



PiMan: system manager of the "Pi of the Sky" experiment

**Krzysztof Nawrocki
Soltan's Institute for Nuclear Studies
for the "Pi of the Sky" collaboration**

Outline



- 'Pi of the Sky' system architecture
- PiMan
 - general assumptions
 - architecture
- External system tools
 - monitoring / recovery / alarms

prototype / fullPi

LCO Prototype



- Operating in Las Campanas Observatory (Chile) since 2004
- two, custom made, cameras
 - FOV: $20^\circ \times 20^\circ$
 - working in coincidence
 - time resolution: $\sim 7\text{s}$
- paralactic mount
- $\sim 1.5 \text{ M}$ frames taken / camera

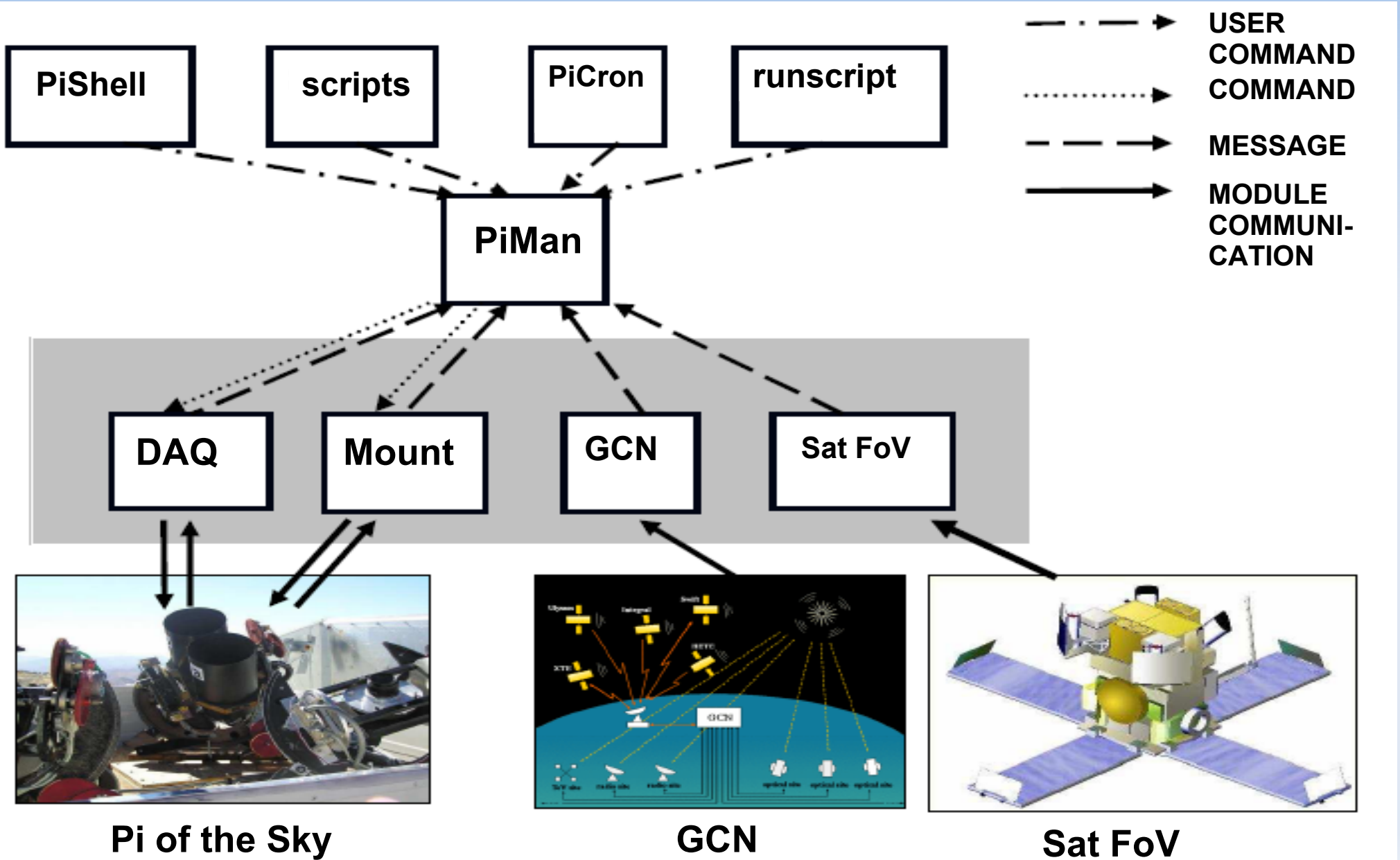


System Architecture

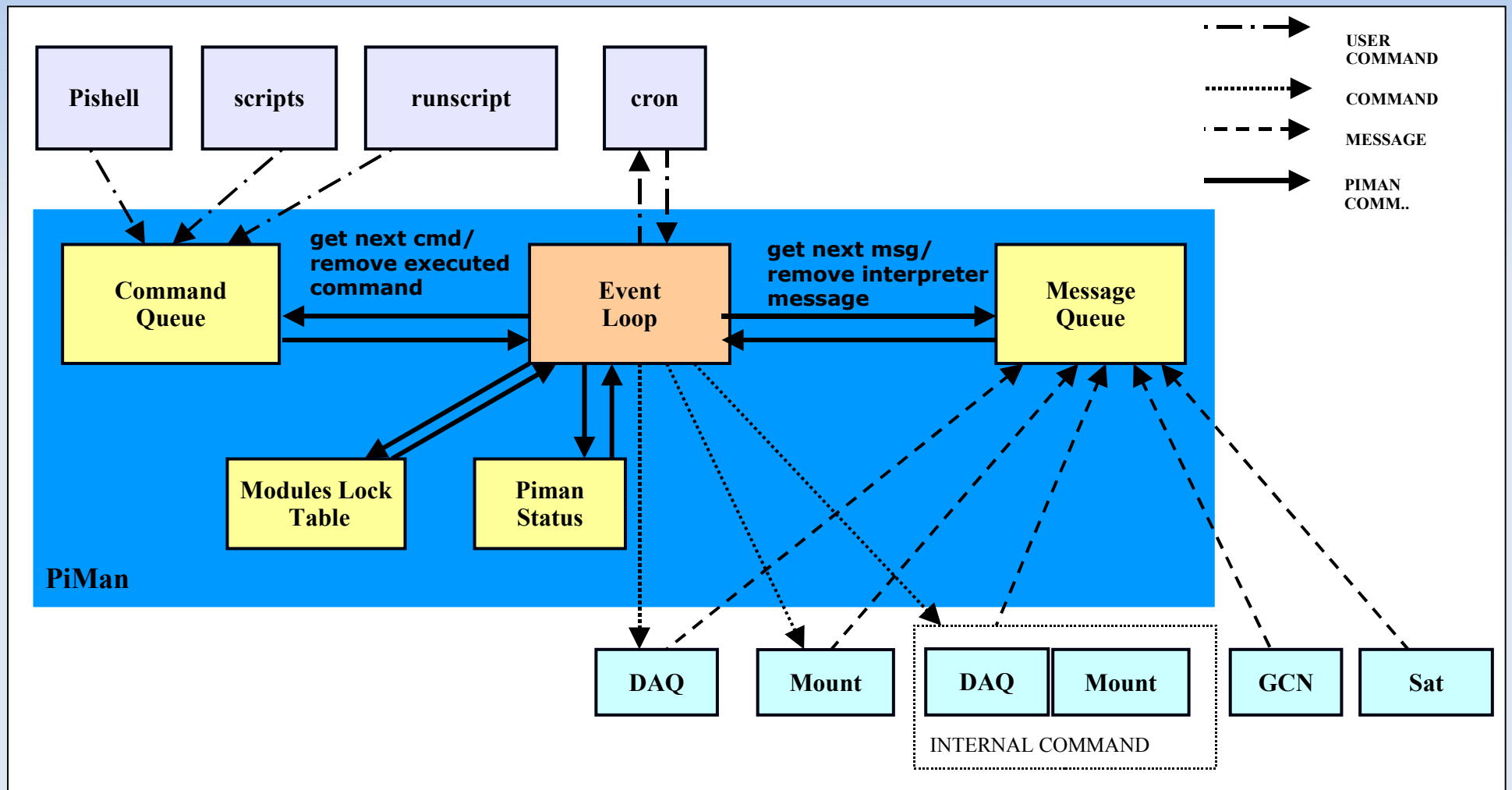


- **General assumptions:**
 - fully autonomous operation
 - low communication bandwidth (if any)
 - full remote control over system
 - scalable
- =>
 - mostly custom made
 - industry standards if applicable/available, eg. CORBA, CANbus, IPMI, IBM DB2, ...
 - redundant wherever possible
 - modular
 - all components available as simulators

System Architecture



PiMan Internals



Night script example



```
# auto-generated script
# night : 20090219
# camera : Cannon EOS f=85mm
# system start time is : 20090219_205201 local ( 20090219_235201 UT )
# PRIMARY SATELLITE = SWIFT
# SECONDARY SATELLITE = INTEGRAL
# SUN sets at 2125 LCO time, at (AZ,H)=(69.40,-12.92) [deg]
# SUN rises at 0630 LCO time
# WARNING : SWIFT pointing information for current night is not available !
# MOON RA=281.50=18h46m01.00s DEC=-25.43 illum = 18.88 %
# MOON rises at 20090220_033201, illum = 18.18 %
# INTEGRAL RA=206.24=13h44m58.32s DEC=9.96
# INTEGRAL rises above horizon at 2350, sets at 1103
piman 0 cron_point_best_target_off
piman 0 interpret_point_trigger_off
piman 1 exec_script_synchro(startup.pish)
daq 2110 start_daq
piman 2110 auto_ag_mode_on
piman 2115 manual_mode_off
# Autopointing command targets : SWIFT, INTEGRAL, GTN
# turning OFF cron
piman 2125 manual_mode_on
internal 2125 forced_point_best_target
mount 2125 raw_cmd(autoguide on)
internal 2125 send_pos_to_mount
mount 2125 stat
piman 2130 cron_send_pos_to_mount_on
internal 2135 send_pos_to_mount
mount 2135 stat
```

Night script example (cont.)

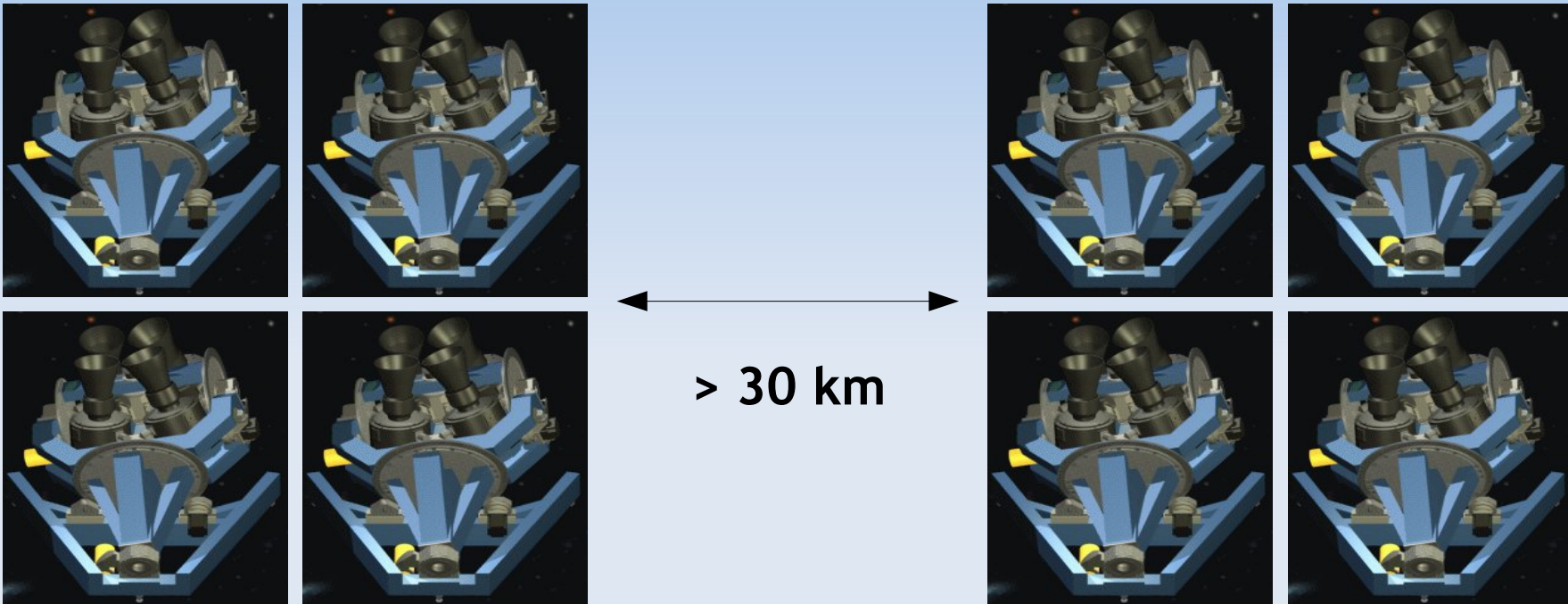


```
# turning ON cron
piman 2135 manual_mode_off
piman 2135 cron_point_best_target_on
piman 2135 interpret_point_trigger_on
piman 2240 manual_mode_on
piman 2240 cron_send_pos_to_mount_off
piman 2240 cron_point_best_target_off
piman 2240 interpret_point_trigger_off
piman 2240 exec_script_synchro(scan_evening.pish)
# calculated scan time = 3580 sec
piman 2330 exec_script_synchro(end_scan.pish)
# Autopointing command targets : SWIFT, INTEGRAL,
GTN
# turning OFF cron
piman 2330 manual_mode_on
internal 2330 forced_point_best_target
mount 2330 raw_cmd(autoguide on)
internal 2330 send_pos_to_mount
mount 2330 stat
piman 2335 cron_send_pos_to_mount_on
internal 2340 send_pos_to_mount
mount 2340 stat
# turning ON cron
piman 2340 manual_mode_off
piman 2340 cron_point_best_target_on
piman 2340 interpret_point_trigger_on
```

```
# morning
piman 0330 exec_script_synchro(scan_morning.pish)
# calculated scan time = 3470 sec
piman 0420 exec_script_synchro(end_scan.pish)
piman 0420 manual_mode_off
# Autopointing command targets : SWIFT, INTEGRAL, GTN
# turning OFF cron
piman 0420 manual_mode_on
internal 0420 forced_point_best_target
mount 0420 raw_cmd(autoguide on)
internal 0420 send_pos_to_mount
mount 0420 stat
piman 0425 cron_send_pos_to_mount_on
internal 0430 send_pos_to_mount
mount 0430 stat
# turning ON cron
piman 0430 manual_mode_off
piman 0430 cron_point_best_target_on
piman 0430 interpret_point_trigger_on
# Do not worry about order, these two commads always go
just before shutdown :
piman 0605 cron_send_pos_to_mount_off
piman 0605 cron_point_best_target_off
piman 0605 interpret_point_trigger_off
piman 0635 exec_script(shutdown.pish)
```




- LCO prototype:
 - Low level monitoring of all modules
 - Recovery System detects problems automatically (eg. mount slide) and applies cures if possible
 - ... if not: custom made alarm system
→ alerts humans by email/sms



- Two sites (16 cameras each) working in coincidence
- FOV: $80^\circ \times 80^\circ$

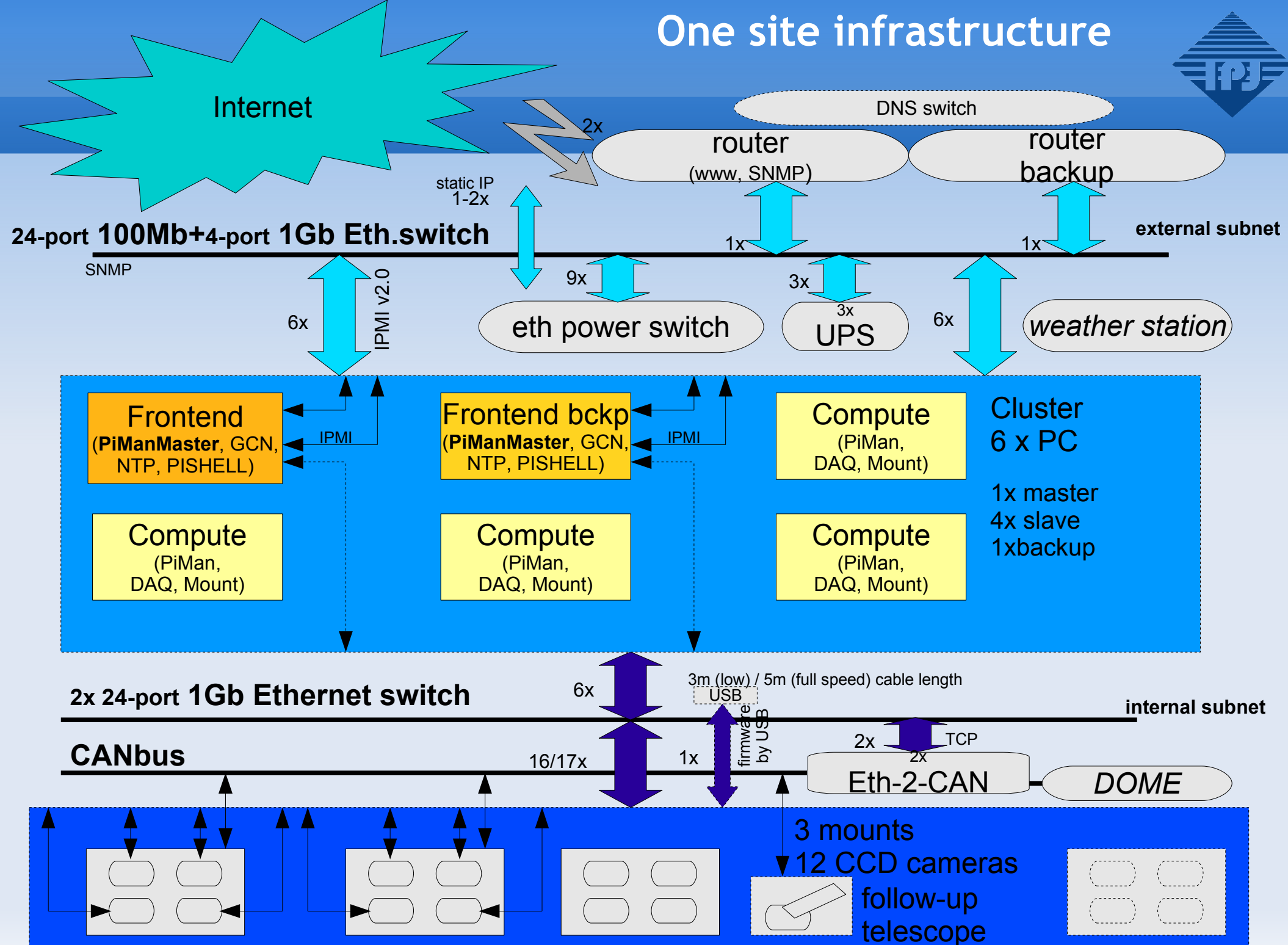
fullPi Architecture



fullPi: checking flash

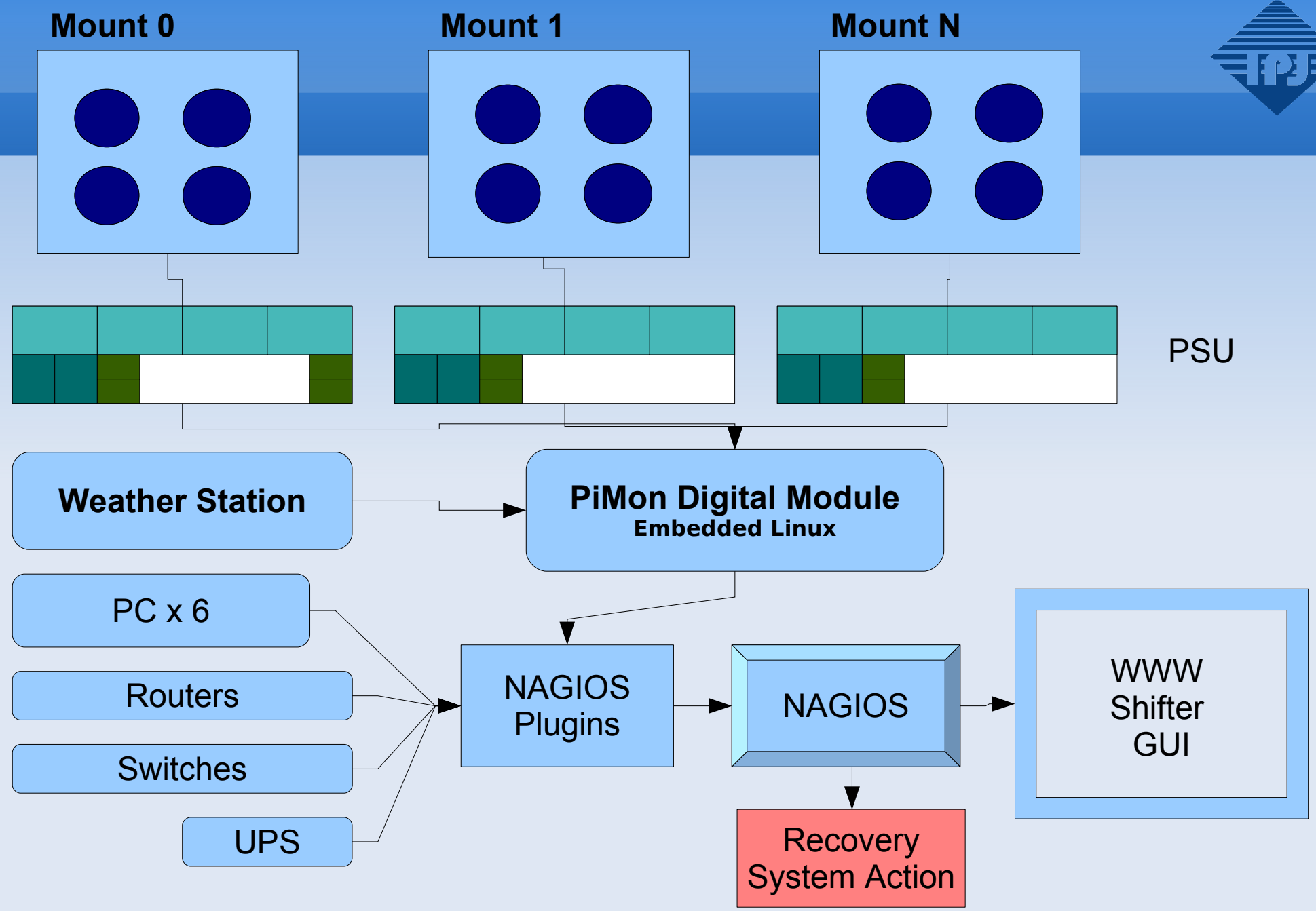


One site infrastructure





- **fullPi:**
 - monitoring / system recovery / alarms are being integrated in one system based on Nagios monitoring tool equipped in custom plugins for all system components
 - dedicated frontend will provide shifters in graphical health monitor for all operated observation sites



- PSU Camera
- PSU Motors RA, DEC
- PSU Motor D/W, Encoders, Eth2CAN



For more information please visit:
<http://grb.fuw.edu.pl>