Automation and remote control as new challenges on the way to GGOS

FESG

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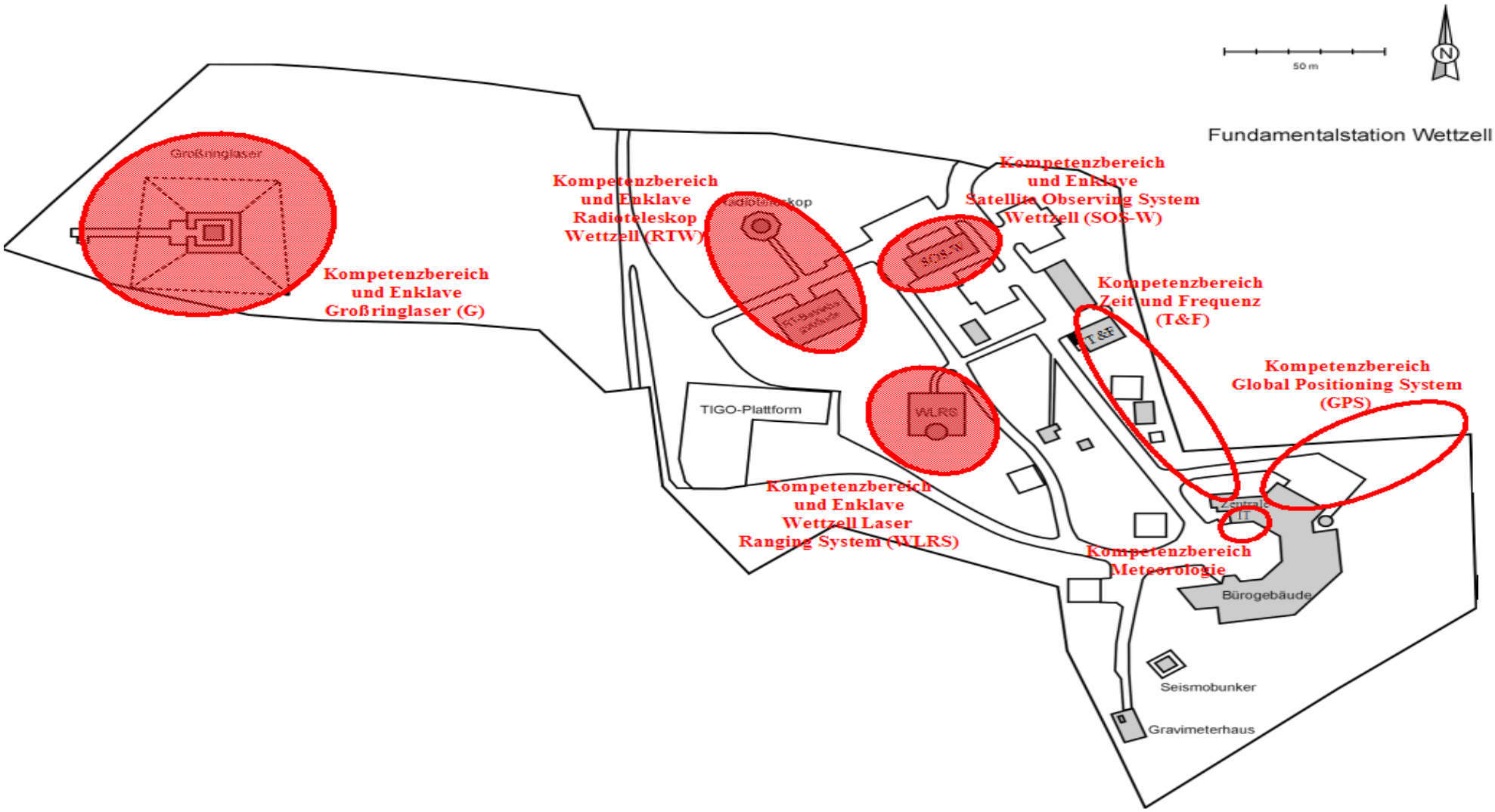
A GGOS site …

Co-located, interoperable systems



Future requirements

SLR

See „The History and Future of Satellite Laser Ranging“(2):
- [...] High Level of Automation [...] Fully automated [...] Semi-automated: Single Operator or Remote Operation[...]
- [...] Kilohertz Systems [...]

See „The SLR 2000 Pseudo Operator“(3):
- „[...] SLR 2000 Pseudo Operator (POP) controls or directs all aspects of the automated SLR 2000 system. [...] POP will monitor the health and safety of the system foremost and control the acquisition and tracking [...] of the satellites.“

VLBI

See IVS Memorandum 2006-008v01: VLBI2010 (1):
- „[...] Increase observation density [...]“
- „[...] For the highest accuracy the global networks must be tied together. [...]“
- „[...] Automate operations and procedures at all stages[...] Flexibility to add/subtract stations on short notice [...] Automated diagnostic procedures and notification of personel when necessary [...]“
- „[...] Monitoring [...] will make it possible to account for factors [...]“
- „[...] new observing strategies [...]“

GNSS

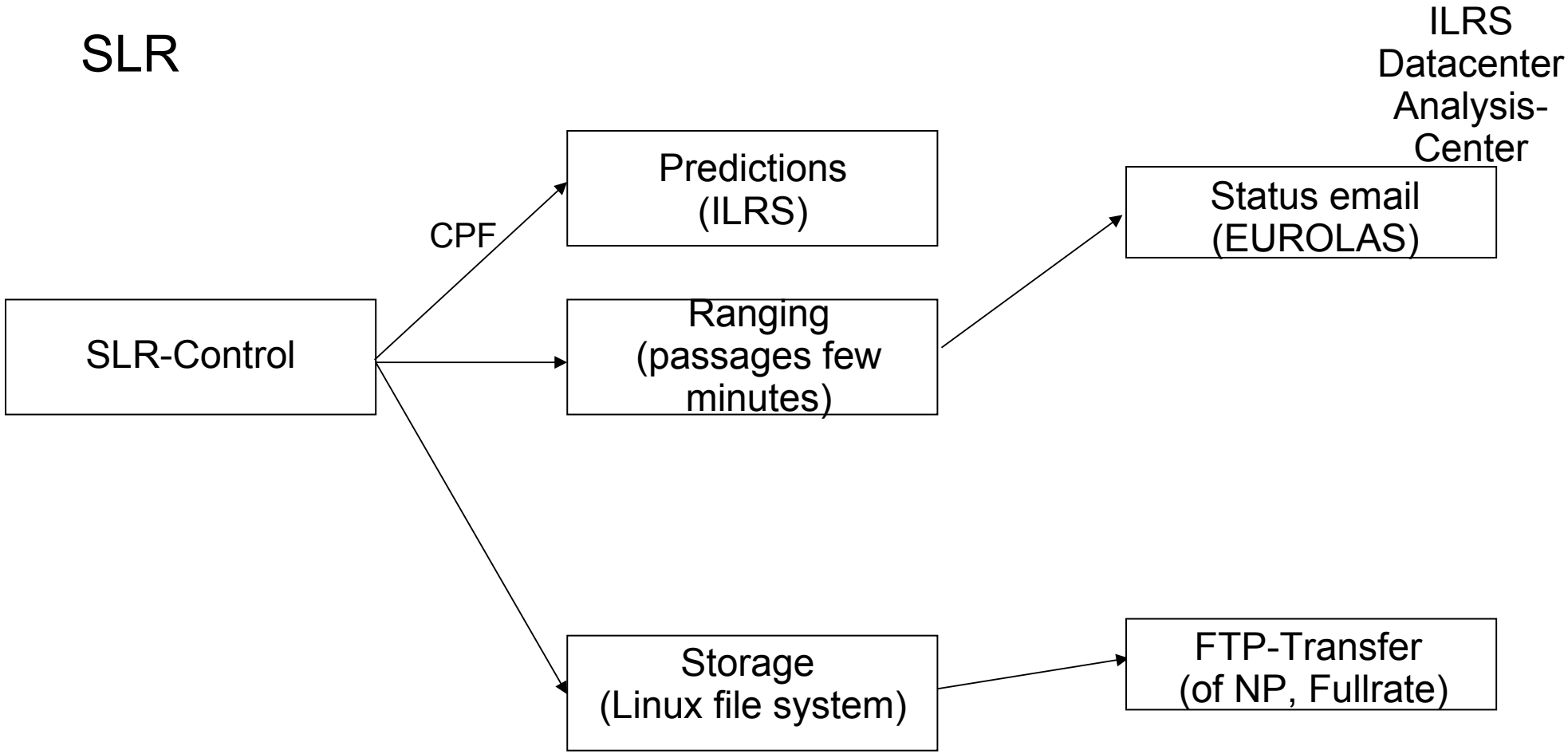
See NTRIP: „Nutzung der Internet-Radio-Technologie zur Übertragung von GNSS-Daten“(4):
- „[...] Echtzeitübertragung von GNSS-Daten [...]“
- „[...] Möglichkeit der Fernwartung [...]“

→ Flexible, remote accessible, reliable, independent, automated and safe systems (throughout all technical levels)

liell, Arthur; et. al.: IVS Memorandum 2006-008v01. „VLBI2010: Current and Future Requirements for Geodetic VLBI Systems“. Sept. 2004
ttp://ilrs.gsfc.nasa.gov/docs/degnan_0603.pdf (3) http://cddis.nasa.gov/slr2000/docs/pseudo_operator.pdf
ttp://igs.bkg.bund.de/root_ftp/NTRIP/documentation/sapos03_gebhard.pdf

Laser Ranging Workflow

The workflows on a technical point of view



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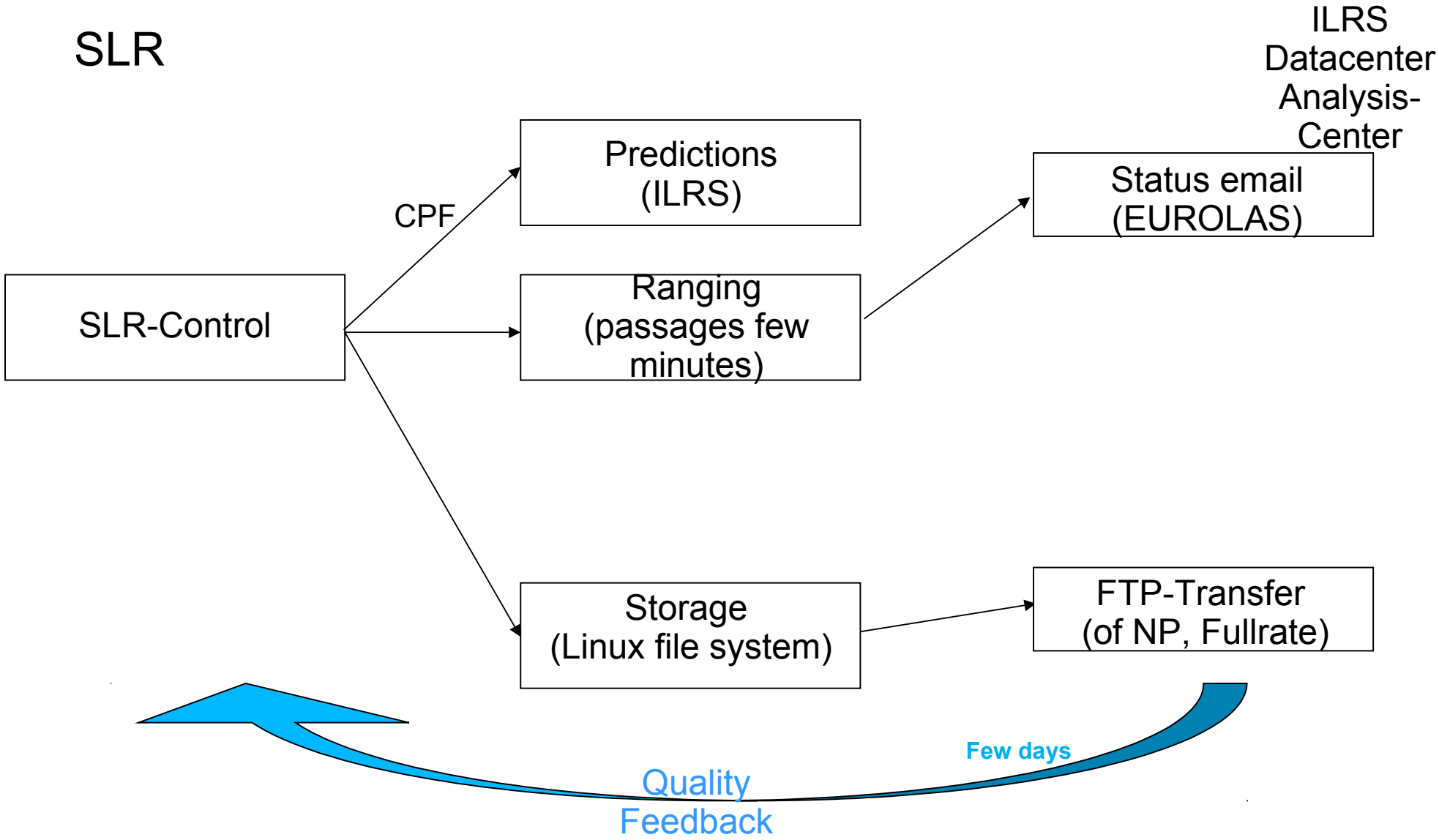

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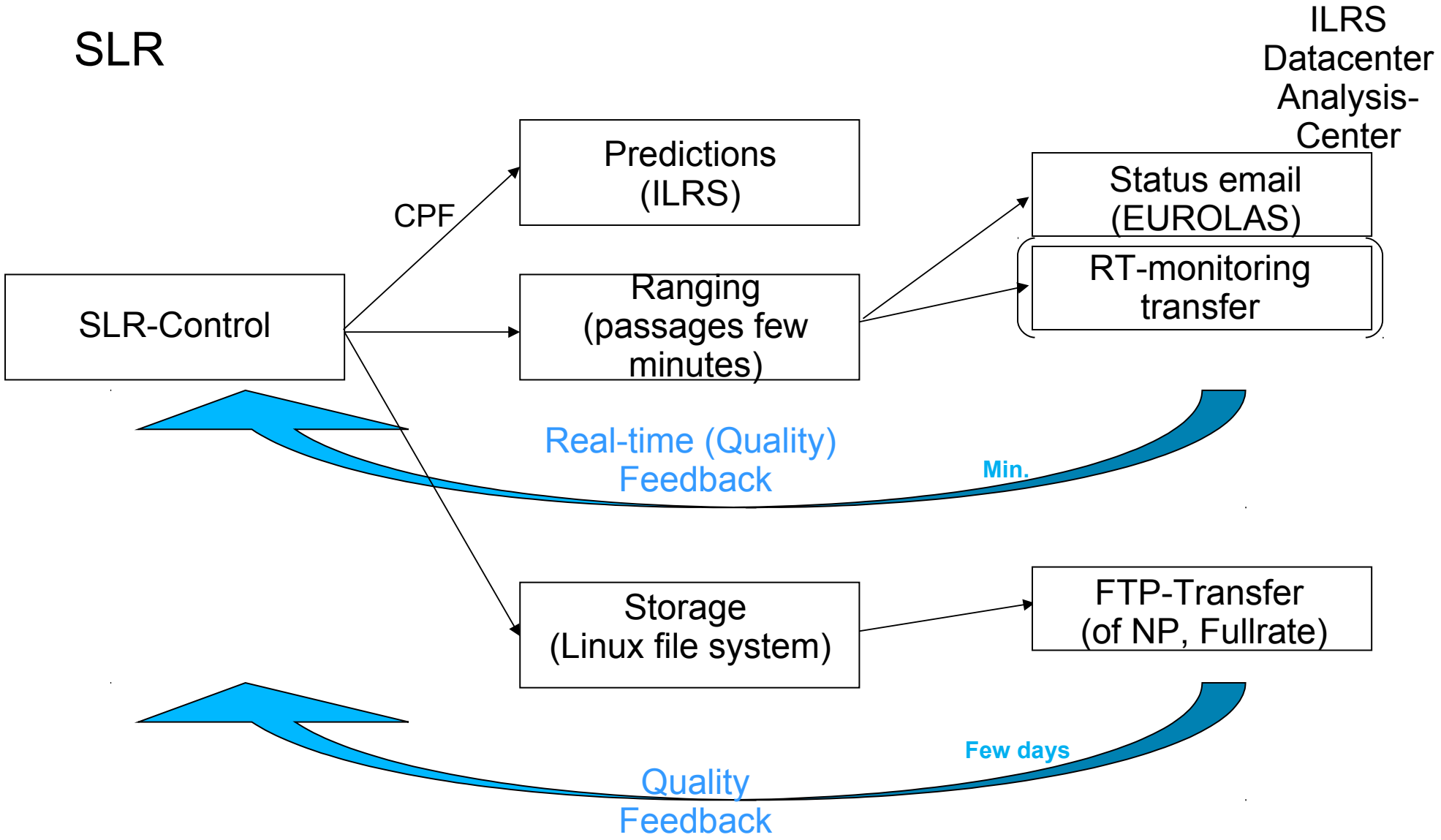

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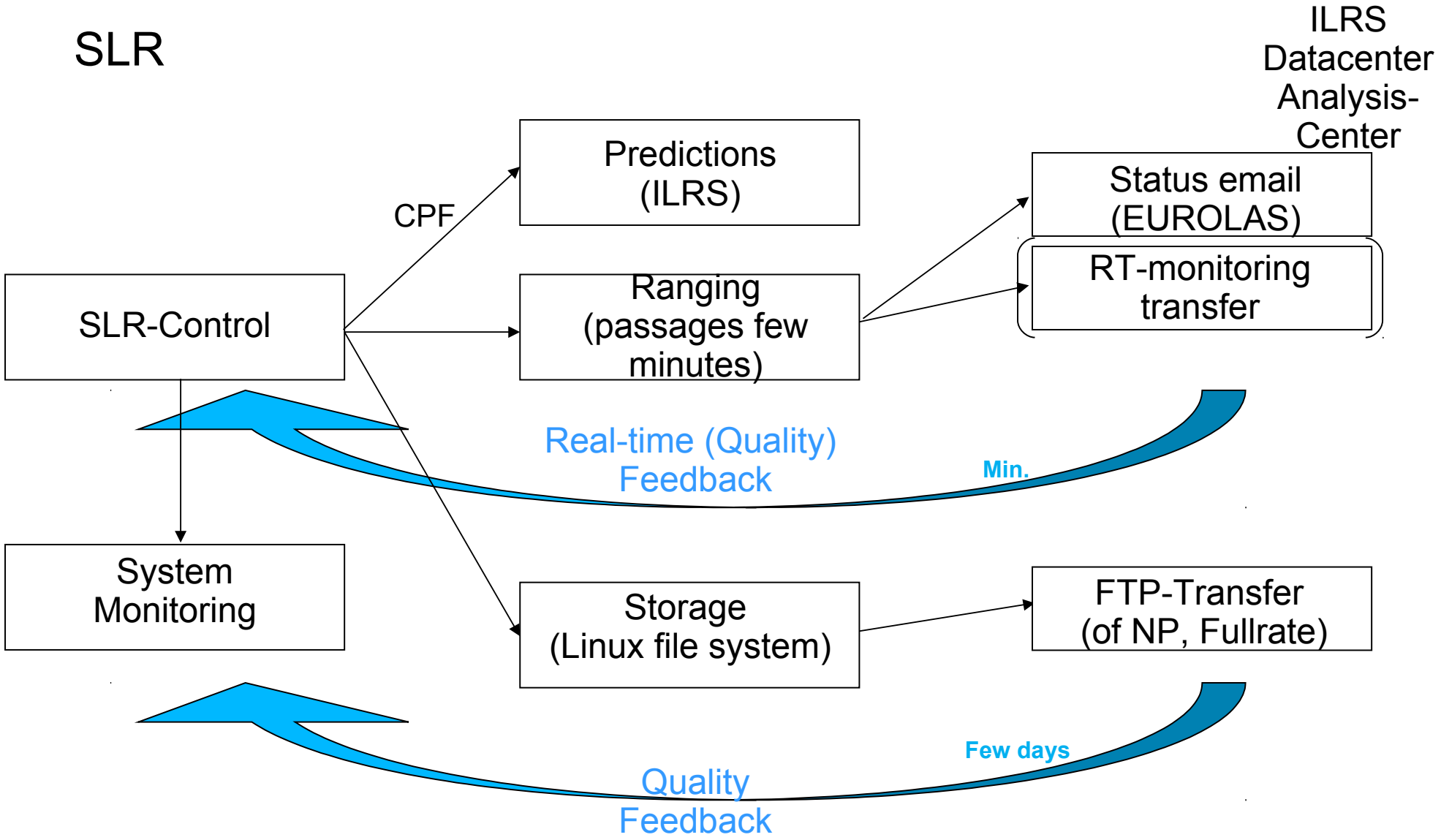

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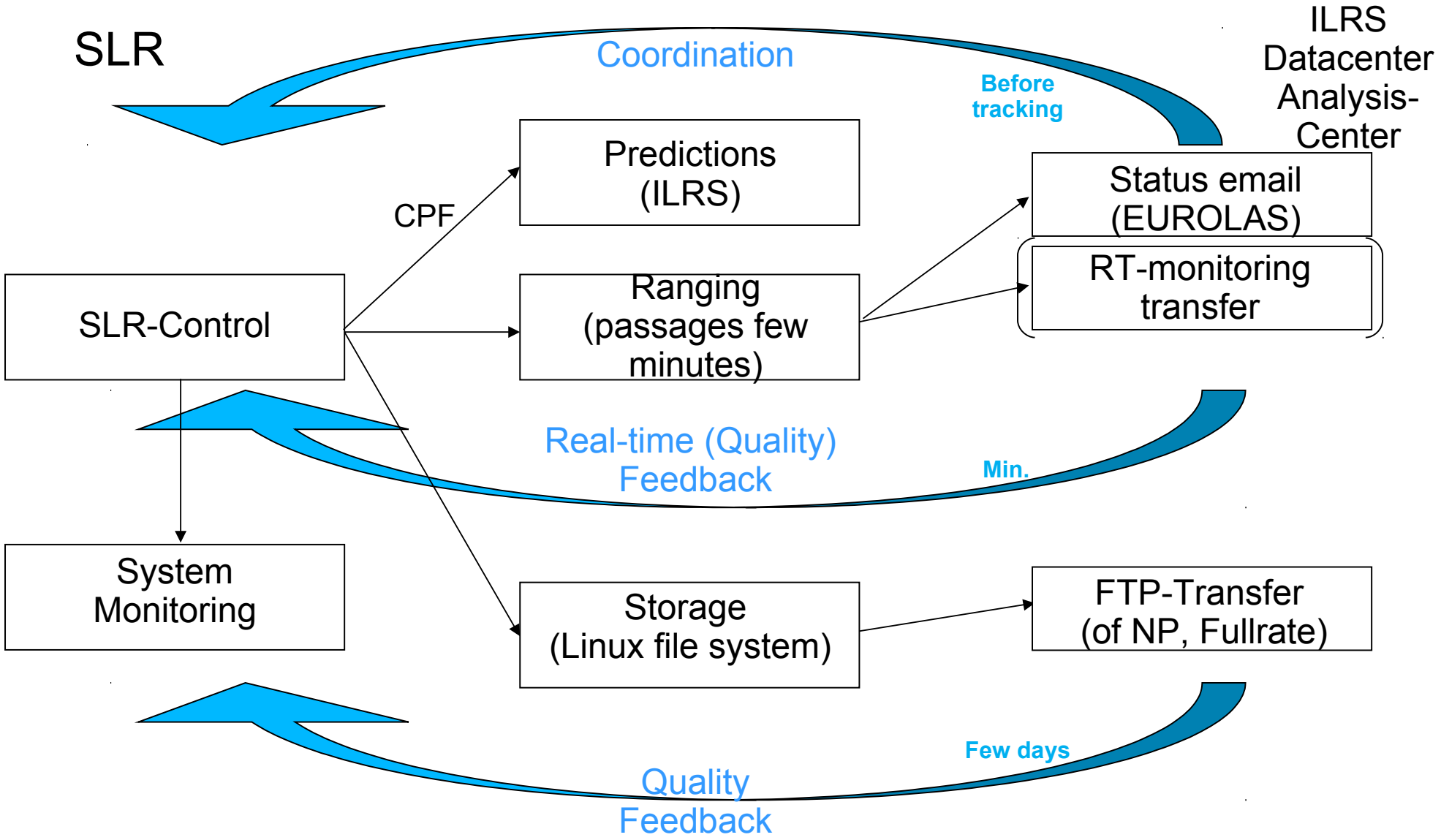


Standardizing interfaces and system software

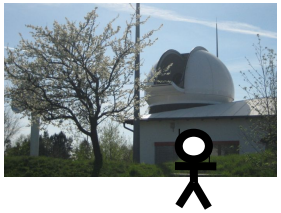
Control includes ...

Interfaces	Access points, available functionalities
Protocols	Communication rules and styles
Workflows	Communication and operation schedule
Data & Formats	Communication data and storage descriptions
SW/HW Techniques	Communication software and hardware in a development process
Strategies	(New) strategies to operate sites using communication
Safety & Security	Authenticity and reliability
...	

Standardization & synergies over services and system borders

New control strategies

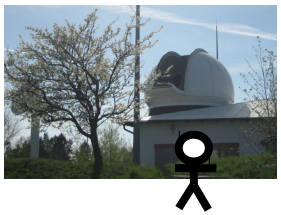
New control strategies



Local

- Standard operations
- Local operator

New control strategies



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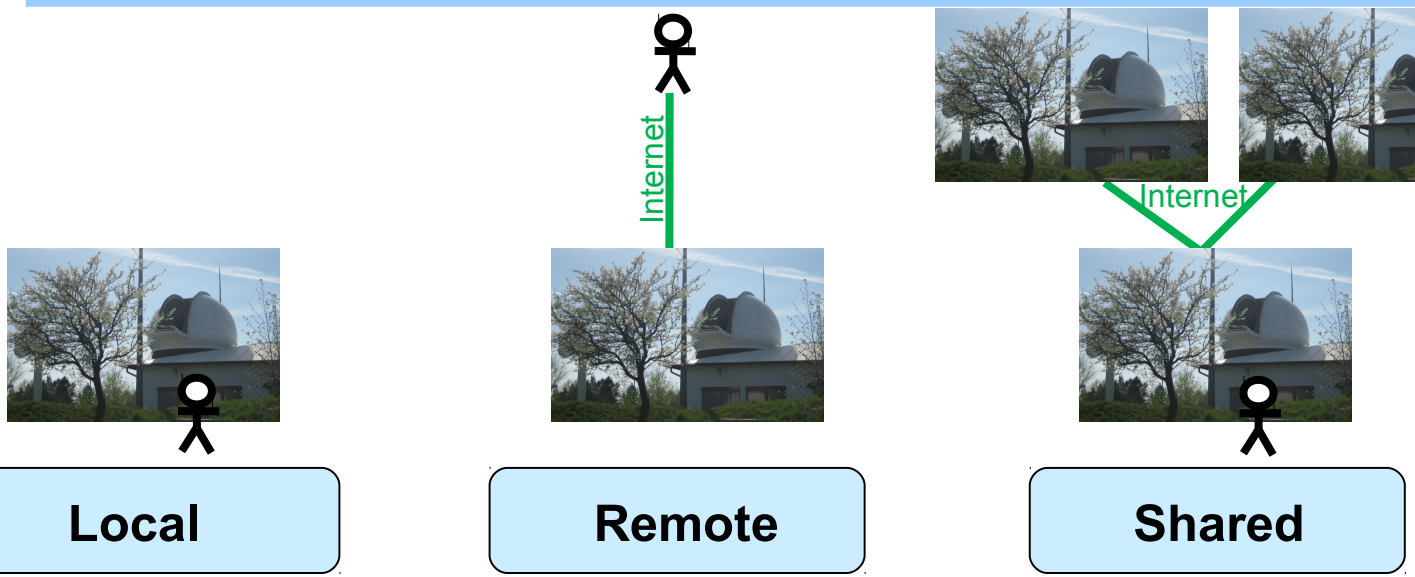
Remote

- Check system states from everywhere at the observatory
- Tele-working
- Remote assistance and diagnostics
- Control very remote, inaccessible telescopes

New control strategies



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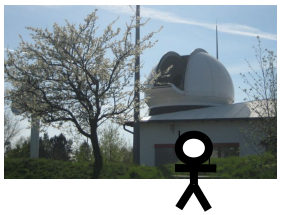
- Save, passive data live monitoring
- Dedicated control access by responsible person
- Shared access from different observatories
- Shared night shifts

New control strategies



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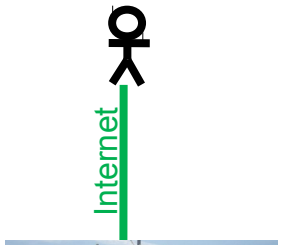

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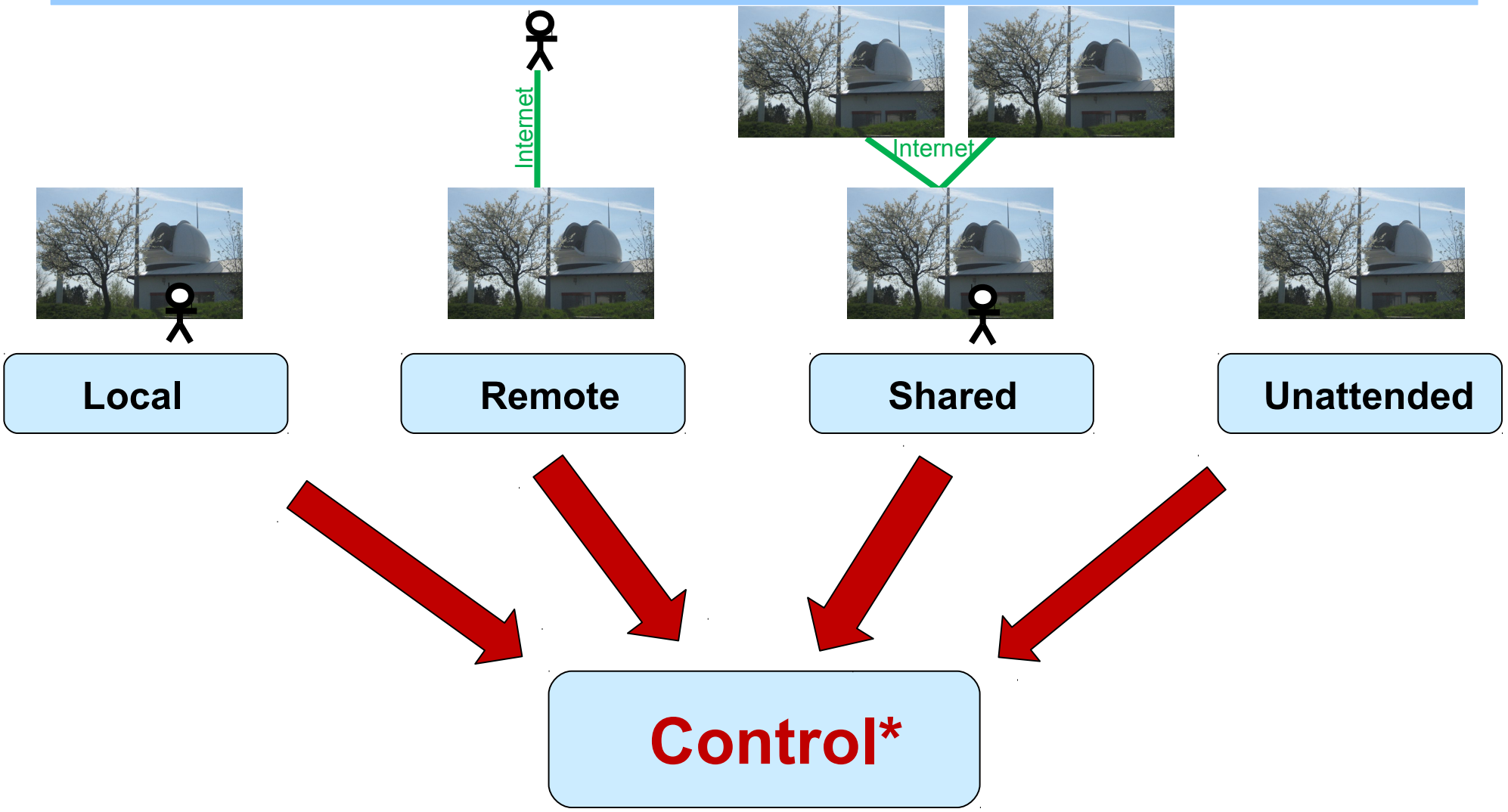
Unattended

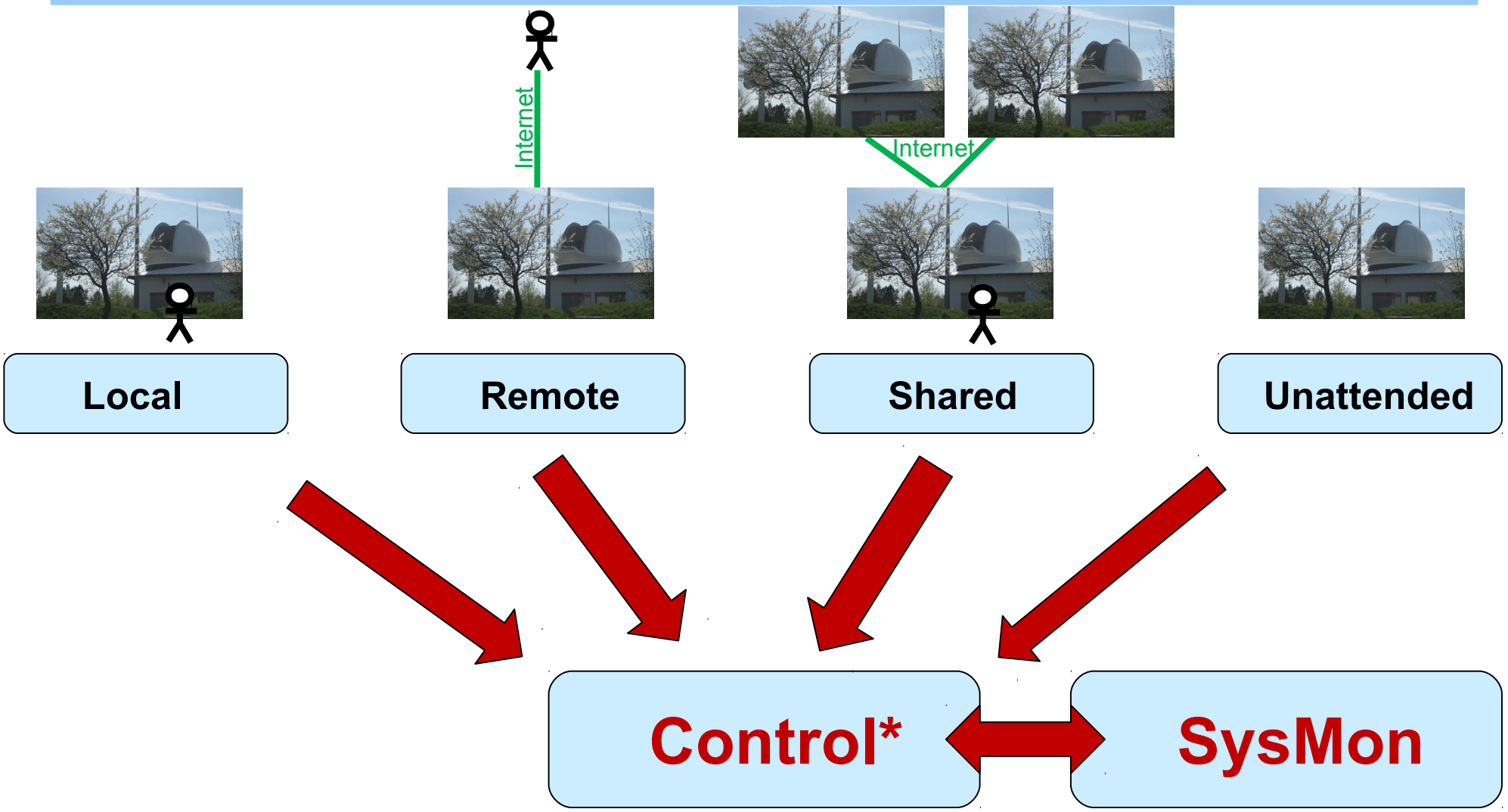
- Observations run autonomous, (semi-) automated and unattended

New control strategies



*** per system with individual restrictions and only with reliable, well educated personnel staff on site**

New control strategies



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An example from astronomy: The Liverpool telescope

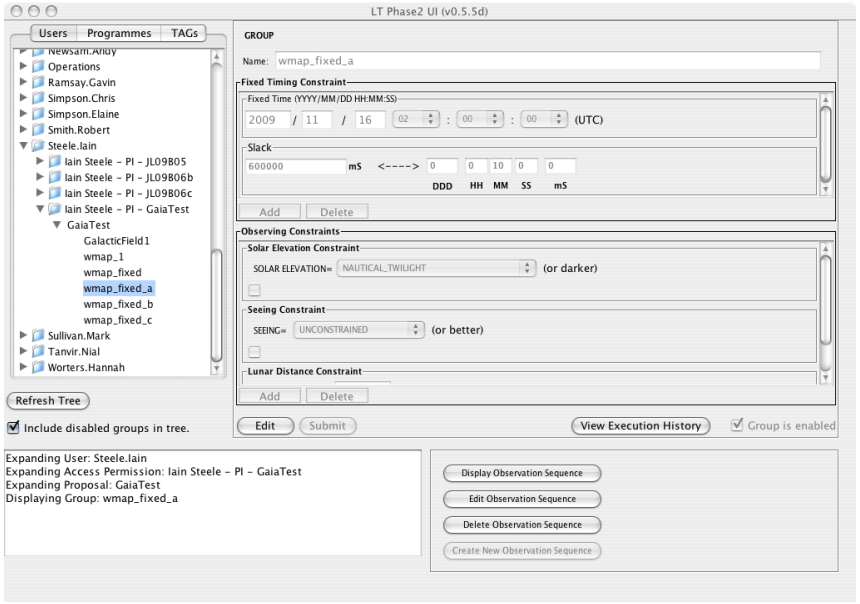
Prof. Iain Steele, Telescope Director

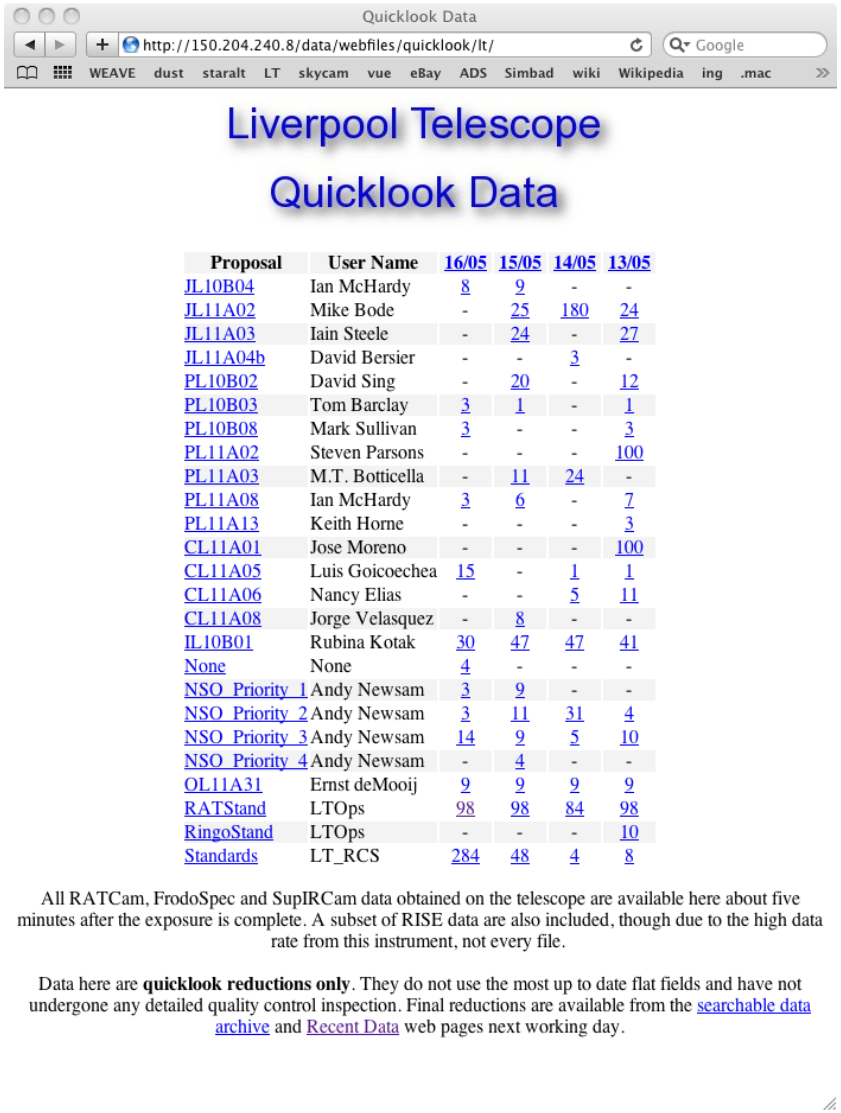
http://telescope.livjm.ac.uk/

The Liverpool Telescope

- 2.0 metre f/10
- La Palma, Canary Islands
- Operating since 2004
- Fully Robotic (no on site staff).
- Multiple instruments (change time 20 seconds)
  - CCD imagers
  - Polarimeter
  - Spectrograph
- Common user (~50 users from ~20 institutions)
- Total Operating Budget 600,000 Euro/year
- http://telescope.livjm.ac.uk/

Web Based User Interaction



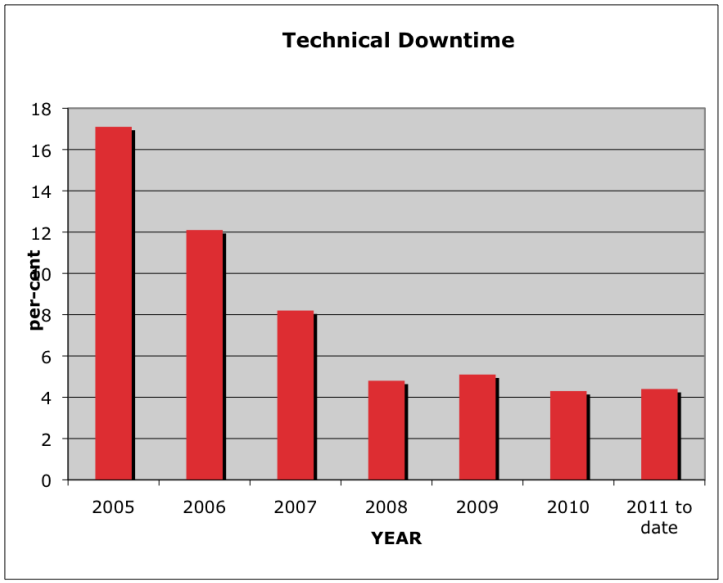


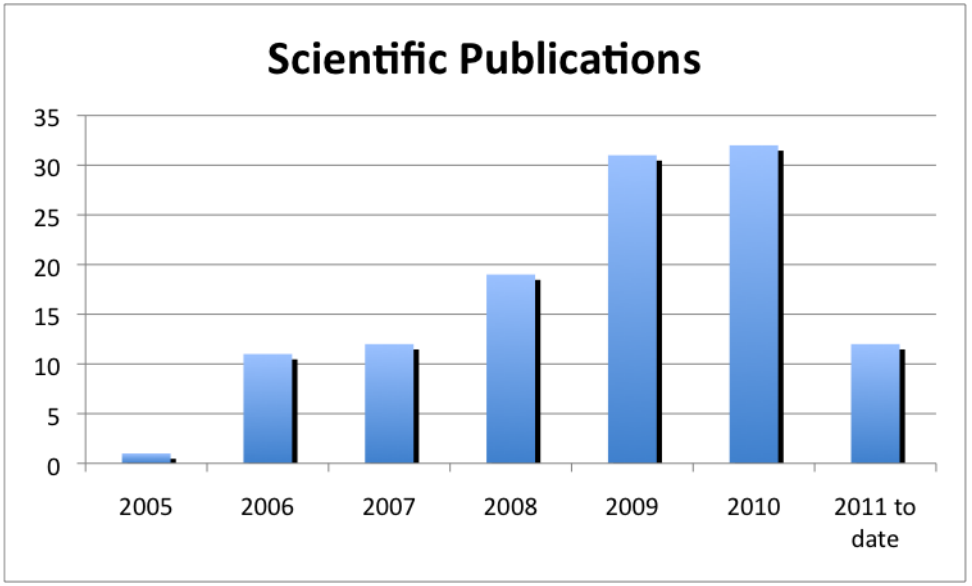
Proposal	User Name	16/05	15/05	14/05	13/05
JL10B04	Ian McHardy	8	9	-	-
JL11A02	Mike Bode	-	25	180	24
JL11A03	Iain Steele	-	24	-	27
JL11A04b	David Bersier	-	-	3	-
PL10B02	David Sing	-	20	-	12
PL10B03	Tom Barclay	3	1	-	1
PL10B08	Mark Sullivan	3	-	-	3
PL11A02	Steven Parsons	-	-	-	100
PL11A03	M.T. Botticella	-	11	24	-
PL11A08	Ian McHardy	3	6	-	7
PL11A13	Keith Horne	-	-	-	3
CL11A01	Jose Moreno	-	-	-	100
CL11A05	Luis Goicoechea	15	-	1	1
CL11A06	Nancy Elias	-	-	5	11
CL11A08	Jorge Velasquez	-	8	-	-
IL10B01	Rubina Kotak	30	47	47	41
None	None	4	-	-	-
NSO_Priority_1	Andy Newsam	3	9	-	-
NSO_Priority_2	Andy Newsam	3	11	31	4
NSO_Priority_3	Andy Newsam	14	9	5	10
NSO_Priority_4	Andy Newsam	-	4	-	-
OL11A31	Ernst deMooij	9	9	9	9
RATStand	LTOps	98	98	84	98
RingoStand	LTOps	-	-	-	10
Standards	LT_RCS	284	48	4	8

All RATCam, FrodoSpec and SupIRCam data obtained on the telescope are available here about five minutes after the exposure is complete. A subset of RISE data are also included, though due to the high data rate from this instrument, not every file.

Data here are **quicklook reductions only**. They do not use the most up to date flat fields and have not undergone any detailed quality control inspection. Final reductions are available from the searchable data archive and Recent Data web pages next working day.

Some statistics and references ...





· **The Liverpool Telescope: performance and first results, Steele I.A. et al..,** ***Proc SPIE, 5489, pp. 679-692 (2004).***
· **Design of low cost and reliable instrumentation for robotic telescopes, Mottram, C.J. et al.. *Proc SPIE, 5492, pp. 677-688 (2004).***
· **Robotic telescope scheduling: the Liverpool Telescope experience, Fraser S. & Steele, I. A., *Proc SPIE 5493, pp. 331-340 (2004).***
· **Switching the Liverpool Telescope from a full-service operating model to self-service, Smith R.J. et al., Proc SPIE 7713 (2010).**

Thank you!