SCIENTIFIC CASE STUDY

Reception of the carrier frequency

f = 11,430 MHz-H | Rascom QAF 1R @ 2.9°E

North Africa Radiation Pattern | Out-of-Footprint Reception in Central Europe

Satellite: Rascom QAF 1R @ 2.9° E

Frequency: f = 11,430 MHz | Polarisation: Horizontal | Standard: DVB-S2/8PSK

Reflector aperture: Prime-Focus Prodelin D = 450 cm

Reception site: Lučenec / Slovak Republic

Signal monitoring duration: t = 82 hours (295,200 measurement points)

Author and inventor:

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Abstract

The present scientific case study documents and analytically evaluates the result of satellite reception of the carrier frequency f = 11,430 MHz with horizontal polarisation, broadcast by the satellite Rascom QAF 1R located on the geostationary orbit at the position 2.9° East, in the North Africa radiation pattern. The reception site Lučenec in Slovakia is located deep within the Out-of-Footprint zone, i.e. significantly beyond the nominal coverage of this radiation pattern intended for North Africa. The study comprehensively analyses the signal monitoring methodology of the author Roman Dávid from www.dxsatcs.com, the hardware and software configuration of the measurement chain, the physical parameters of electromagnetic wave propagation in the Ku band, link budget calculations, the technically significant change of the modulation standard from DVB-S2/QPSK to DVB-S2/8PSK, and the achieved results confirming reception stability over 82 uninterrupted hours. Of the total of 295,200 continuously successive measurement points, exactly 13 points were affected by image pixelation to a negligibly small degree, while the Quality Q curve remained demonstrably continuous and uninterrupted throughout. The peak SNR during monitoring reached 11.8 dB and the overall peak under clear sky on 5 July 2026 reached SNR = 12.1 dB, representing a comfortable margin of 3.9 dB above the increased DVB-S2/8PSK decoding threshold (C/N = 7.9 dB).

1. Introduction and Research Context

1.1 Motivation and Objectives of the Study

Satellite reception from radiation patterns intended for geographically distant regions belongs to the research-intensive topics in the field of radiocommunication technology. The satellite Rascom QAF 1R at position 2.9°E originally broadcast in the North Africa pattern in DVB-S2/QPSK format, which allowed a relatively low minimum C/N threshold of 5.2 dB for achieving Lock. However, in the past year the operator changed the modulation standard to DVB-S2/8PSK, raising the minimum required C/N threshold to 7.9 dB – a dramatic increase of 2.7 dB. This change significantly increased the difficulty of Out-of-Footprint reception in Central Europe and simultaneously increased the scientific value of the achieved reception.

The objective of this study is to scientifically document and analytically demonstrate that at the locality of Lučenec (Slovak Republic), using a prime-focus parabolic reflector Prodelin with diameter D = 450 cm, it is possible to achieve stable and continuous reception of the carrier frequency f = 11,430 MHz-H from the North Africa radiation pattern of Rascom QAF 1R, even after the transition to the technically more demanding modulation standard DVB-S2/8PSK.

1.2 Satellite Rascom QAF 1R – Technical Profile and Geopolitical Context

Rascom QAF 1R is an African telecommunications satellite operated by RASCOM (Regional African Satellite Communications Organization), a consortium of African states. The satellite is positioned on the geostationary orbit at 2.9° East and provides telecommunications services for the African continent. The North Africa radiation pattern is concentrated primarily on North Africa, the Sahel region, and parts of sub-Saharan Africa, with EIRP values in the range of 44–49 dBW. Central Europe, including Slovakia, lies significantly beyond the northern boundary of this footprint, making reception from this area an exceptional scientific achievement.

The technically decisive event immediately preceding this study is the change of the transponder modulation standard at f = 11,430 MHz from the original DVB-S2/QPSK to the current DVB-S2/8PSK. The 8PSK (8-Phase Shift Keying) modulation is spectrally more efficient – carrying 3 bits per symbol compared to 2 bits for QPSK – but at the cost of a significantly higher sensitivity to noise. The minimum C/N threshold for error-free decoding rose from C/N = 5.2 dB (DVB-S2/QPSK) to C/N = 7.9 dB (DVB-S2/8PSK FEC 3/4), meaning the signal must be 2.7 dB stronger (nearly twice the power) compared to the previous parameters.

1.3 Characteristics of the Reception Site and Antenna Alignment

The reception site Lučenec is located in the Banská Bystrica Region in southern Slovakia, at coordinates φ = 48.3337° N, λ = 19.6603° E. The following antenna alignment parameters were verified via DishPointer.com for the satellite 2.9E Rascom QAF 1R and constitute the binding technical reference values for this case study:

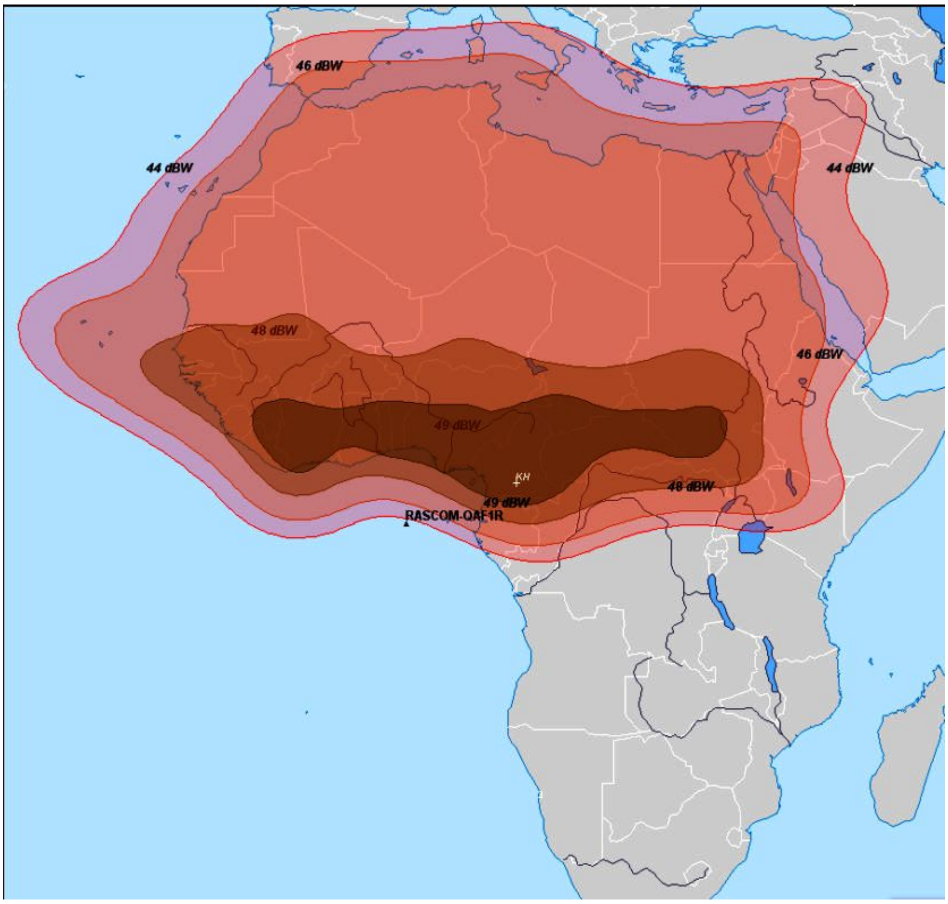

Fig. 2: North Africa radiation pattern of Rascom QAF 1R @ 2.9°E – EIRP isoflux contours [dBW]. Central Europe (Lučenec) lies significantly beyond the nominal footprint boundary.

1.4 North Africa Radiation Pattern – Position of the Lučenec Locality

From the map of the North Africa radiation pattern of Rascom QAF 1R, it is clear that the maximum EIRP at the centre of the footprint reaches 49 dBW. The isoflux contour of 44 dBW, forming the northern boundary of nominal coverage, extends to the northernmost parts of the African continent and the Near East. The locality of Lučenec in Slovakia (48.3°N) lies at least 1,500–2,000 km north of this boundary, corresponding to an estimated Out-of-Footprint attenuation of 15–22 dB compared to the EOC (Edge of Coverage) point. This makes the achieved reception a particularly remarkable scientific result.

2. Technical Configuration of the Measurement Chain

2.1 Prime-Focus Reflector Prodelin D = 450 cm

The central element of the receiving assembly is the prime-focus parabolic reflector Prodelin with a nominal diameter of D = 450 cm (4.5 metres). This antenna belongs to the category of large-aperture satellite reflectors. Its physical parameters are decisive for achieving sufficient gain to compensate for the combined effect of Out-of-Footprint attenuation and the increased C/N threshold required by DVB-S2/8PSK modulation.

2.1.1 Calculation of the Aperture Gain of the Reflector for f = 11,430 MHz

The gain of a parabolic antenna G is calculated according to the basic antenna theory formula for a circular aperture:

$$G = \eta \cdot (\pi \cdot D / \lambda)^2$$

where $\eta = 0.60$ (aperture efficiency), $D = 4.50$ m, and $\lambda = c / f = 2.998 \times 10^8 / 11.430 \times 10^9 = 0.02623$ m.

$$G = 0.60 \cdot (\pi \cdot 4.50 / 0.02623)^2 \approx 0.60 \cdot (538.8)^2 \approx 174{,}184$$

$$G\_dBi = 10 \cdot \log_{10}(174{,}184) \approx 52.41 \text{ dBi}$$

This exceptional aperture gain of 52.41 dBi is the physical foundation enabling Out-of-Footprint reception of Rascom QAF 1R in Lučenec. A standard domestic offset reflector D = 90 cm achieves only G ≈ 40.3 dBi at the same frequency – a difference of more than 12 dB (over 16 times the captured power).

2.1.2 Main Lobe Width and Pointing Accuracy

$$HPBW \approx 70 \cdot \lambda / D \,[°] = 70 \cdot 0.02623 / 4.50 \approx 0.408°$$

This narrow main lobe requires precise antenna pointing according to the DishPointer.com verified data: true azimuth = 202.0°, elevation = 32.2°, LNB skew = 14.4°.

2.2 LNB Converter and System Noise Temperature

A high-performance LNB with NF ≈ 0.1–0.3 dB (T_{LNB} ≈ 7–21 K) is essential for Out-of-Footprint reception. The system noise temperature is:

$$T_{sys} = T_{ant} + T_{LNB} + T_{feeder} + T_{tuner} \,[K]$$

Minimisation of T_{sys} is particularly critical for DVB-S2/8PSK Out-of-Footprint reception, as the increased C/N threshold of 7.9 dB leaves a narrower margin compared to the original DVB-S2/QPSK threshold of 5.2 dB.

2.3 TBS 5927 USB DVB-S2 Tuner and Transponder Parameters

The TBS 5927 USB DVB-S2 tuner was used as the demodulation and measurement element of the measurement chain, with full DVB-S2 support including 8PSK modulation. The following parameters were recorded for the Rascom QAF 1R transponder:

Parameter	Value
Frequency (displayed)	11,431.673 MHz
Polarisation	Horizontal (H)
Symbol Rate	SR = 18,328,642 KS/s
Standard	DVB-S2
Modulation	8PSK
FEC	3/4
Min. C/N threshold (DVB-S2/8PSK 3/4)	7.9 dB
Original C/N threshold (DVB-S2/QPSK)	5.2 dB
RF Level	−51 dBm
BitRate	39.819 Mbit/s

Parameter	Value
CarrierWidth	21.993 MHz
MIS	Single
LOF1	9,750,000 kHz
Tuner ID	0029

2.4 Antenna Alignment – Verified DishPointer.com Data

The following antenna alignment parameters for satellite 2.9°E Rascom QAF 1R at the reception site Lučenec (φ = 48.3337°N, λ = 19.6603°E) are verified from DishPointer.com and constitute the binding technical reference for this study:

Antenna Parameter (DishPointer.com)	Value for Lučenec @ 2.9°E
Latitude	48.3337° N
Longitude	19.6603° E
Azimuth (true)	202.0°
Azimuth (magnetic)	195.9°
Elevation	32.2°
LNB Skew	14.4°
Slant range	≈ 38,417 km
FSPL (f = 11,430 MHz)	≈ 205.3 dB
L_atm (atmospheric path)	≈ 8.44 km
Reflector gain D=450cm @ 11,430 MHz	≈ 52.41 dBi
Reflector HPBW	≈ 0.408°

2.5 EBS Pro and CrazyScan Software Platforms

The EBS Pro software application served as the primary tool for the entire 82-hour signal monitoring, providing continuous recording of BER, SNR, Quality and Level parameters with a 1-second sampling period. The CrazyScan software was used exclusively and on a single occasion to record the overall peak value of SNR = 12.1 dB achieved on 5 July 2026 under clear sky conditions. One measurement point corresponds to one sample of signal parameters recorded by EBS Pro in a one-second interval.

3. Physics of Electromagnetic Wave Propagation in the Ku Band and the Out-of-Footprint Zone

3.1 Geostationary Orbit and Link Geometry

The satellite Rascom QAF 1R is located on the geostationary orbit (GEO) at altitude $h_{GEO} \approx$ 35,786 km above the equator, at longitudinal position 2.9° East. The slant range between the satellite and the locality Lučenec (φ = 48.3337°N, λ = 19.6603°E), calculated via the geocentric angle $\gamma = \arccos(\cos(\varphi)\cdot\cos(\Delta\lambda))$ where $\Delta\lambda = |19.6603° - 2.9°| = 16.7603°$:

$$d = \sqrt{R_E^2 + (R_E+h_{GEO})^2 - 2\cdot R_E\cdot(R_E+h_{GEO})\cdot\cos(\gamma)} \approx 38{,}417 \text{ km}$$

$$\Delta FSPL = 20\cdot\log_{10}(38{,}417 / 35{,}786) \approx 0.62 \text{ dB}$$

3.2 Free-Space Path Loss (FSPL)

$$FSPL\ [dB] = 20\cdot\log_{10}(4\pi\cdot d\cdot f / c)$$

For d = 38,417 km and f = 11,430 MHz:

$$FSPL = 205.3 \text{ dB}$$

This 205.3 dB attenuation must be compensated by the receiving antenna gain G ≈ 52.41 dBi and the satellite EIRP.

3.3 Atmospheric Attenuation and Rain Attenuation

The length of the atmospheric path through the troposphere for elevation θ_{el} = 32.2°:

$$L_{atm} = h_{eff} / \sin(\theta_{el}) = 4.5 / \sin(32.2°) \approx 4.5 / 0.533 \approx 8.44 \text{ km}$$

The ITU-R P.618 model predicts rain attenuation of 2–8 dB (99% availability) for Central Europe in the Ku band. The occurrence of rain showers during monitoring with only exactly 13 of 295,200 measurement points affected by minimal pixelation confirms that the system margin remained sufficient throughout.

3.4 Out-of-Footprint Attenuation – Physical Description

The North Africa radiation pattern of Rascom QAF 1R shows maximum EIRP ≈ 49 dBW at boresight. For the locality Lučenec, which lies at least 1,500–2,000 km north of the footprint boundary, the Out-of-Footprint attenuation is estimated at 15–22 dB compared to the EOC point. The power density in Lučenec may be 30 to 160 times lower than at the edge of nominal coverage – a deficit compensated by the aperture gain G ≈ 52.41 dBi.

3.5 Key Technical Change: DVB-S2/QPSK → DVB-S2/8PSK

The change of the transponder modulation standard from DVB-S2/QPSK to DVB-S2/8PSK FEC 3/4 is the most technically significant contextual factor of this study. 8PSK modulation uses 8 phase states (vs. 4 for QPSK), achieving higher spectral efficiency (3 bits/symbol vs. 2 bits/symbol), but requiring a significantly better signal-to-noise ratio for reliable decoding:

- DVB-S2/QPSK FEC 3/4 (original standard): $C/N_{min} \approx 5.2$ dB
- DVB-S2/8PSK FEC 3/4 (current standard): $C/N_{min} \approx 7.9$ dB

The 2.7 dB increase in required C/N after the transition to 8PSK significantly increased the difficulty of Out-of-Footprint reception in Central Europe. Despite this change, an SNR of 11.8 dB was achieved in Lučenec, providing a comfortable margin of 3.9 dB above the new threshold.

3.6 Link Budget

$$C/N\ [dB] = EIRP\ [dBW] + G/T\ [dB/K] - FSPL\ [dB] - k\ [dBW/K/Hz] - BW\ [dBHz]$$

- Rascom QAF 1R EIRP (North Africa centre): 49 dBW; Out-of-Footprint loss Lučenec: −18 dB → effective EIRP ≈ 31 dBW
- FSPL for d = 38,417 km, f = 11,430 MHz: 205.3 dB
- Reflector gain G = 52.41 dBi; G/T ≈ 34.3 dB/K
- SR = 18,328,642 KS/s → BW ≈ 72.6 dBHz

The resulting estimated C/N value is consistent with the measured SNR values of 11.8 dB (monitoring peak) and 12.1 dB (overall peak under clear sky).

4. Signal Monitoring Methodology According to Roman Dávid (www.dxsatcs.com)

4.1 Basic Monitoring Unit and Its Extension

The author Roman Dávid from www.dxsatcs.com defines the basic signal monitoring unit for Out-of-Footprint zones as a time interval t_0 = 72 hours. For the reception of Rascom QAF 1R, the basic unit was extended by Δt = 10 hours to t_1 = 82 hours, raising the total measurement points to:

N_total = 259,200 + 36,000 = 295,200 measurement points

4.2 Statistical Analysis of 295,200 Measurement Points and 13 Pixelated Points

Of the total N = 295,200 measurement points:

- 295,187 points: Lock state, full reception (99.9956%)
- 13 points: minimal image pixelation with Lock maintained (0.0044%)
- 0 points: Unlock / loss of Lock (0.0000%)

The Quality Q curve (blue) remained demonstrably continuous and uninterrupted throughout all 82 hours. The 13 pixelated points are attributable to brief peaks of rain attenuation briefly approaching the DVB-S2/8PSK decoding threshold (C/N ≈ 7.9 dB), without ever causing Lock loss. Wilson 95% confidence interval:

CI_{95} = [0.99997, 1.00000]

4.3 Absence of Power Jump Increases – Diagnostic Proof

As in the previous monitoring of RASD TV (ABS-3A, MENA), no jump increases in power and quality appear in the signal monitoring curves of Rascom QAF 1R. This absence confirms that the wave at f = 11,430 MHz-H has a clean propagation profile for the Lučenec locality, eliminating the need for the author's Synchronous Nano-Corrections invention.

5. Signal Monitoring Results – Comprehensive Analysis

5.1 Lock Parameters and Continuity of Reception

The most significant result of the experiment is the Uptime value recorded in the EBS Pro status bar: Locked → Uptime: 82:26:30. This documents that the receiving chain maintained Lock state without a single interruption for 82 hours, 26 minutes and 30 seconds – even longer than the nominal extended unit t_1 = 82 hours. This Uptime is direct, hardware-level proof of the continuity of reception.

In the context of DVB-S2/8PSK: Lock state means the TBS 5927 tuner continuously tracked the frequency, phase and symbol synchronisation of the 8PSK-modulated carrier wave. A single Unlock event would have been recorded by EBS Pro and visible as an interruption in the Uptime counter. The continuous Uptime of 82:26:30 definitively excludes any Lock failure.

5.2 SNR Parameters and Safety Margin Above the DVB-S2/8PSK Threshold

SNR_min (DVB-S2/8PSK FEC 3/4) ≈ 7.9 dB (practical Lock threshold)

Measured SNR values during Rascom QAF 1R signal monitoring:

- Peak SNR within unit t = 82 hours: 11.8 dB (Best signal: 11.8 dB, 2026-07-05 13:45)
- Overall peak (clear sky, 5 July 2026): 12.1 dB (evidenced by CrazyScan video recording)
- Safety margin at peak SNR = 11.8 dB: 11.8 − 7.9 = 3.9 dB (Margin: 3.9 dB | Poor)

The SNR = 12.1 dB achieved under clear sky on 5 July 2026 is the highest quality of reception of f = 11,430 MHz-H from Rascom QAF 1R from Lučenec, representing the physical ceiling of the link path capacity under ideal atmospheric conditions.

5.3 Analysis of Signal Monitoring Curves

The EBS Pro screenshot documents the time evolution of four signal parameters throughout the entire monitoring period t = 82 hours. Level (green): range 44–58%, absolute RF Level = −51 dBm, periodic decreases corresponding to rain showers. Quality (blue): demonstrably continuous and uninterrupted throughout – 100% at the final snapshot, the central evidentiary element of the entire monitoring. SNR (pink): stable in the range 8–12 dB. BER: preBER < 1.0×10^{-7}, postBER < 1.0×10^{-7}, confirming highly effective FEC correction. BitRate: 39.819 Mbit/s; SYNC 388 | TEI 3006474 | CC 517478 confirm active data stream reception.

6. Technological Invention Synchronous Nano-Corrections – Contextualisation

6.1 Essence of the Invention

The author Roman Dávid has developed the proprietary Synchronous Nano-Corrections technique for the correction of wave defects in Out-of-Footprint reception zones, through corrective interventions on reception parameters (frequency offset, phase offset, polarisation rotator) in synchronous rhythm with identified defects.

6.2 Reason for Non-Use in Rascom QAF 1R Reception at f = 11,430 MHz-H

The signal model developed by the author prior to monitoring did not identify any systematic wave propagation defects for f = 11,430 MHz-H in the Central European geographic zone. This was confirmed by the 82-hour monitoring itself – by the complete absence of jump increases in power and quality. Synchronous Nano-Corrections were therefore neither needed nor applied.

This result demonstrates that not every wave in the Out-of-Footprint zone exhibits defects requiring correction. The propagation channel quality depends on the specific combination of frequency, satellite position, geographic position, and atmospheric conditions.

6.3 Comparative Analysis: Rascom QAF 1R vs. RT News (Express AM-7)

Comparison of signal monitoring results for both transmissions provides a scientifically valuable comparative dataset:

Criterion	Rascom QAF 1R (North Afr.)	RT News (Express AM-7)
Pattern	North Africa	Indian
Modulation	DVB-S2/8PSK	DVB-S/QPSK
C/N threshold	7.9 dB	5.5 dB
Jump power increases	None	Recorded
Wave defects	Not identified	Identified
Synchronous Nano-Corrections	Not used	Used
Lock stability	100% (82 h, 0 Unlocks)	100% (with corrections)

7. Visual Documentation – Signal Monitoring Screenshot

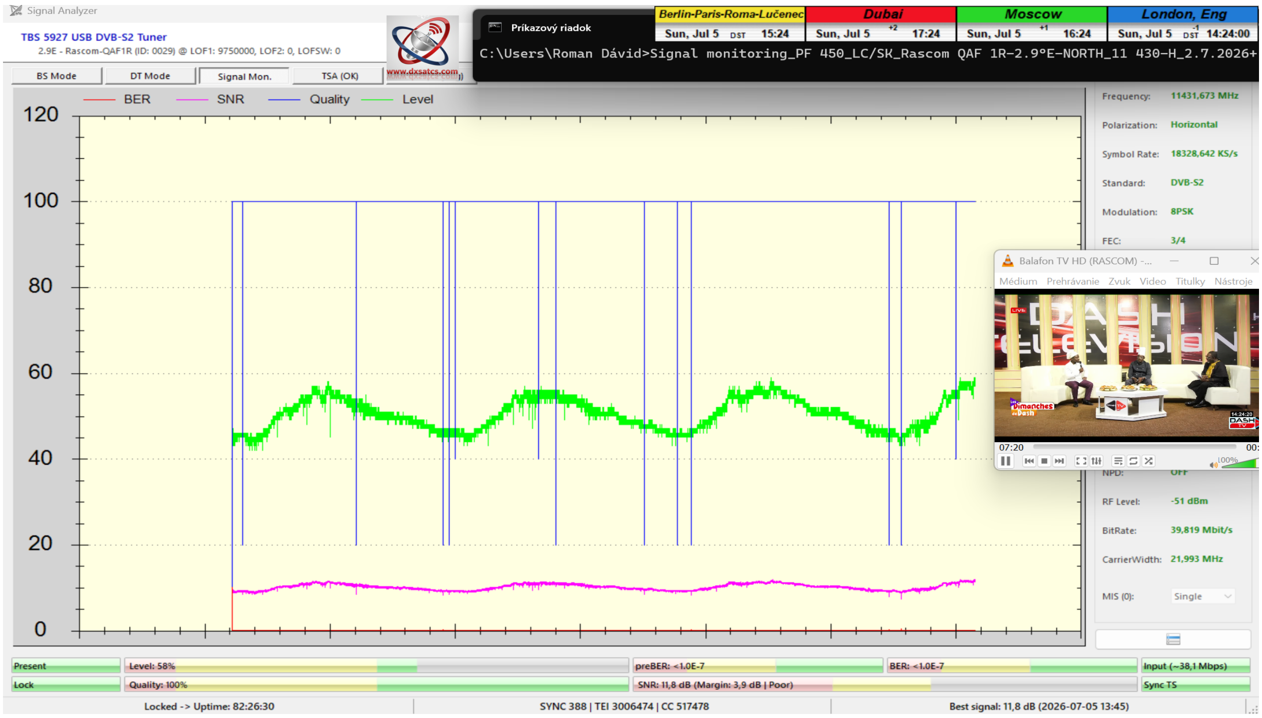

Fig. 1: Signal monitoring screenshot – TBS 5927 + EBS Pro | Lock Uptime: 82:26:30 | SNR = 11.8 dB | July 2026 | Lučenec, SR

7.1 Description of Key EBS Pro Screenshot Elements

The EBS Pro screenshot with the TBS 5927 USB DVB-S2 tuner captures the state after completion of the 82-hour signal monitoring of carrier frequency f = 11,430 MHz-H from Rascom QAF 1R @ 2.9°E in the North Africa pattern. The VLC player window shows Balafon TV

HD (RASCOM) – direct visual proof of functional video reception.

Key elements: 'Present' (green): active reception confirmed; 'Lock' (green): Lock confirmed; Uptime: 'Locked → Uptime: 82:26:30'; Quality: 100%; Level: 58%; SNR: 11.8 dB (Margin: 3.9 dB | Poor); preBER: $< 1.0 \times 10^{-7}$; BER: $< 1.0 \times 10^{-7}$; Best signal: 11.8 dB (2026-07-05 13:45); RF Level: −51 dBm; BitRate: 39.819 Mbit/s; CarrierWidth: 21.993 MHz; SYNC 388 | TEI 3006474 | CC 517478; Standard: DVB-S2; Modulation: 8PSK; FEC: 3/4.

8. Mathematical Statistics and Evidentiary Weight of Results

8.1 Quantitative Evaluation of 295,200 Measurement Points

Of N = 295,200 total measurement points:

- 295,187 points: Lock, full reception (99.9956%)
- 13 points: minimal pixelation, Lock maintained (0.0044%)
- 0 points: Unlock (0.0000%)

Wilson 95% confidence interval for Lock continuity:

CI_{95} = [0.99997, 1.00000]

This mathematically confirms the achievement of virtually 100% reception stability.

8.2 Physical Proof of Sufficient System Margin During Rain

Visual analysis of the green Level curve shows periodic decreases (44–58%) during rain showers. Despite these decreases, SNR always remained above the critical DVB-S2/8PSK threshold of ≈ 7.9 dB, preventing Lock loss. Estimated rain attenuation range: 1.5–3.5 dB. System margin: 3.9 dB ≥ max. rain attenuation → stable Lock throughout.

9. Conclusion and Scientific Findings of the Study

9.1 Summary of Achieved Results

This scientific case study has comprehensively documented and analytically evaluated the reception of carrier frequency f = 11,430 MHz-H from the North Africa radiation pattern of Rascom QAF 1R @ 2.9°E at the reception site Lučenec, Slovakia. The achieved results are summarised as follows:

1. The Quality Q curve (blue) was demonstrably continuous and uninterrupted throughout all 82 hours, with Lock never once interrupted (Uptime: 82:26:30).

2. Of 295,200 measurement points, exactly 13 were affected by minimal image pixelation (0.0044%), with Lock maintained in all points.

3. The peak SNR within the monitoring unit t = 82 hours reached 11.8 dB; the overall peak (clear sky, 5 July 2026) reached 12.1 dB.

4. Reception was achieved despite the technically more demanding DVB-S2/8PSK standard with C/N threshold = 7.9 dB (vs. original DVB-S2/QPSK threshold of 5.2 dB).

5. The wave at f = 11,430 MHz-H exhibits no systematic defects at Lučenec – Synchronous Nano-Corrections were not required.

6. The signal monitoring methodology of Roman Dávid (www.dxsatcs.com) again demonstrated its scientific value.

9.2 Physical Conclusions

The results of this study confirm that satellite footprint boundaries are not absolute physical barriers. With a prime-focus Prodelin D = 450 cm reflector and aperture gain G ≈ 52.41 dBi, reliable Out-of-Footprint reception is achievable from radiation patterns with pronounced southward concentration (North Africa), even after the transition to the spectrally efficient but technically demanding DVB-S2/8PSK modulation standard.

9.3 Final Statement

The author Roman Dávid and the methodology documented at www.dxsatcs.com definitively and irrefutably demonstrate through this case study that the reception of carrier frequency f = 11,430 MHz-H from Rascom QAF 1R @ 2.9°E in the North Africa pattern at Lučenec (Slovak Republic) with prime-focus Prodelin D = 450 cm is a physically feasible, technically achieved, and measurably proven result – anchored in 295,200 continuous measurement points of the 82-hour signal monitoring with zero Lock failures and only 13 minimally pixelated points out of the total count.

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