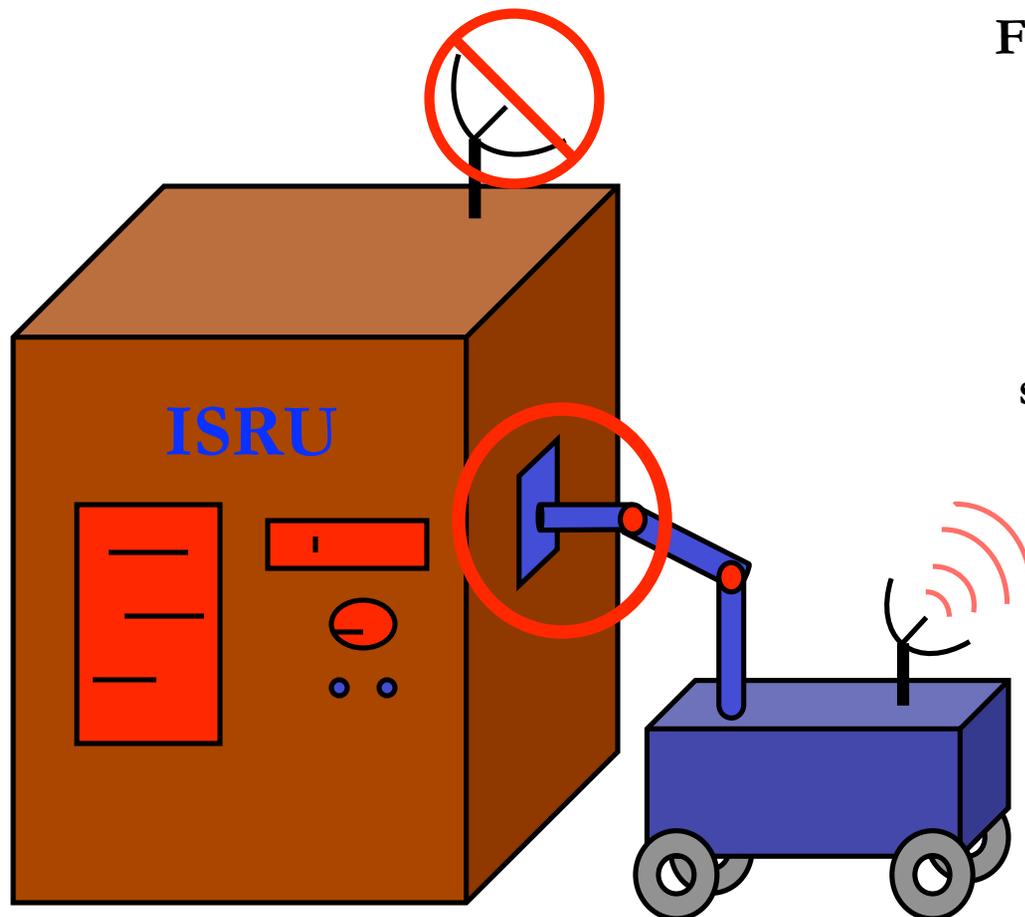


Almost mass free:

Adding some plugs
and a small control
board.

No extra specialized
device sent
This robot has some other
Primary purpose

All the diagnostic tools you
could wish for!



Communicate with computer (root
access in single user mode)

Force a reboot of the computer

Provide power to computer

Read contents of memory

Keep local store (in DPP) of
state/diagnostic information

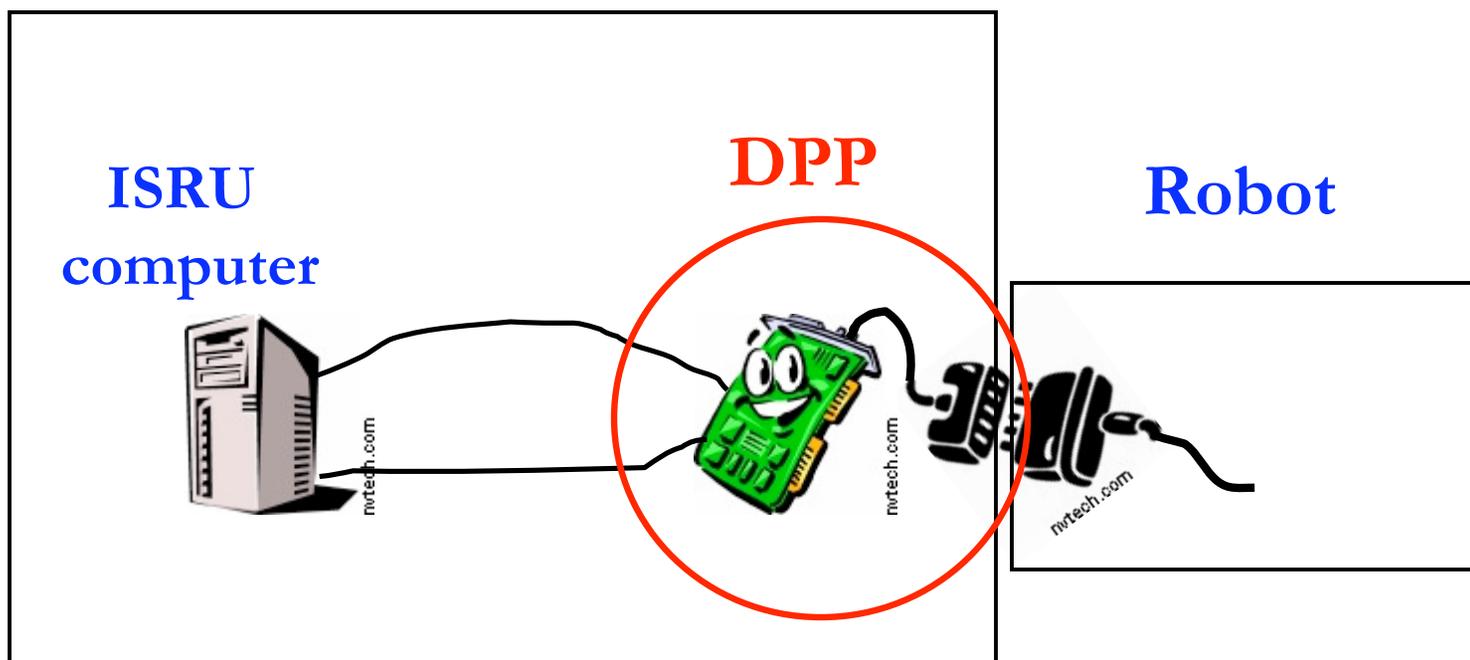
Reprogram computer

Reprogram FPGA

Perform other system tests

DPP Architecture

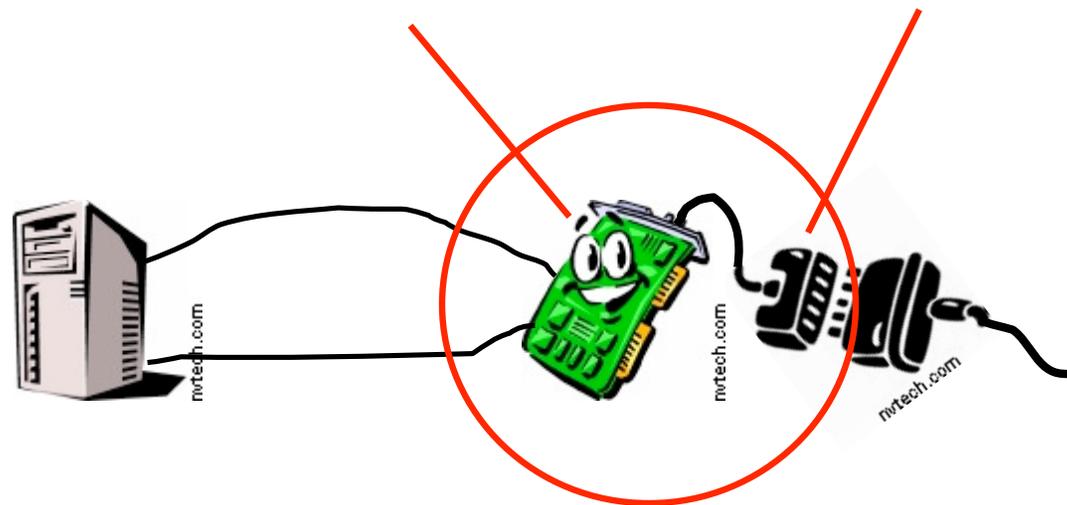
ISRU Plant



DPP Architecture

Interface Controller

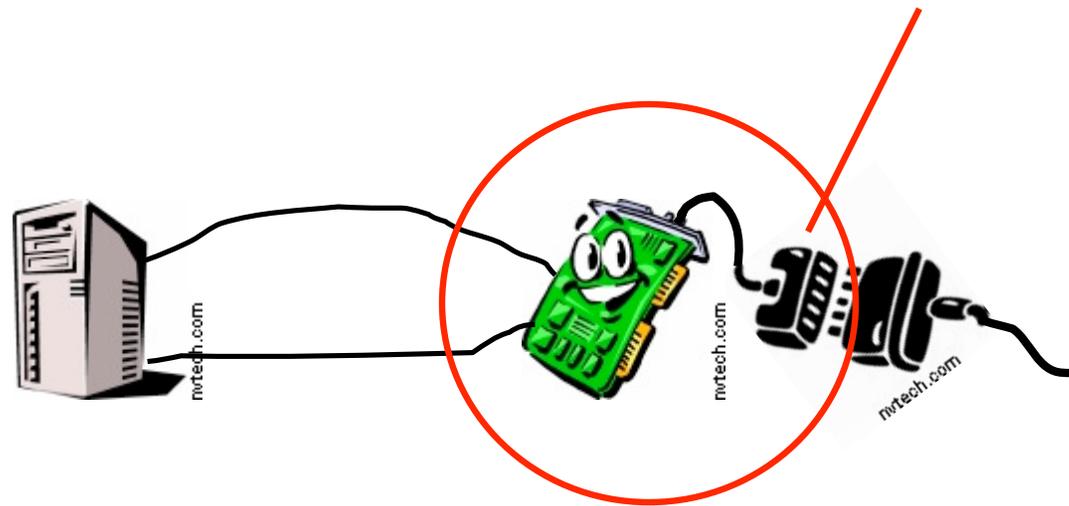
Connector



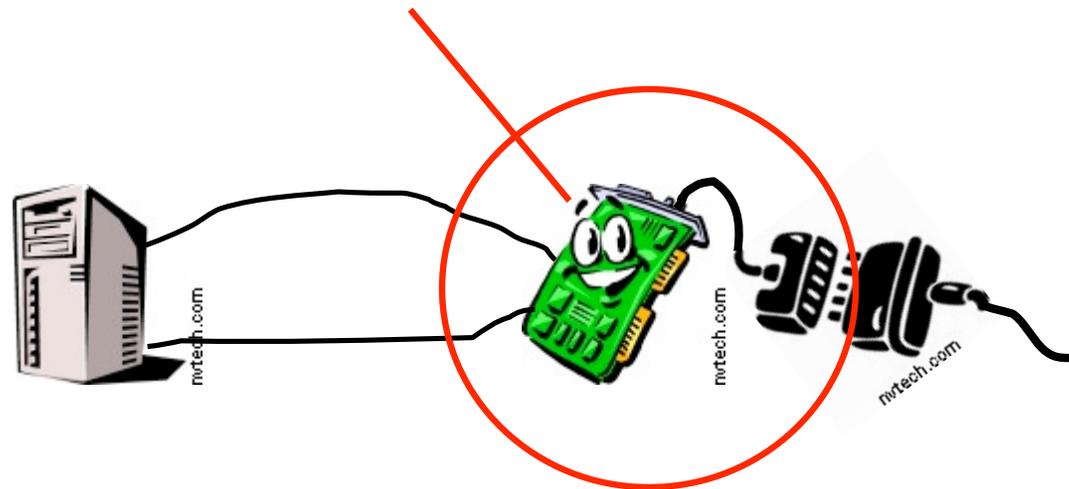
Provide data connection – RS232

Provide Power Connection

Only part that needs to be standardized Connector



Interface Controller



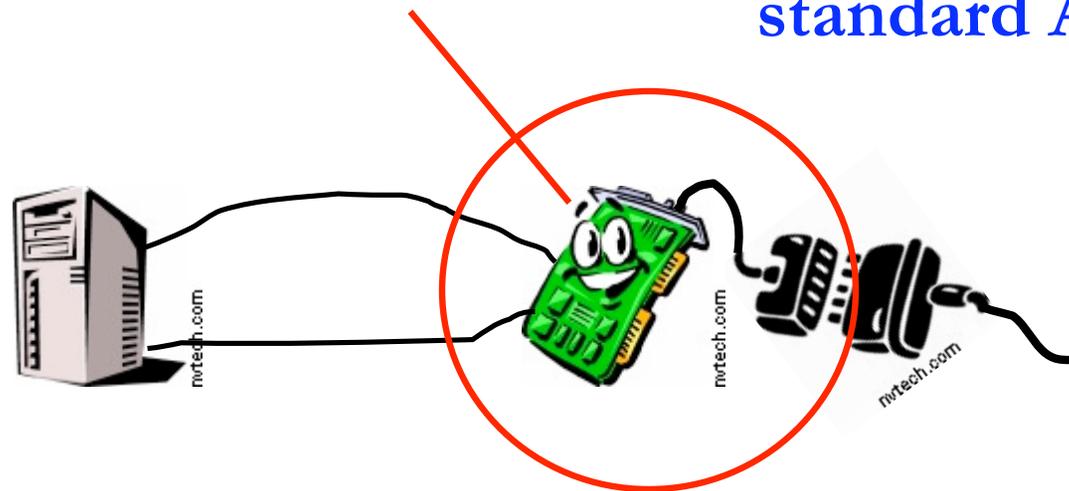
**Small Microprocessor
Powered from Robot
Mediates interaction with system**

Interface Controller

Doesn't even have to be standardized design

Interface Controller

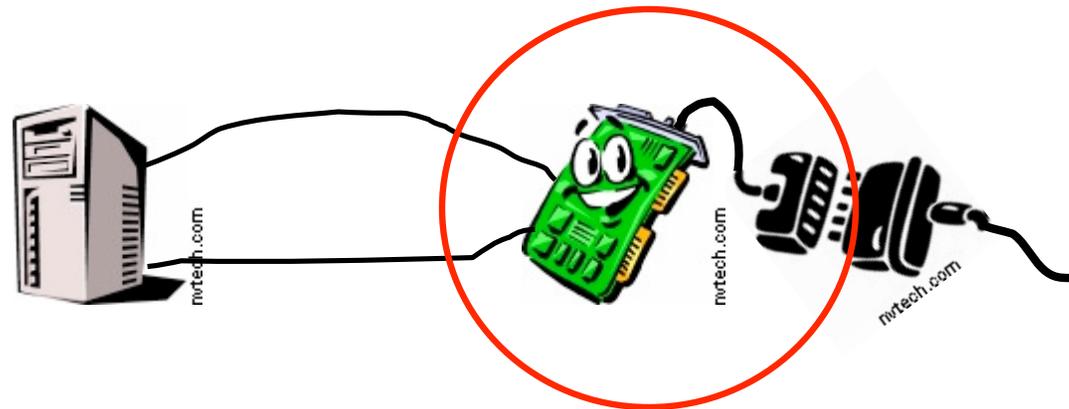
But, should have
standard API



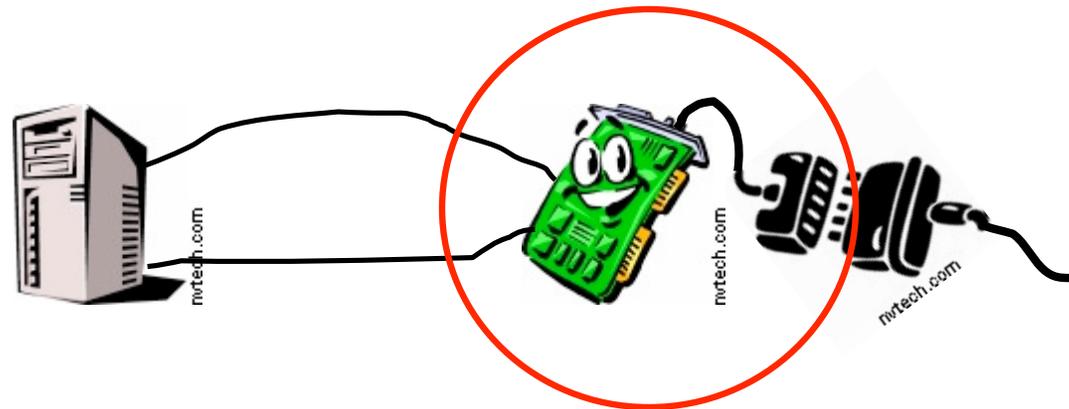
**Small Microprocessor
Powered from Robot
Mediates interaction with system**

Interface Controller

In response to standard command, IC:
Reboots computer, reads memory, acts as
pass through to computer, etc.



In response to standard command, IC:
Reboots computer, reads memory, acts as
pass through to computer, etc.



This allows **DPP** to be independent of
how the **ISRU** computer is implemented



Random Wacky Ideas



Use RFID or other wireless method to communicate between robot and DPP

**Provide system power through inductive charging
To avoid physical connectors**



Conclusions



- This is not hard!
- Will require adoption of a standard across all those who will be building hardware for the moon.
- Can increase reliability of overall system.
- The DPP is enabled by the change of having many pieces of hardware in one local.