

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

FESG

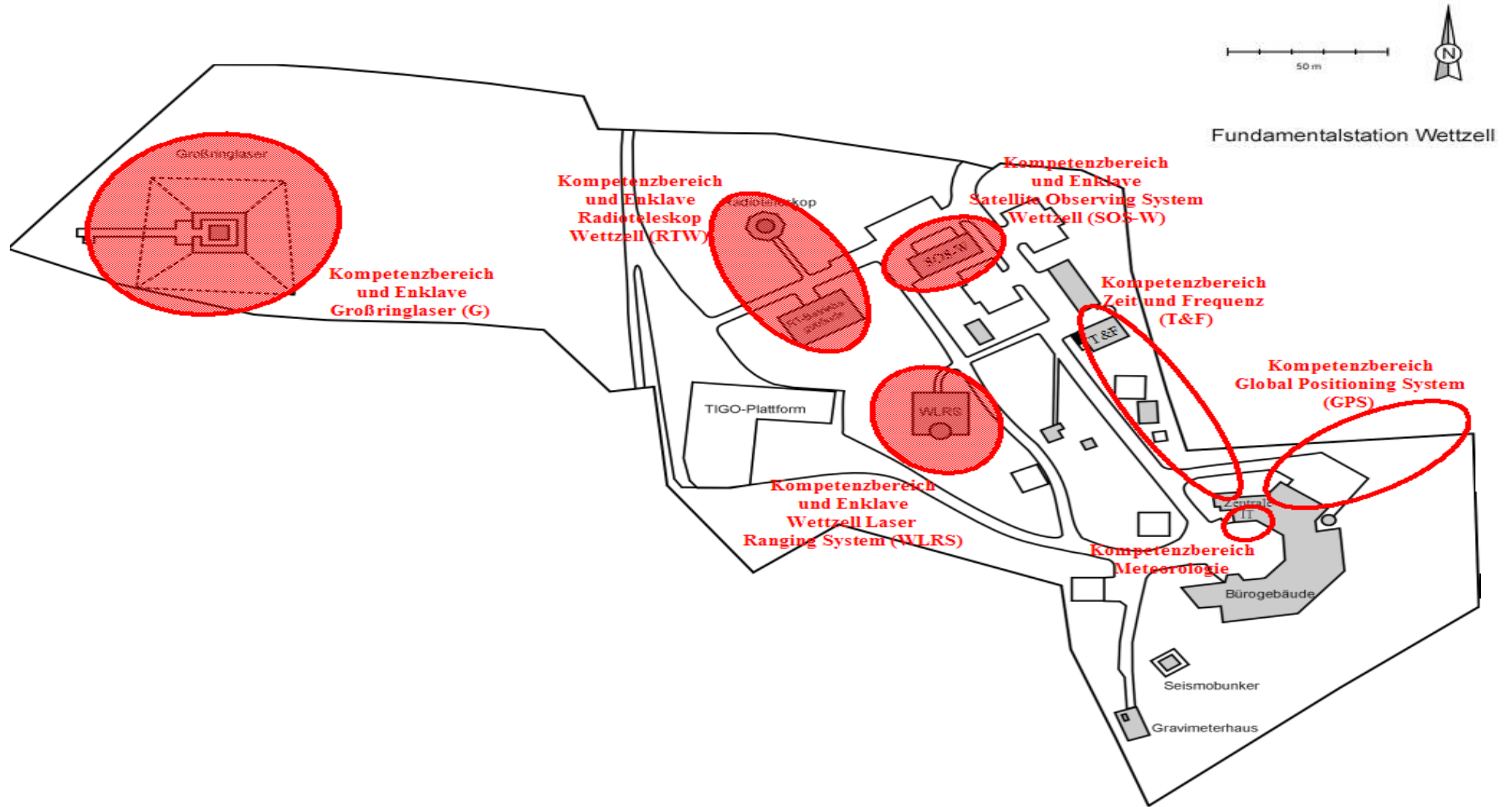
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Dassing, R. (BKG); Mühlbauer, M. (BKG); Plötz, C (BKG), Schreiber, U. (FESG),**

A GGOS site ...

Co-located, interoperable systems



Ursprünglicher Stationsplan von Dr. Klügel, FS Wettzell

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⁾:

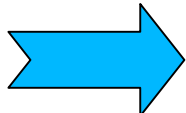
 - „[...] SLR 2000 Pseudo Operator (POP) controls or directs all aspects of the automated SLR 2000 system. [...] POP will monitor the health and safety of the system foremost and control the acquisition and tracking [...] of the satellites.“

- 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)

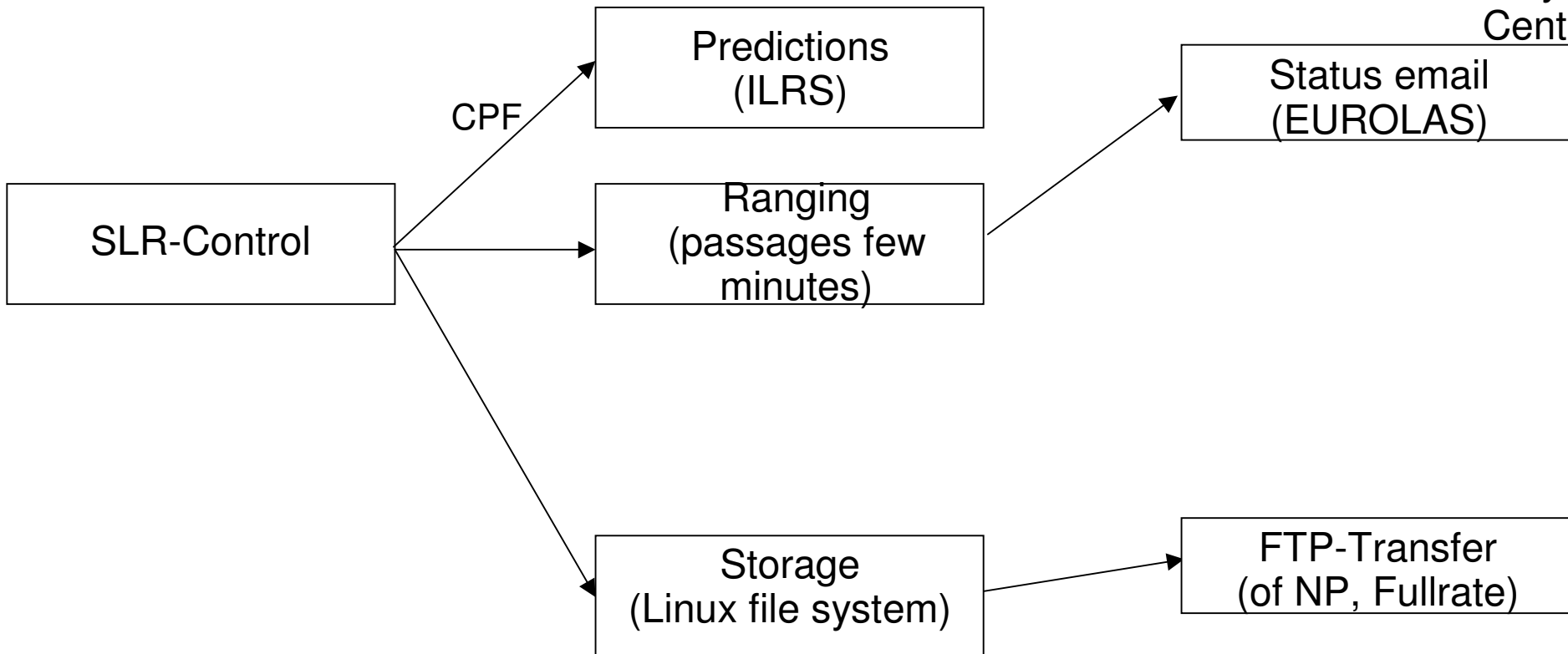
(1) Niell, Arthur; et. al.: IVS Memorandum 2006-008v01. „VLBI2010: Current and Future Requirements for Geodetic VLBI Systems“. Sept. 2004
 (2) http://ilrs.gsfc.nasa.gov/docs/degan_0603.pdf (3) http://cddis.nasa.gov/slr2000/docs/pseudo_operator.pdf
 (4) http://igs.bkg.bund.de/root_ftp/NTRIP/documentation/sapos03_gebhard.pdf

Laser Ranging Workflow

The workflows on a technical point of view

SLR

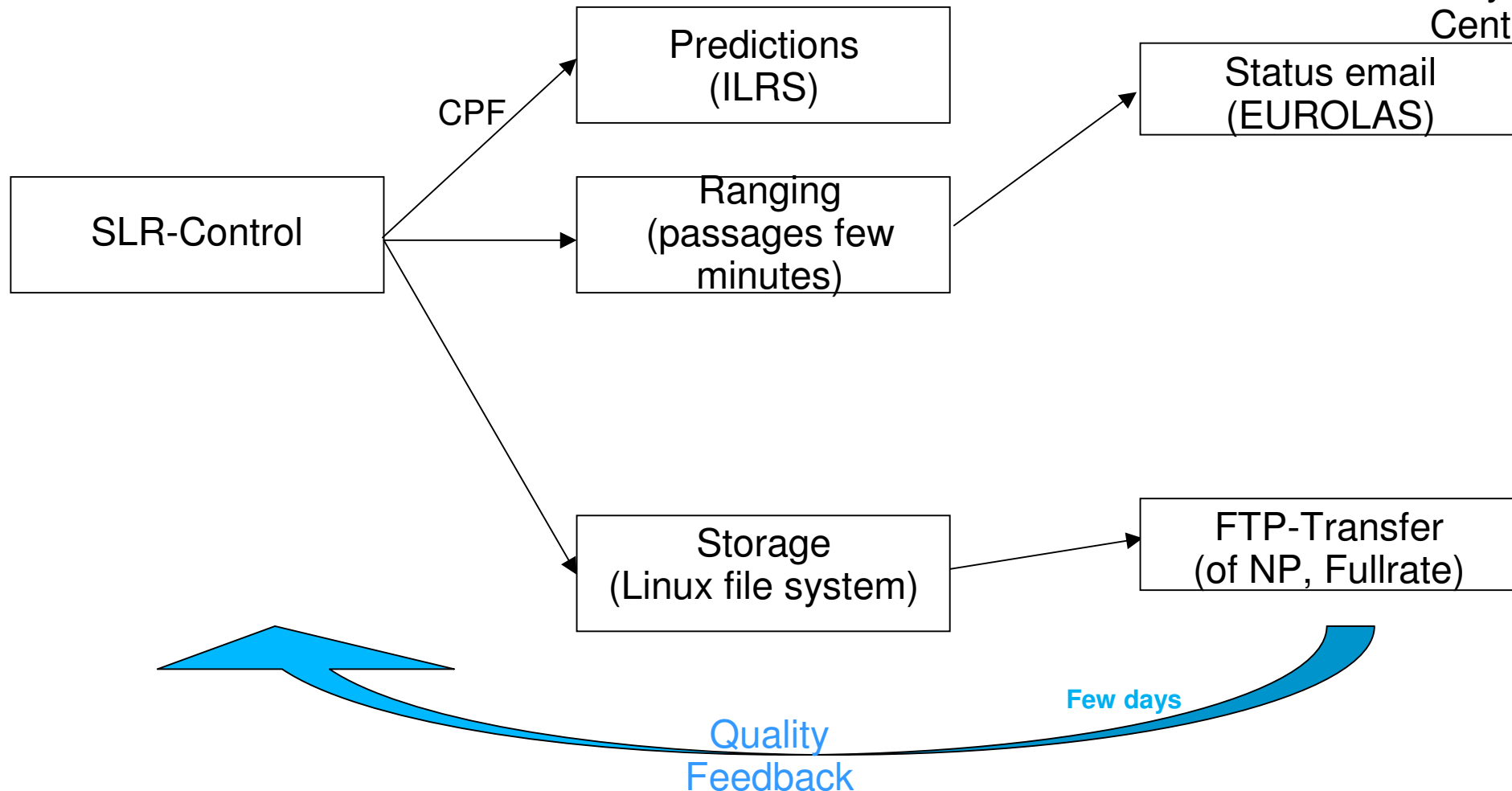
ILRS
Datacenter
Analysis-
Center



The workflows on a technical point of view

SLR

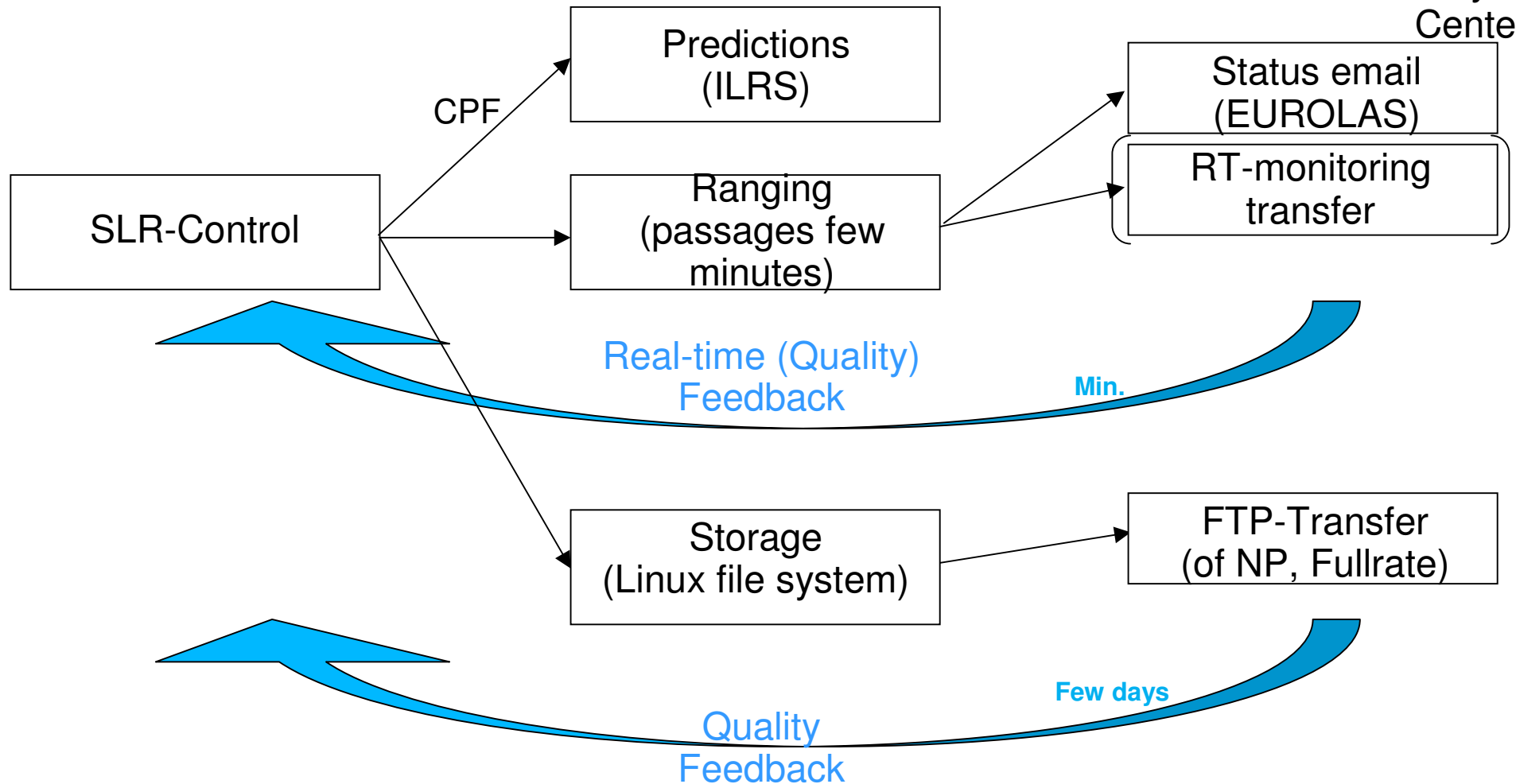
ILRS
Datacenter
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The workflows on a technical point of view

SLR

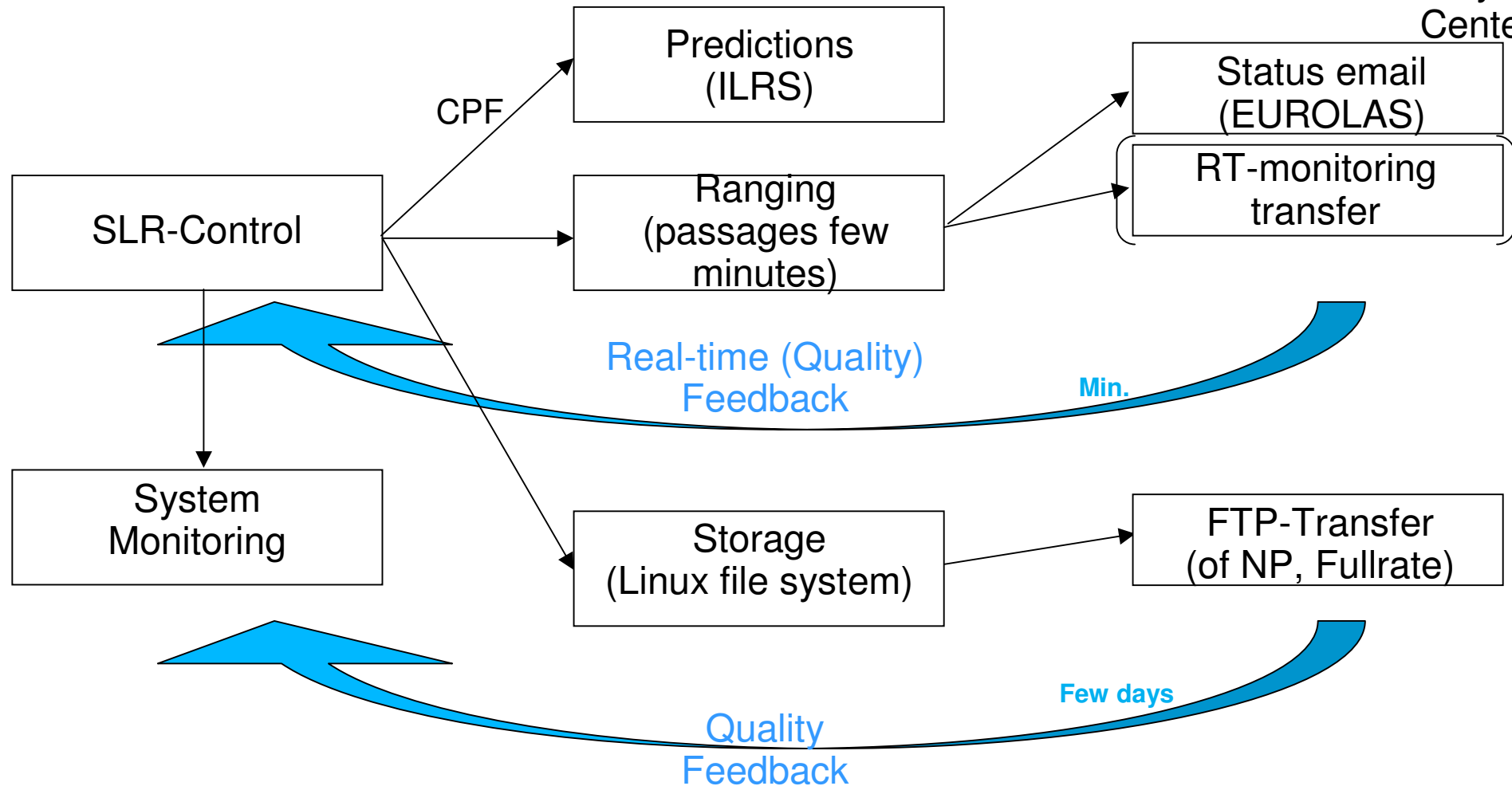
ILRS
Datacenter
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Center



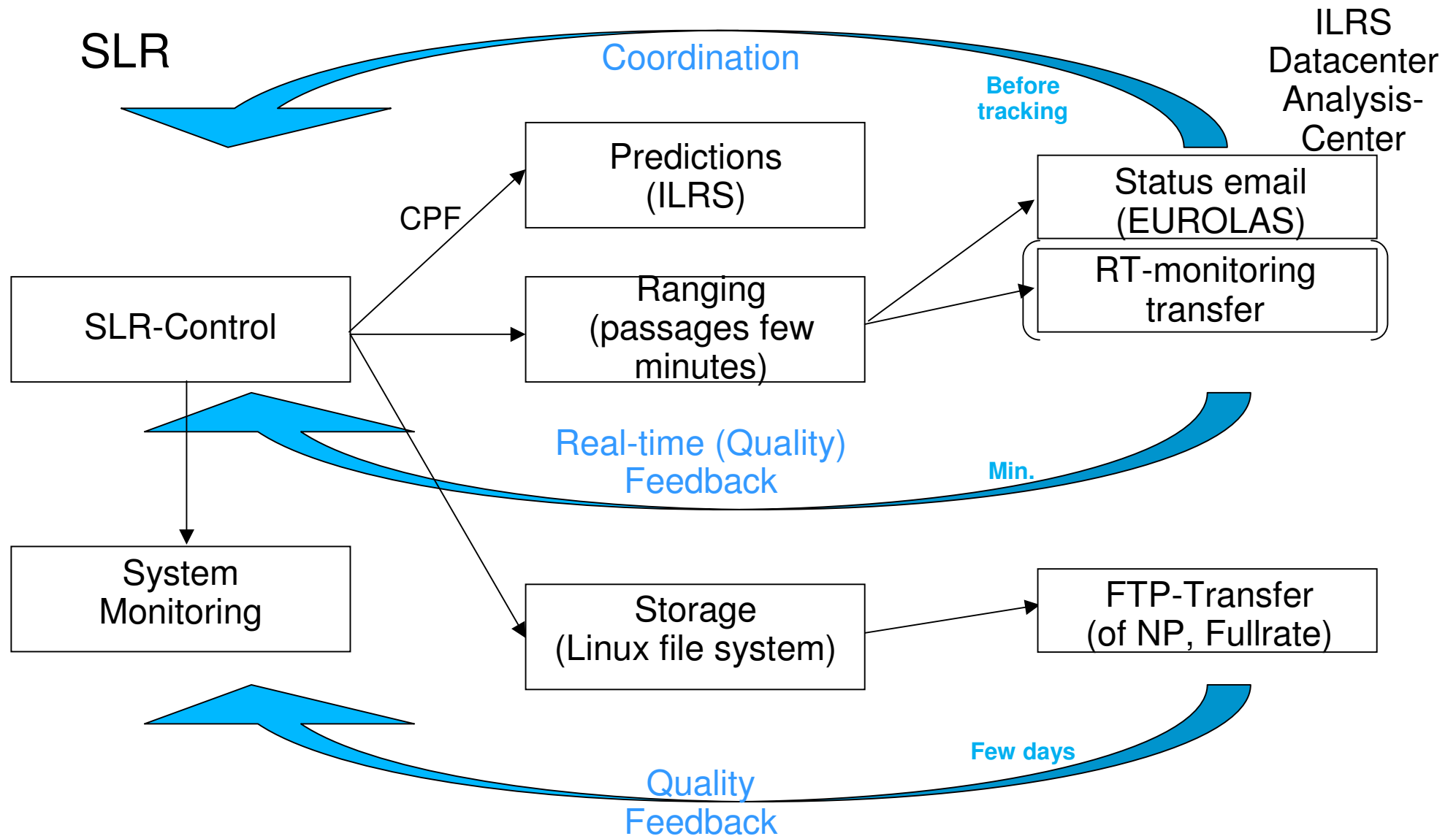
The workflows on a technical point of view

SLR

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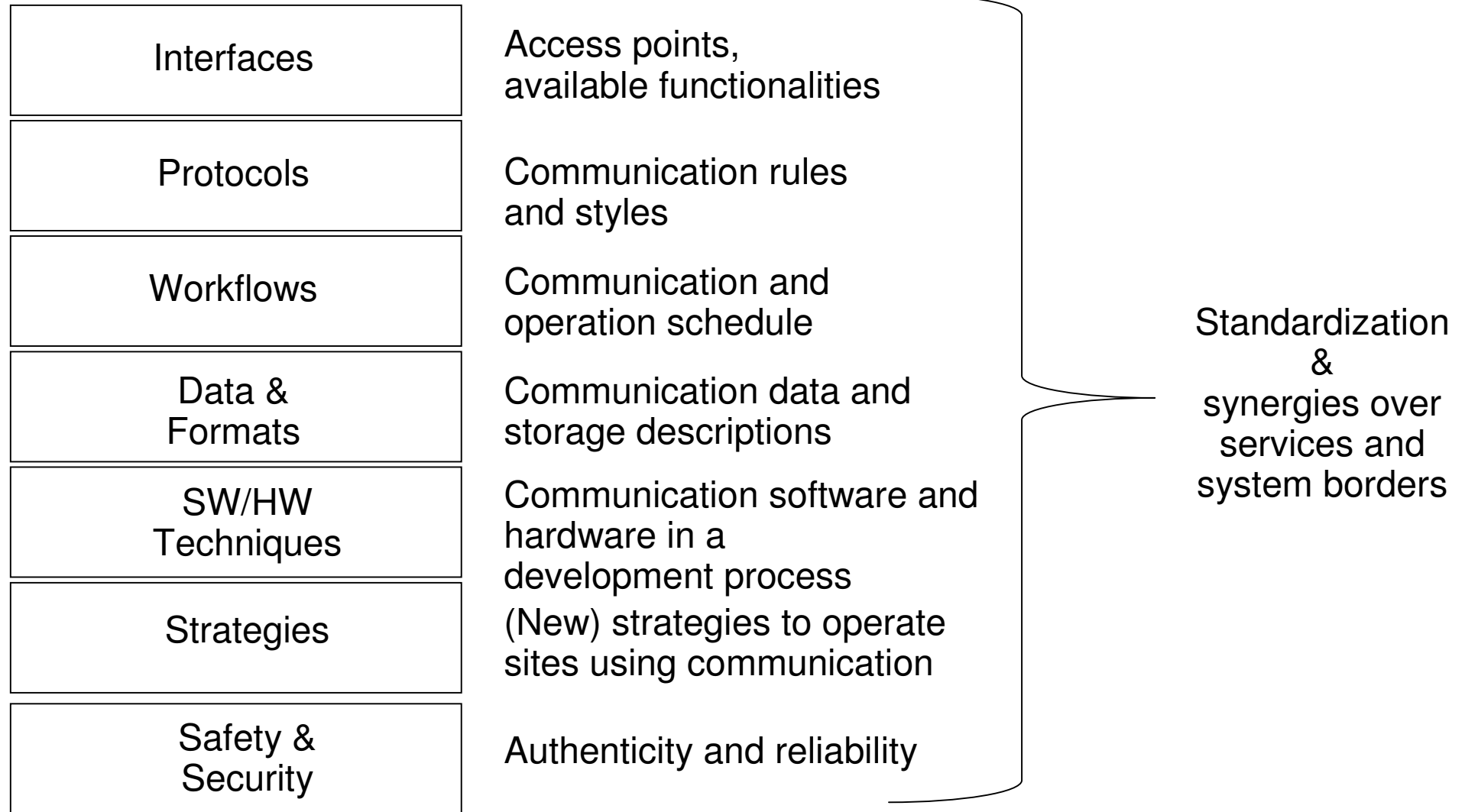


The workflows on a technical point of view



Standardizing interfaces and system software

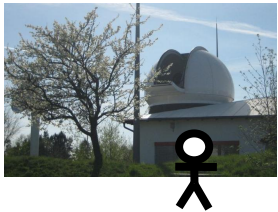
Control includes ...



...

New control strategies

New control strategies



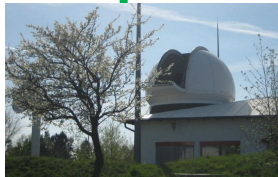
Local

- Standard operations
- Local operator

New control strategies



Local

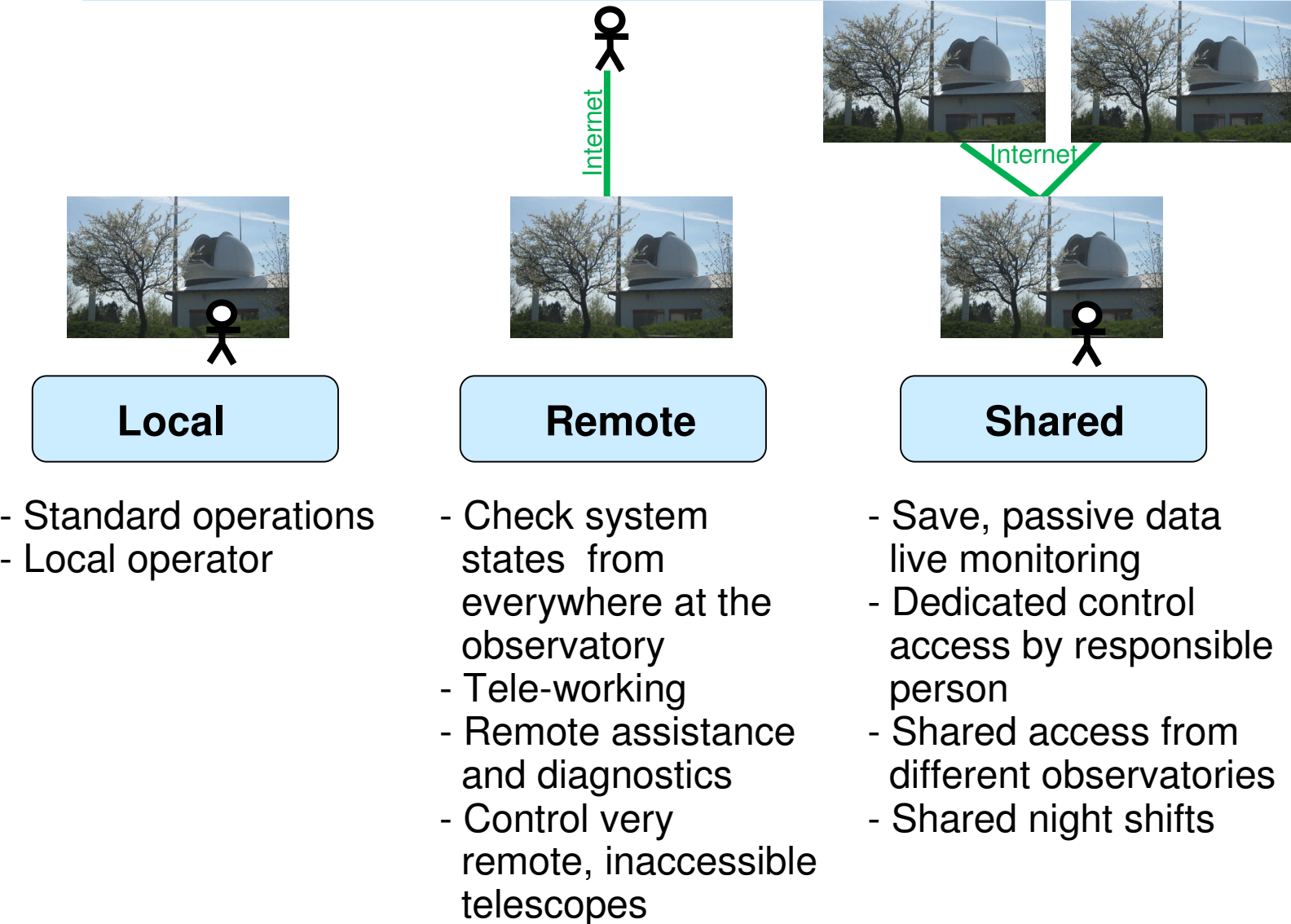


Remote

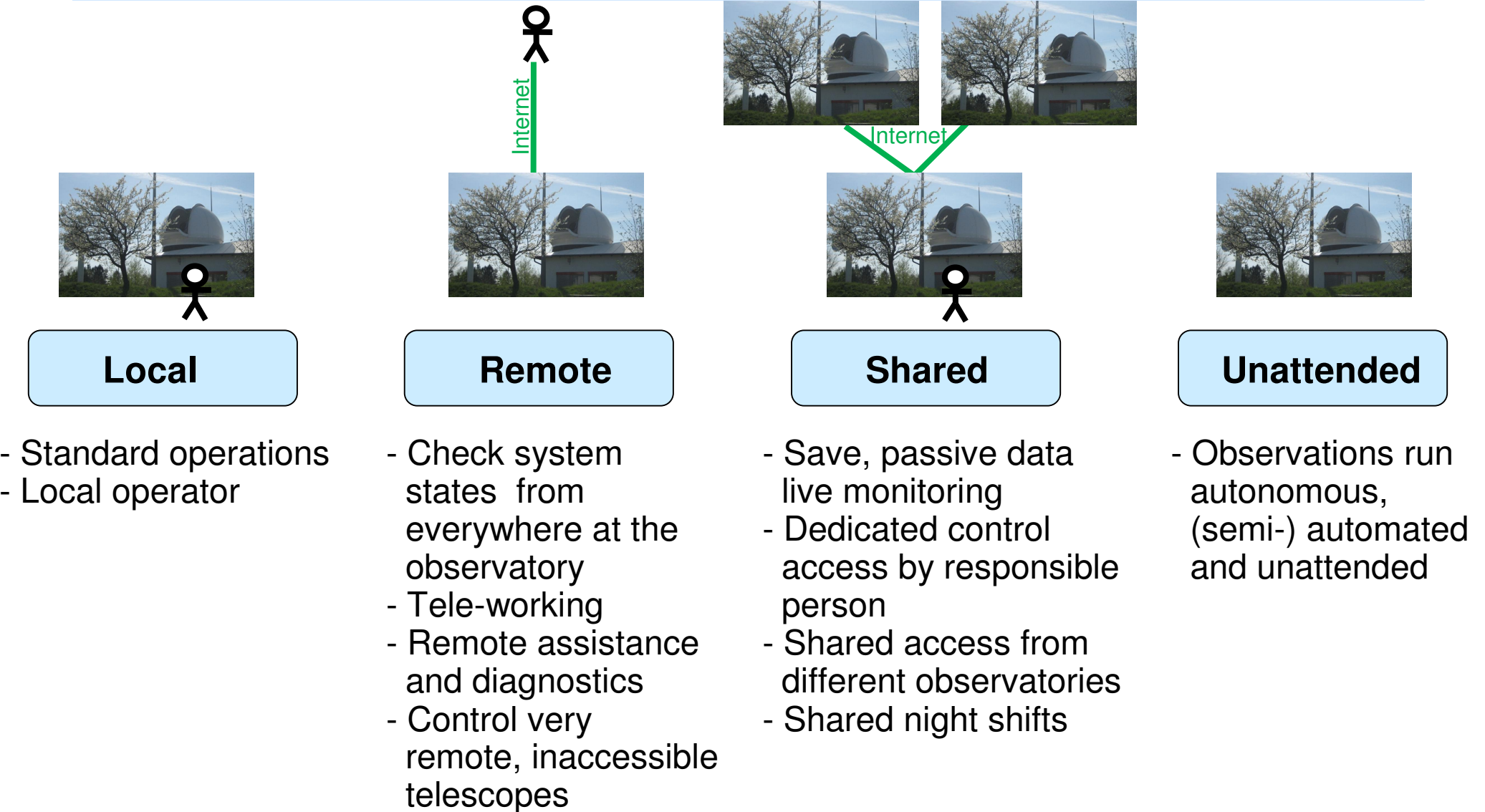
- Standard operations
- Local operator

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

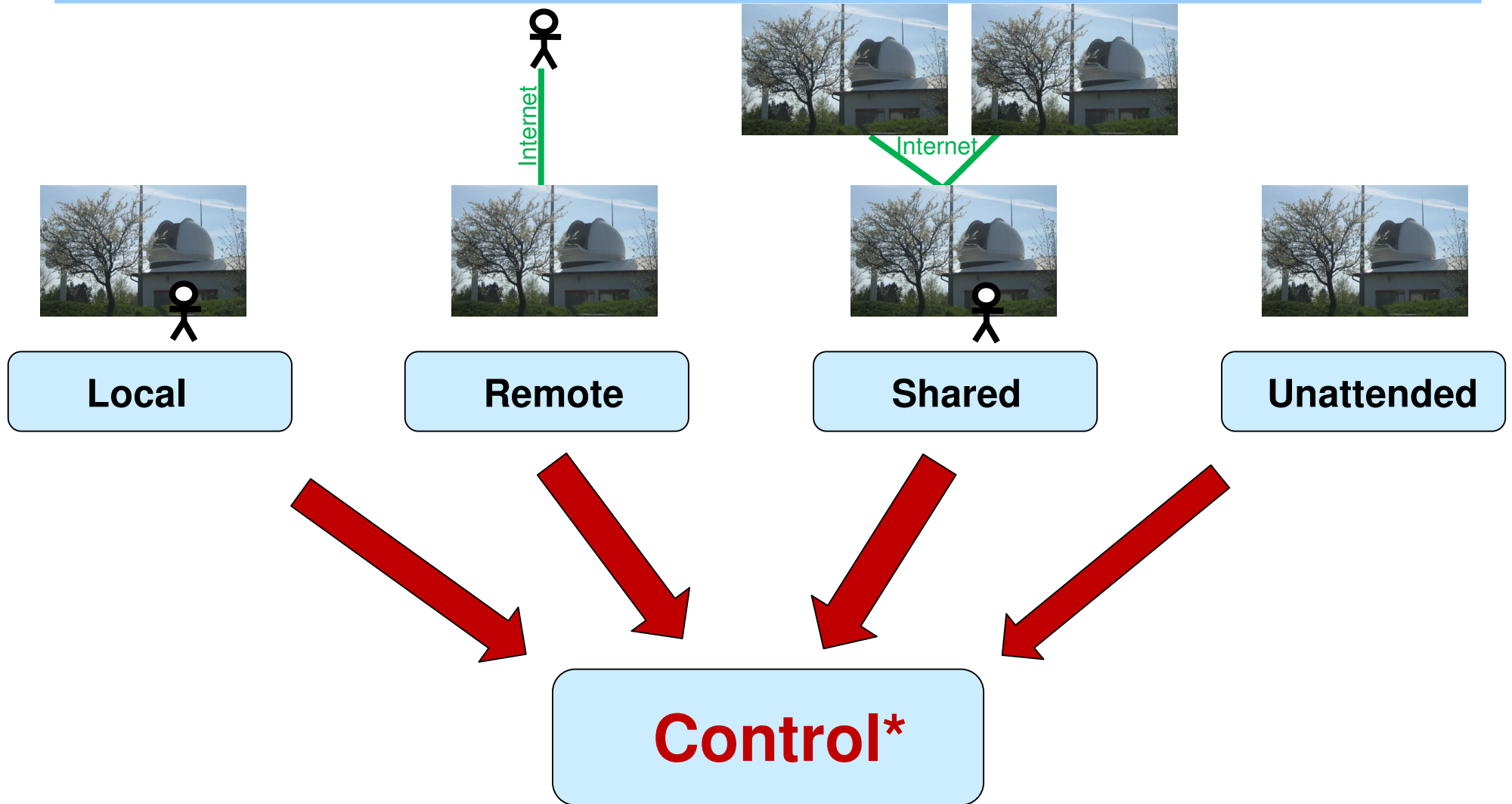
New control strategies



New control strategies

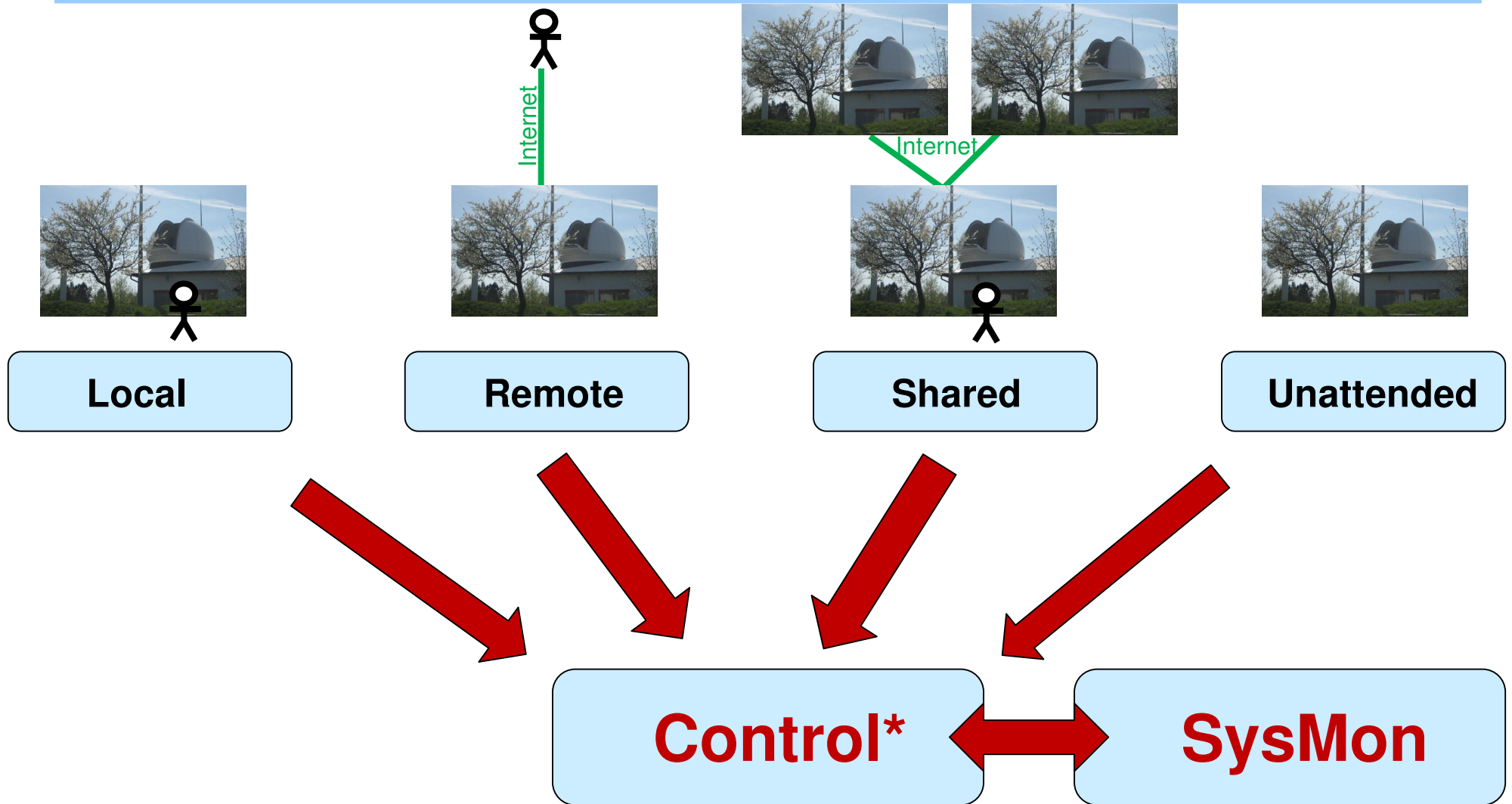


New control strategies



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

New control strategies



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

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

Live Status 2011 May 17 11:12:55 GMT

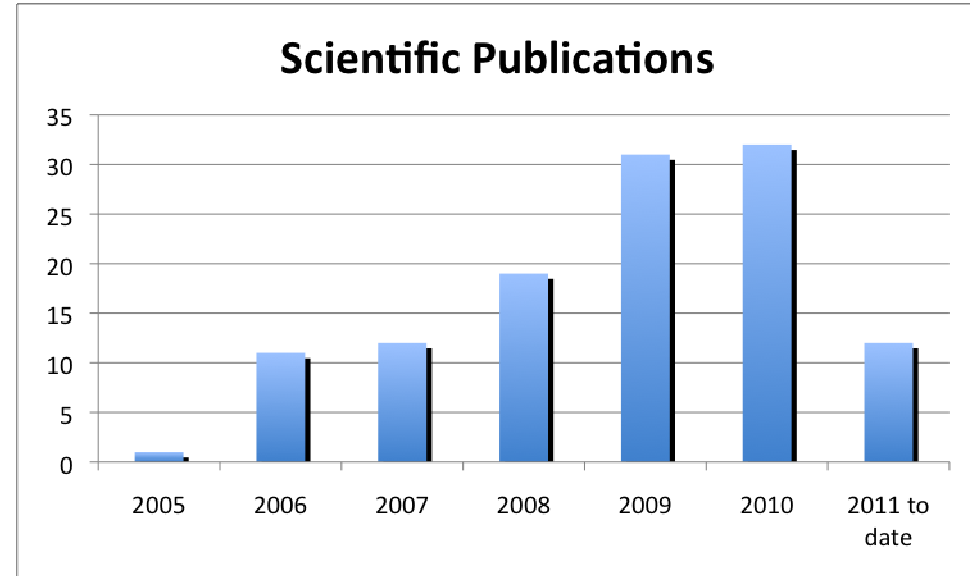
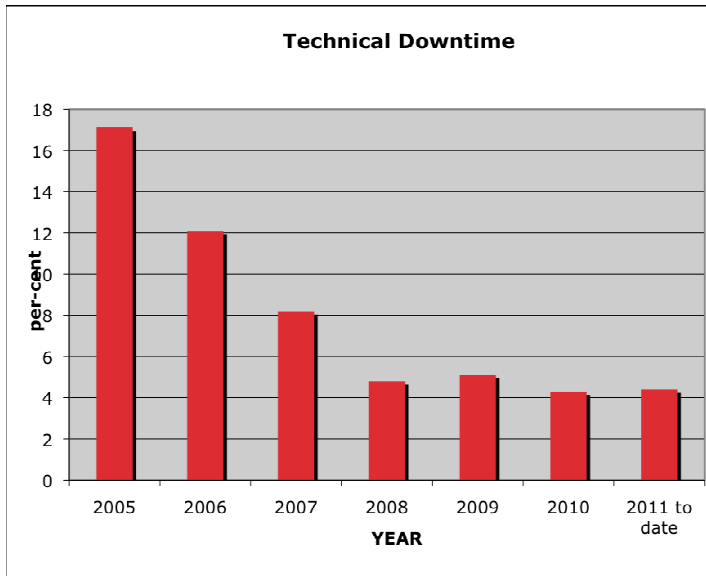
Liverpool Telescope Quicklook Data

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 Home	-	-	-	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 deMooyj	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!