



„Quality of Service“ aspects in GNSS reference network services based on international standards

ALLSAT OPEN 2010

QoS (Quality of Service) - General



- QoS (Quality of Service) means how service performance meets requirements.
- The goal of QoS is to provide guarantees on the ability of a network to deliver predictable results.
- Exchangeable/Open use of QoS information needs international standardisation
- Defined for telecommunication (e.g. availability (uptime), bandwidth (throughput), latency (delay), and error rate).
- But relevant for GNSS reference networks ?



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QoS (Quality of Service) – Requirements



- Typical QoS parameters in the GNSS world
 - Accuracy
 - Reliability
 - Availability
 - TTFA
- Free-will certification ascos
 - Accuracy: 2cm (horizontal)
 - Reliability: 2 sigma
 - Availability: 99% (monthly basis)
 - TTFA: N/A
 - + High service quality (Helpdesk availability, time to activate customer)



QoS (Quality of Service) – User Requirements



- Beginning of reference networks...(1999)
 - Accuracy: 2cm
 - Reliability: 2 sigma
 - Availability: working times; minutes of outage times acceptable
 - TTFA: several minutes acceptable



- Today
 - Accuracy: 2cm (horizontal)
 - Reliability: 2 sigma
 - Availability: always
 - TTFA: several seconds



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QoS (Quality of Service) – User Requirements Summary



- Especially where cost-intensive machinery is involved
 - Accuracy: 2cm (not that critical)
 - Reliability: 2 sigma
 - Availability: 24/7
 - TTFA: immediate and continuous fixed solution



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QoS (Quality of Service) – functional chain



- Free-will certification ascos
 - Yearly repetition
 - No QoS in real-time
 - No QoS interface to user/receiver

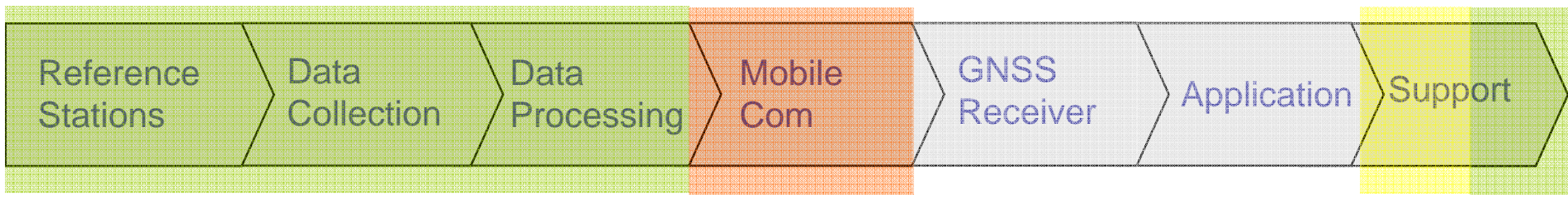


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QoS (Quality of Service) – Status



ICD



Covered

RTCM

Covered

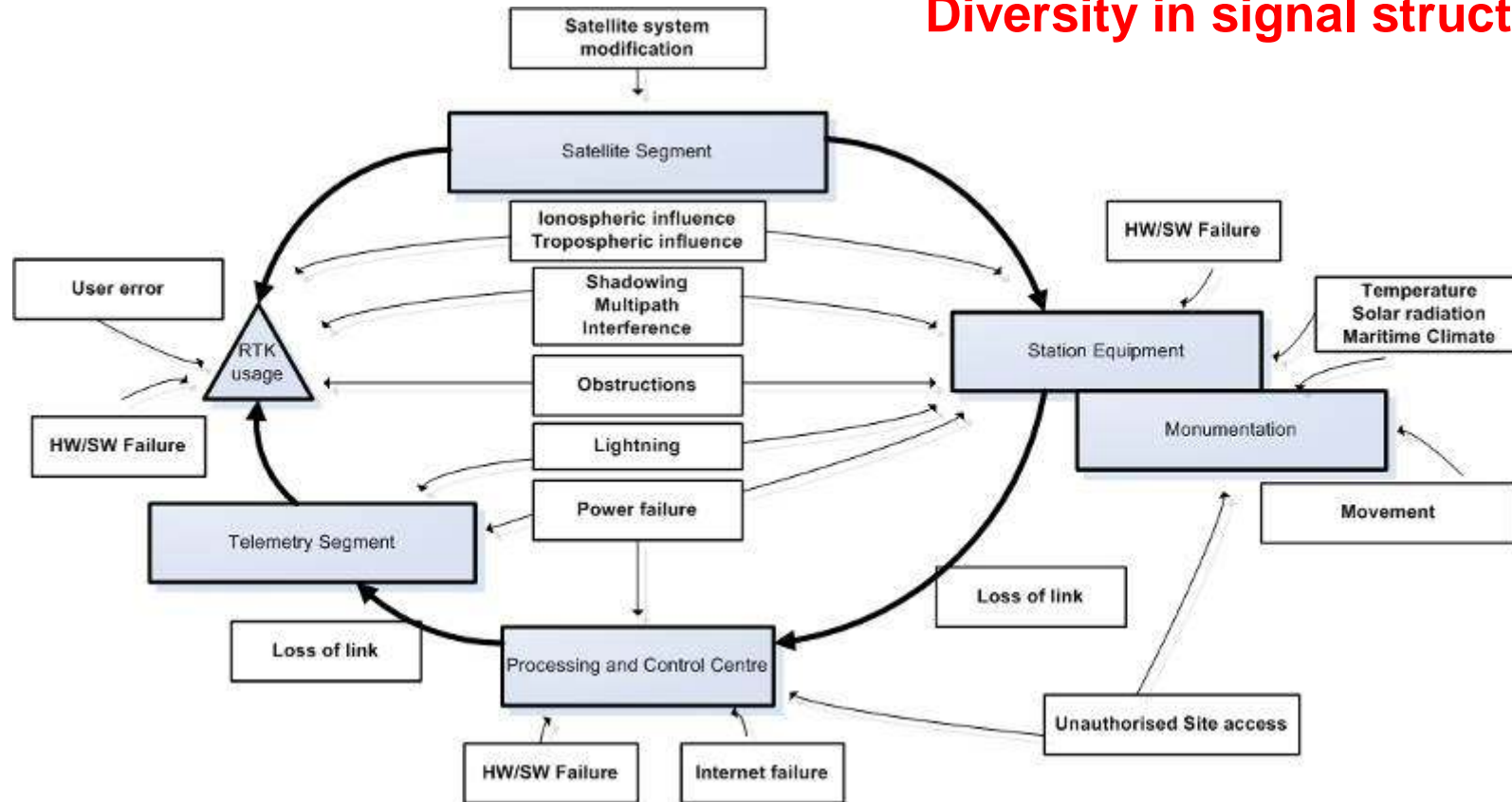
Basic Rover Support



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Diversity in signal structure

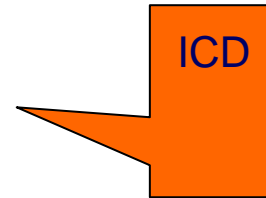


QoS (Quality of Service) – Interfaces



- Satellite Segment

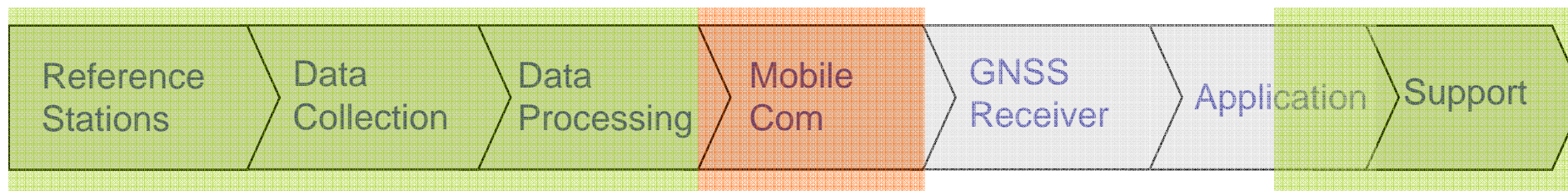
- Higher complexity due to “4G” and more frequencies
- Changes to satellite segment not as expected or not according to ICD
- e.g. PRN 32 GPS 2008/2009 (firmware update required for some brands)
- e.g. Frequency change of 4 GLONASS satellites in March 2009 (firmware update required for some brands)



- RTCM
 - Some room for interpretation
 - e.g. GLONASS biases



QoS (Quality of Service) – Outlook and challenges



Open Service:

- Cooperation with receiver manufacturers in terms of current RTCM definition
- Potential demand of standardising QoS parameters in GNSS reference networks
- RTCM committee members: 20% 'mere' GNSS Service Provider



QoS (Quality of Service) – Challenges



Example **Availability:**

→ 99%

- What time reference (daily, monthly)?
- What is measured (data flow only, decoded RTCM messages)?
- At which level (regional or for each reference station)?
- ...

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QoS (Quality of Service) – Challenges



Example **Availability**

Potential failures at:

- GNSS antenna
- GNSS cable
- GNSS receiver
- Power supply
- Communication hardware
- Communication carrier
- Data Carrier
- Networking Hardware (e.g. 2 Servers)
- Processing Software (e.g. 2 Apps)
- Processing Centre Infrastructure (Cooling, Power, SW Maintenance)
- mobile communication to user

99% availability means:

A day: ~ 14 minutes outage
--> Redundancy!

A month: ~ 432 minutes outage
--> 7 hours repair time



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QoS (Quality of Service) – Conclusion



Conclusions

- Customer requirements for QoS will increase
- Today no transparency
- Potential demand of standardising QoS parameters in GNSS
- Service providers should benefit
- Relevance of QoS:

Application	outage equals	QoS requirements
Surveying	→ 1hour ~ 50 €	Not relevant!
Machine automation	→ 1hour ~ 500 €	Relevant!
Special purpose	→ 1 hour > 500€	Essential!

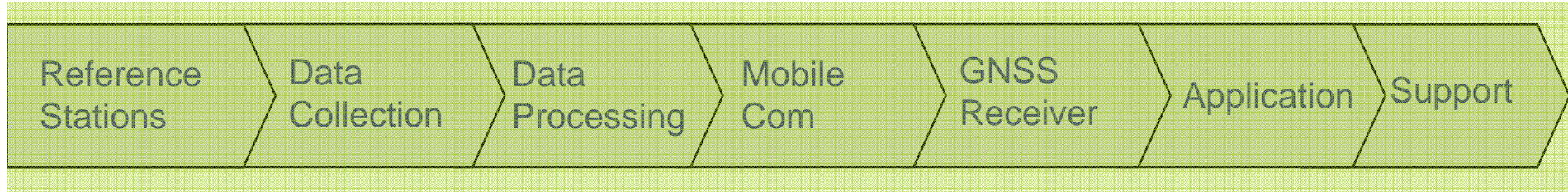
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QoS (Quality of Service) – Fehmarnbelt



Requirements Fehmarnbelt Fixed Link – Local Positioning System (FBPS):



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