7/23/2025

Analysis of Recurrent DSL Disconnects

A Case Study in User-Side Diagnostics

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1. 🕮 Study Introduction

This technical analysis was conducted as part of a personal initiative aimed at identifying and understanding recurrent service disruptions on my residential DSL line. Over the course of several days, I experienced multiple symptoms — including disconnections, frozen streams, and bandwidth instability — prompting a structured evaluation of the line's behavior. The goal of this study is to correlate observable events with measurable transmission indicators (e.g., CRC errors, SNR, bandwidth fluctuations), and to assess whether the underlying causes are physical, environmental, or configuration-related.

By relying on a consistent data capture setup and a variety of quality metrics, I aim to provide a thorough, empirical account of the Freebox's operational behavior under real-world conditions, using only accessible diagnostic methods and tools. This report combines quantitative measurement with qualitative interpretation to support actionable conclusions.

This initiative was launched in direct response to a technical incident currently open with Free's support service, which remained unresolved despite multiple user-side symptoms and reported outages. Given the lack of closure and limited visibility into diagnostic procedures from the operator's side, I undertook this independent analysis to gather empirical evidence and provide a structured assessment of the line's behavior — with the aim of accelerating troubleshooting and facilitating informed follow-up with Free's technical team.

This study was carried out with the technical contribution of a network architect specialized in dark fiber infrastructure. Their advanced expertise greatly supported the interpretation of physical layer behaviors and infrastructure-level signal patterns. I extend my sincere appreciation for their collaboration and the time they dedicated to strengthening the analytical depth of this report.

2. Study overview

📘 **Technical Line Quality Assessment – Summary Sheet**

Context: Following persistent disconnection issues and degraded bandwidth on my residential DSL line, I launched a structured investigation aligned with an open incident reported to Free's technical support. This initiative is rooted in direct observation and aims to complement or accelerate official troubleshooting.

Methodology Overview:

- Data captured via a Linux machine (Ubuntu 25.04) connected to the Freebox via Ethernet.
- A monitoring agent extracted line status metrics every 30 seconds via HTTP.
- Metrics include: Bandwidth, Attenuation, SNR, CRC/FEC/HEC error rates, and sync event logs.

Key Findings:

- Over **26 disconnection events** occurred, systematically interrupting live sessions (VPN, SSH, etc.) and requiring manual user reconnection.
- Downstream signal quality is consistently degraded (SNR < 10 dB; Attenuation > 45 dB).
- CRC and FEC errors show significant peaks, confirming frequent transmission instabilities.
- Bandwidth fluctuates heavily, with only 13% of samples reaching acceptable downstream thresholds (>5 Mbps).

Conclusion & Intent: This report correlates service disruptions with physical signal metrics and substantiates the presence of chronic line degradation. It is intended as a technical complement to the open service ticket with Free.

3. General information

Freebox Information	
Model	ADSL Freebox v5
Firmware	1.5.35
Connexion mode	Unbundled

4. 📐 Measurement Principles and Interpretation

To ensure consistent and temporally accurate data acquisition, the following methodology was applied:

📡 Data Capture Setup

- A Linux-based machine running **Ubuntu 25.04** was connected to the Freebox via direct Ethernet interface.
- A custom agent was deployed on this machine to perform **HTTP queries** targeting the Freebox's internal status page (192.168.0.254). The extracted data — including connection status, line metrics, and timestamps — was parsed and stored in structured log files.
- Given the domestic scope of the study and the prohibitive cost of professional-grade probes, more robust alternatives were not employed. The study assumes that the Freebox reports are sufficiently accurate or, at minimum, consistent and stable throughout the observation period.
- To strike a balance between precision and data volume, a **30-second sampling interval** was selected.
- During the capture period, the agent experienced several brief stoppages, resulting in **temporal gaps**. These gaps were excluded from analysis and are not considered in event statistics, which are derived exclusively from timestamped log entries.

🧮 Data Processing Pipeline

- Captured data logs were fed into a dedicated analytical software environment for structured evaluation.
- For **direct indicators** (e.g., bandwidth, attenuation, SNR), raw values were retained alongside their exact timestamps to preserve temporal fidelity.
- For **cumulative indicators**, a custom algorithm converted time-aggregated values into normalized per-hour metrics, accounting for sample spacing and interruptions.
- No curve-smoothing techniques — such as **Moving Average**, **Savitzky-Golay filter**, or **Lowess/Loess regression** — were applied to the data, in order to avoid introducing artifacts or distorting short-term fluctuations critical to signal integrity analysis.

5. Analysis

Disconnection and Resynchronization Events

Overview and Technical Impact

Over the observation period, a total of **26 disconnection/resynchronization events** were recorded on the Freebox DSL line. These events represent abrupt terminations of DSL synchronization, followed by automatic reestablishment of the link. Such interruptions often indicate physical instability, transient line faults, or aggressive line profiling by the DSLAM (via DLM).

Each resynchronization results in recalculated bandwidth values, often revealing degraded or fluctuating throughput — further evidence of line sensitivity or external interference.

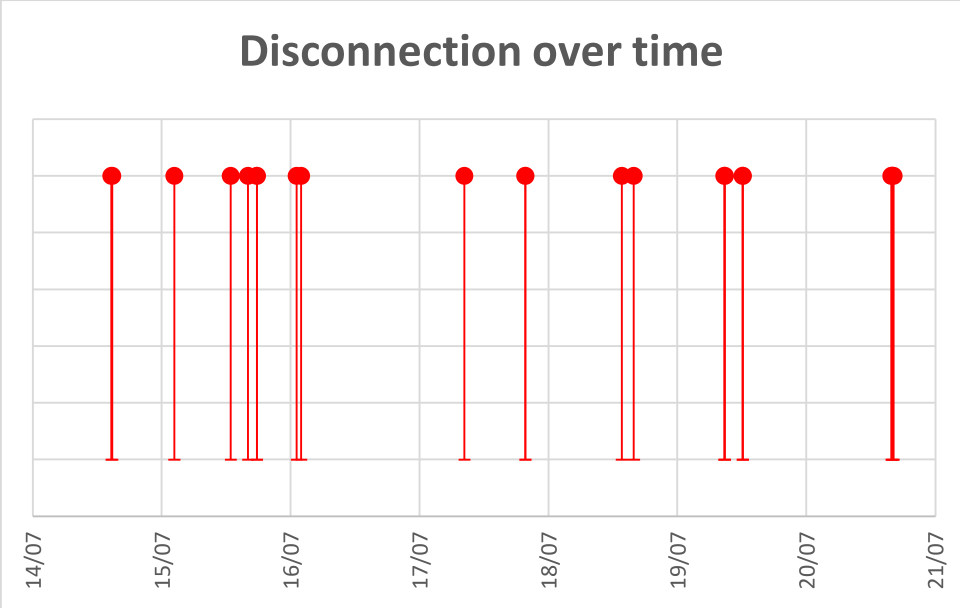
Unit of Measurement: Event timestamp and post-resync bandwidth values (Mbps)

Disconnection logs

Timestamp	Status	Up (Mbps)	Down (Mbps)
14/07/2025 14:37	Disconnection		
14/07/2025 14:38	Reconnection	961	2354
14/07/2025 14:47	Disconnection		
14/07/2025 14:48	Reconnection	1025	4298
15/07/2025 02:20	Disconnection		
15/07/2025 02:21	Reconnection	1025	5396
15/07/2025 12:50	Disconnection		
15/07/2025 12:51	Reconnection	1025	4808
15/07/2025 16:04	Disconnection		
15/07/2025 16:05	Reconnection	1025	5004
15/07/2025 17:42	Disconnection		
15/07/2025 17:44	Reconnection	997	1790
15/07/2025 17:44	Disconnection		
15/07/2025 17:46	Reconnection	916	1045
16/07/2025 01:07	Disconnection		
16/07/2025 01:08	Reconnection	1025	4788
16/07/2025 01:57	Disconnection		
16/07/2025 01:58	Reconnection	1025	4712
17/07/2025 08:21	Disconnection		
17/07/2025 08:22	Reconnection	1025	4663
17/07/2025 19:41	Disconnection		
17/07/2025 19:42	Reconnection	969	1084
17/07/2025 19:42	Disconnection		
17/07/2025 19:43	Reconnection	1025	4861
18/07/2025 13:38	Disconnection		
18/07/2025 13:39	Reconnection	1025	4765
Total disconnections		13	

Timestamp	Status	Up (Mbps)	Down (Mbps)
18/07/2025 15:53	Disconnection		
18/07/2025 15:53	Reconnection	1025	4923
19/07/2025 08:42	Disconnection		
19/07/2025 08:43	Reconnection	1025	4827
19/07/2025 08:48	Disconnection		
19/07/2025 08:49	Reconnection	1025	4758
19/07/2025 08:51	Disconnection		
19/07/2025 08:51	Reconnection	1013	1554
19/07/2025 12:07	Disconnection		
19/07/2025 12:08	Reconnection	1025	2210
19/07/2025 12:10	Disconnection		
19/07/2025 12:11	Reconnection	1025	1327
19/07/2025 12:12	Disconnection		
19/07/2025 12:13	Reconnection	843	3136
20/07/2025 15:49	Disconnection		
20/07/2025 15:50	Reconnection	876	838
20/07/2025 15:51	Disconnection		
20/07/2025 15:51	Reconnection	1025	4252
20/07/2025 16:01	Disconnection		
20/07/2025 16:02	Reconnection	1016	3470
20/07/2025 16:02	Disconnection		
20/07/2025 16:03	Reconnection	1025	4132
20/07/2025 16:04	Disconnection		
20/07/2025 16:05	Reconnection	1025	4732
20/07/2025 16:14	Disconnection		
20/07/2025 16:15	Reconnection	1025	4893
Total disconnections		13	

Disconnection over time



🔍 Interpretation

- **Frequency:** Disconnections occur irregularly, with bursts of instability notably around **July 15**, **July 19**, and **July 20**, highlighting moments of acute line degradation.
- **Recovery Time:** Reconnection typically follows within one minute, demonstrating responsive re-synchronization behavior. However, the transient loss of DSL sync is not seamless from the user's perspective.
- **Impact on Live Sessions:** Each disconnection systematically **terminates active remote sessions** — such as SSH, RDP, VPN, or cloud service links. In environments lacking automatic reconnection logic (e.g. persistent tunnels or resilient platforms), the **user must manually re-establish** each session post-resync, which introduces delays, frustration, and lost workflow continuity. This behavior was directly observed during the study.
- **Bandwidth Variability:** Post-sync renegotiation shows bandwidth fluctuation, ranging from **843/838 Mbps** to **1025/5396 Mbps**, pointing to unstable line profiling and potential DLM adaptations reacting to prior disconnections.

📌 These events directly affect usability for connected applications, supporting the need for signal-level diagnostics and long-term corrective actions.

Bandwidth Analysis

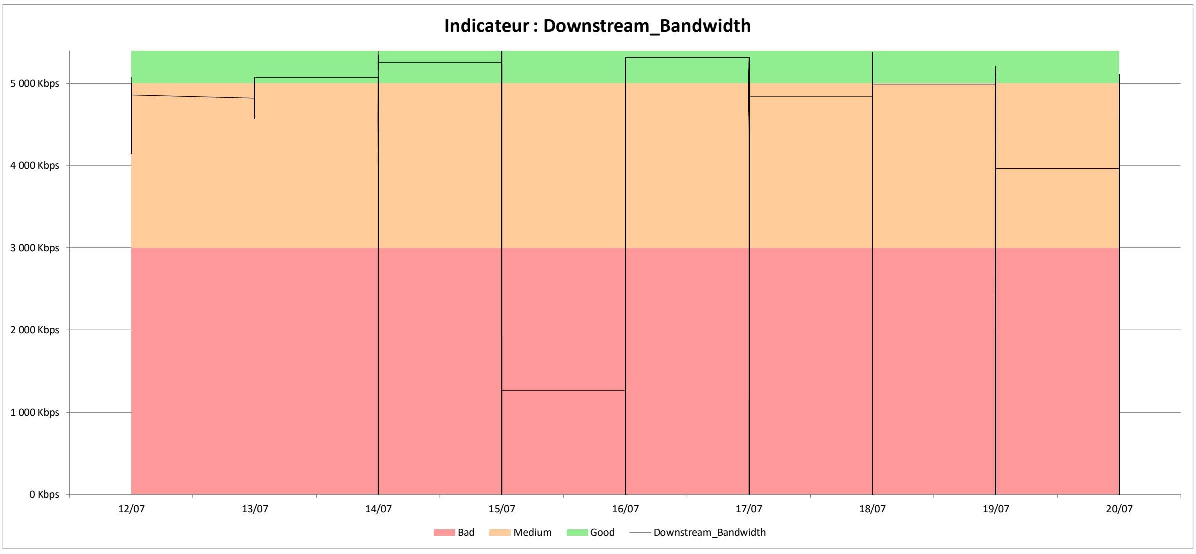
Overview and Technical Relevance

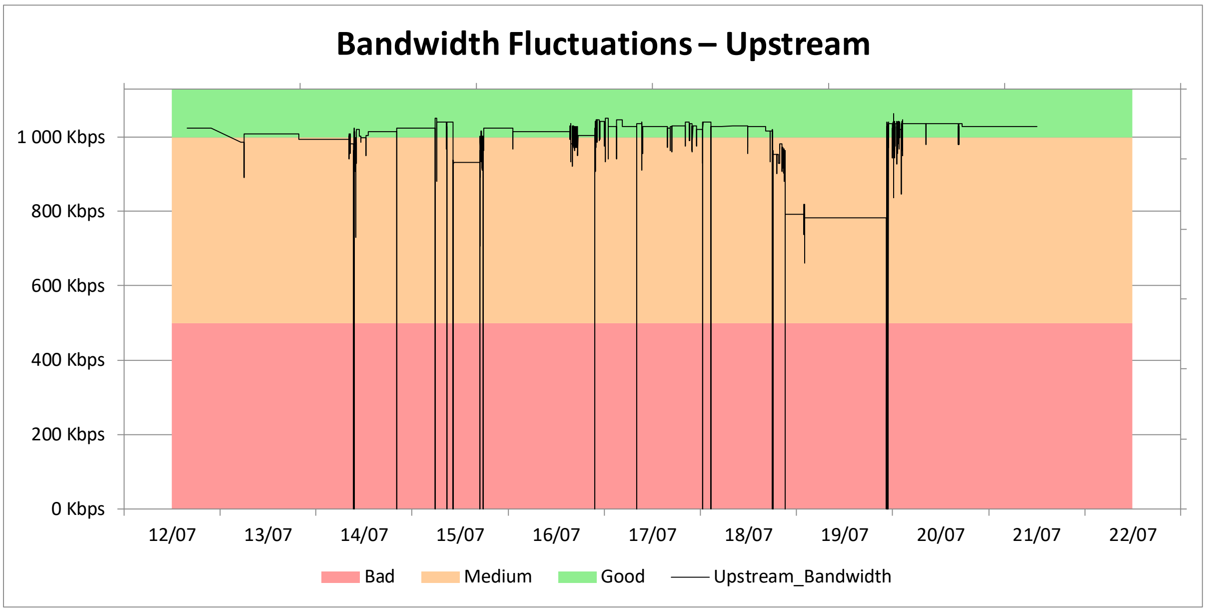
Bandwidth refers to the effective binary throughput between the user's modem and the DSLAM (Digital Subscriber Line Access Multiplexer), typically measured in kilobits per second (Kbps).

- **Downstream Rate** defines the total capacity received from the DSLAM during synchronization, influenced by line attenuation, DLM (Dynamic Line Management) profiles, and modulation schemes like DMT, ADSL2, or ADSL2+.
- **Upstream Rate** reflects the transmission capacity from the modem to the DSLAM. It's constrained by narrower upstream frequency allocations and is essential for interactive services such as HTTP requests, VoIP, and file uploads.

📏 *Unit of Measurement: Kilobits per second (Kbps)*

Bandwidth Variation Over Time





Signal Quality Thresholds

1. Quality Metric threshold - Downstream		
Signal Quality	**threshold (Mbps)**	**Range**
Good	5000 Kbps	> 5000 Kbps
Medium	3000 Kbps	[5000 - 3000] Kbps
Bad	> 3000 Kbps	[0 - 3000] Kbps

1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (Mbps)**	**Range**
Good	1000 Kbps	> 1000 Kbps
Medium	500 Kbps	[1000 - 500] Kbps
Bad	> 500 Kbps	[0 - 500] Kbps

Threshold Note

These thresholds are **moderately conservative**, with the "Bad" tier beginning below 3000 Kbps downstream and 500 Kbps upstream. While some DSLAM profiles may tolerate lower rates without triggering errors, this schema emphasizes sustained capacity over short bursts, ensuring reliable performance for multimedia and interactive applications.

Quantitative Metrics

2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	699 Kbps	704 Kbps
Max	5396 Kbps	1129 Kbps
Average	4419 Kbps	1047 Kbps
P90	5074 Kbps	1101 Kbps

Qualitative Distribution

3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	13,10%	83,42%
Medium	81,75%	16,39%
Bad	5,16%	0,19%

Interpretation

- The **downstream throughput** is predominantly in the *medium* quality zone, with only 13.1% of samples reaching above 5000 Kbps. This suggests stable service for basic usage, though large transfers and streaming may suffer during dips.
- The **upstream rate** is excellent, with over 83% of samples classified as *Good* — sufficient for smooth performance in applications requiring reverse traffic, like VoIP and uploads.
- The **P90 readings** indicate that most measurements skirt the edge of *Good*, making performance sensitive to brief line fluctuations.

📌 The overall bandwidth profile is asymmetric yet effective, with upstream robustness supporting interactivity, while downstream variability may contribute to freeze or latency issues reported elsewhere in the study.

Attenuation Analysis

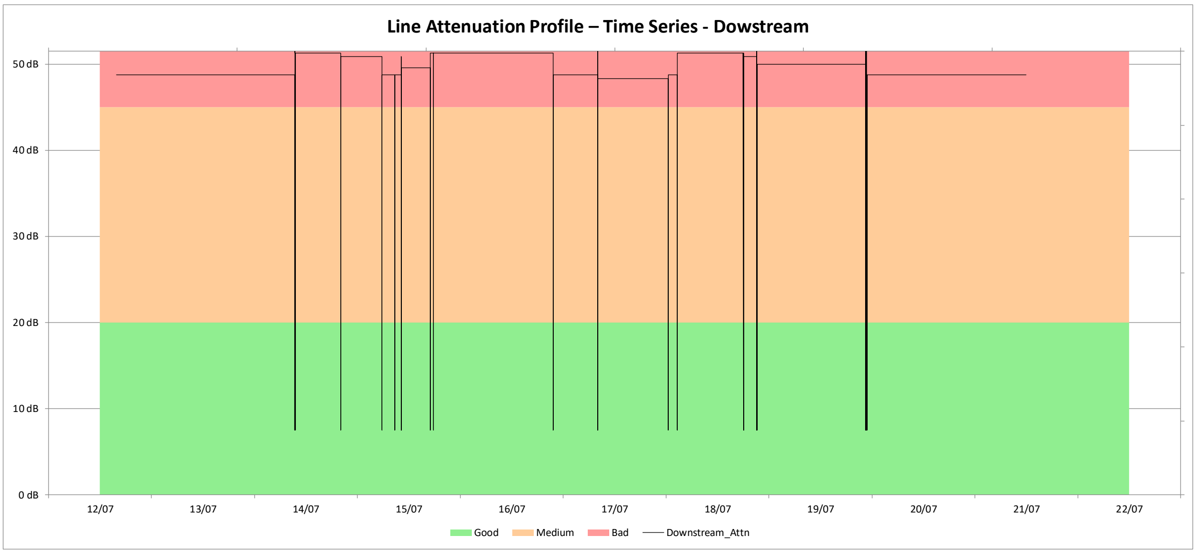
Overview and Technical Relevance

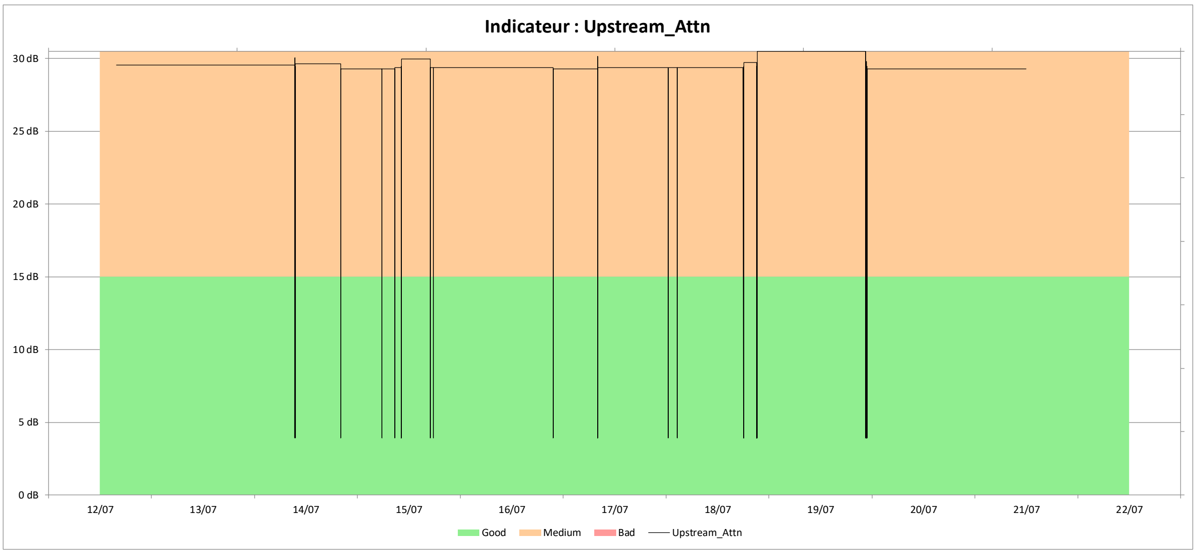
Attenuation refers to the logarithmic reduction in signal power as it travels through copper telephone lines. It is measured in decibels (dB) and is a direct indicator of signal degradation caused by the distance to the DSLAM, the cable's cross-sectional area, and its overall quality.

In DSL systems, downstream attenuation above ~50 dB can lead to unstable synchronization and degraded performance. Although upstream attenuation tends to be lower, it remains critical to line stability and bidirectional data integrity.

📏 *Unit of Measurement: Decibels (dB)*

Temporal Profile of Line Attenuation





📊 Signal Quality Thresholds

📊 1. Quality Metric threshold - Downstream		
Signal Quality	**threshold (dB)**	**Range**
Good	20,00 dB	< 20 dB
Medium	45,00 dB	[20 - 45] dB
Bad	> 45,00 dB	> 45 dB

📊 1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (Mbps)**	**Range**
Good	15,00 dB	< 15 dB
Medium	35,00 dB	[15 - 35] dB
Bad	> 35,00 dB	> 35 dB

Threshold Note These thresholds are slightly stricter than commonly accepted values. Industry standards typically consider attenuation below 30 dB as excellent, and values above 45 dB as unsuitable for stable ADSL service. These thresholds set the *"Bad"* zone starting at 45 dB (downstream) and 35 dB (upstream), which aligns with the upper limits of acceptable performance but applies a more conservative cutoff for upstream quality.

📊 Quantitative Metrics

📊 2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	47,50 dB	29,10 dB
Max	51,50 dB	30,50 dB
Average	49,01 dB	29,36 dB
P90	51,00 dB	30,50 dB

📈 Qualitative Distribution

📊 3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	0,19%	0,19%
Medium	0,00%	99,81%
Bad	99,81%	0,00%

🔍 Interpretation

- **Downstream attenuation** values consistently exceed the 45 dB threshold, categorizing the line as degraded for over 99% of samples — a strong indicator of reduced throughput capacity and potential sync instability.
- **Upstream attenuation**, although not optimal, remains in the medium range nearly all the time (99.81%), indicating functional service without critical issues.
- The narrow range of **variation (Min to Max)** suggests the problem is structural — likely due to physical line conditions rather than temporal interference.

📌 *The line's attenuation profile confirms the downstream is heavily penalized by distance or cable quality, and may explain recurrent disconnections and bandwidth limitations.*

Signal-to-Noise Ratio (SNR) Analysis

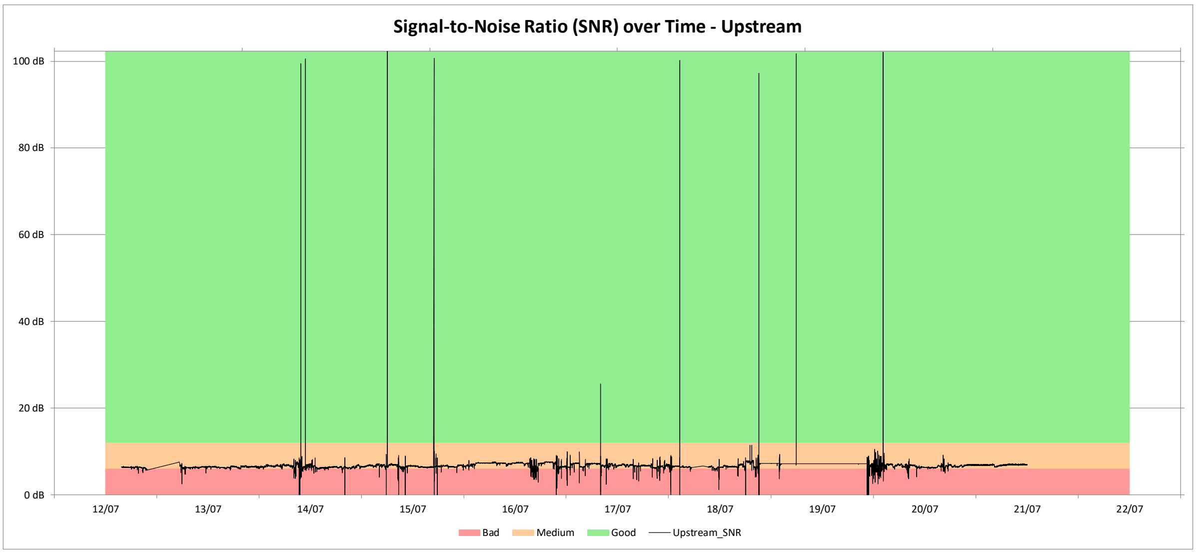
Overview and Technical Relevance

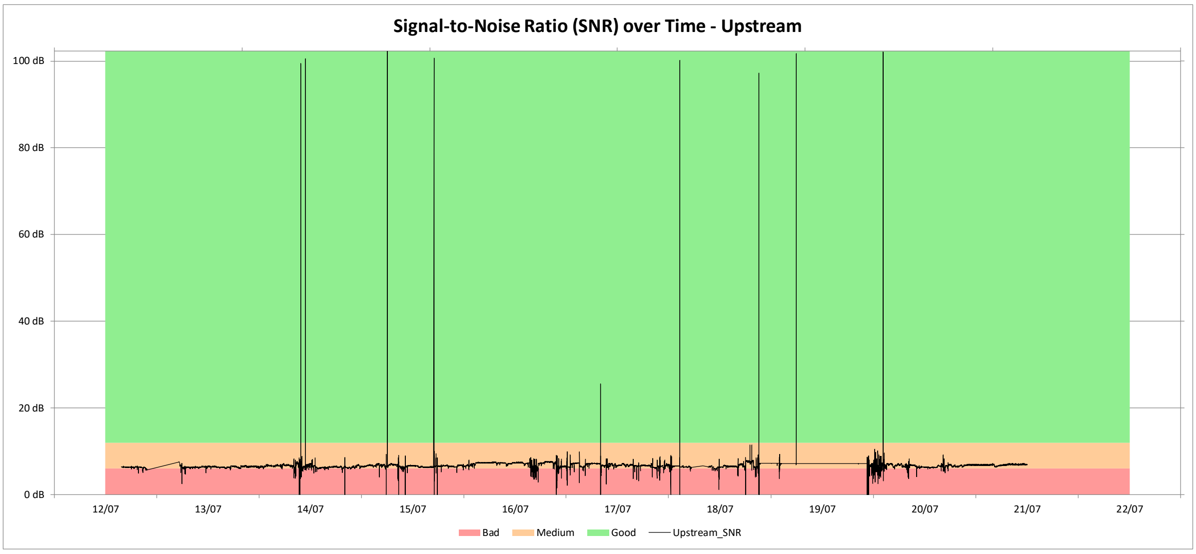
Signal-to-Noise Ratio (SNR) represents the logarithmic comparison between usable signal power and background noise across the DSL frequency spectrum. It is a key indicator of signal integrity, impacting modulation stability, error rates, and throughput performance.

- Higher SNR values allow for efficient modulation schemes (e.g., DMT, G.INP), better resilience against interference, and enhanced overall connection stability.
- Persistently low SNR levels are typically caused by electromagnetic interference, excessive crosstalk (NEXT/FEXT), poor shielding, or aging infrastructure.

📏 *Unit of Measurement: Decibels (dB)* 📌 *Healthy DSL lines generally exhibit SNR values above 20 dB downstream and 12 dB upstream.*

SNR Dynamics Across Observation Window





📊 Signal Quality Thresholds

📊 1. Quality Metric threshold - Downstream		
Signal Quality	**threshold (dB)**	**Range**
Good	20 dB	> 20 dB
Medium	10 dB	[20 - 10] dB
Bad	< 10 dB	< 10 dB

📊 1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (dB)**	**Range**
Good	12 dB	> 12 dB
Medium	6 dB	[12 - 6] dB
Bad	< 6 dB	< 6 dB

Threshold Note

These thresholds are **aligned with standard DSL diagnostics**, though slightly more conservative on the upstream side. In practice, values below 10 dB downstream or 6 dB upstream often correlate with sync drops and degraded service—hence their classification in the "Bad" tier here.

📊 Quantitative Metrics

📊 2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	2,30 dB	1,20 dB
Max	22,10 dB	102,30 dB
Average	7,13 dB	6,76 dB
P90	9,20 dB	7,20 dB

📈 Qualitative Distribution

📊 3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	3,53%	0,04%
Medium	1,84%	97,22%
Bad	94,67%	2,75%

🔍 Interpretation

- **Downstream SNR** is severely degraded across the board — nearly 95% of samples fall in the *Bad* range, with average values far below the stability threshold. This is likely a major contributor to observed sync issues and line errors.
- **Upstream SNR**, while not ideal, remains predominantly in the *Medium* zone, with minimal samples classified as *Bad*. The unusually high **maximum value (102.3 dB)** suggests a spike or reporting anomaly that merits further investigation.
- **Average levels** suggest systemic noise issues on the downstream path, potentially related to crosstalk, electrical interference, or poor copper conditions.

📌 The SNR profile confirms that downstream instability is significant and persistent — a critical finding correlating with the service disruptions noted in other sections of the report.

Forward Error Correction (FEC) Analysis

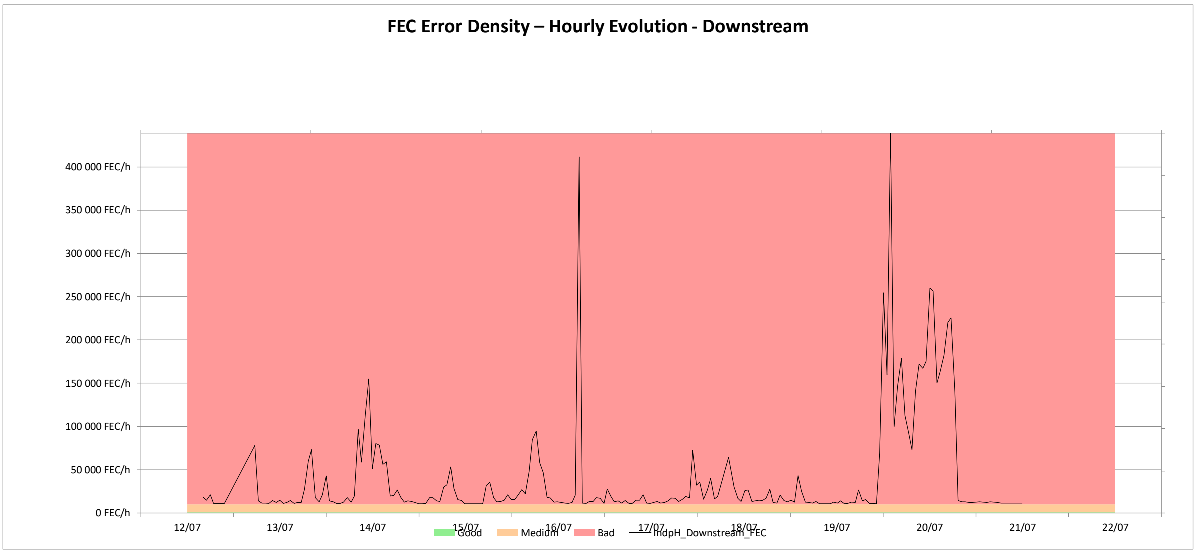
Overview and Technical Relevance

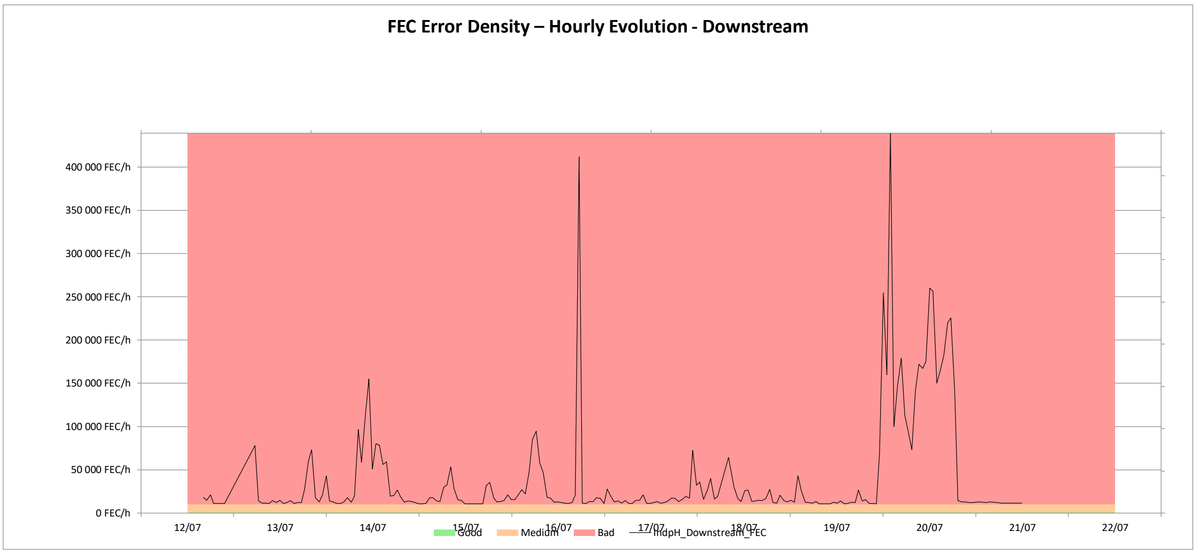
Forward Error Correction (FEC) mechanisms are essential in DSL systems for ensuring data integrity on both the downstream (DSLAM to modem) and upstream (modem to DSLAM) transmission paths. These systems detect and proactively correct transmission errors via embedded algorithms, maintaining signal stability even under adverse line conditions.

- **Downstream FEC** (fec_down) repairs data corrupted during reception from the DSLAM.
- **Upstream FEC** (fec_up) corrects issues during transmission from the modem to the DSLAM.
- Corrections may be expressed as raw totals or rates per hour, depending on sampling method.

📏 *Unit of Measurement: FEC corrections per hour (FEC/h)*

Hourly Distribution of FEC Error Events





Signal Quality Thresholds

1. Quality Metric threshold - Downstream		
Signal Quality	**threshold (FEC/h)**	**Range**
Good	1000 FEC/h	< 1000 FEC/h
Medium	10000 FEC/h	1000 - 10000] FEC/h
Bad	> 10000 FEC/h	> 10000 FEC/h

1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (FEC/h)**	**Range**
Good	500 FEC/h	> 500 FEC/h
Medium	5000 FEC/h	[500 - 5000] FEC/h
Bad	> 5000 FEC/h	> 5000 FEC/h

Threshold Note

These thresholds are relatively **tolerant**, acknowledging that FEC corrections are part of normal DSL functioning. However, sustained high rates — particularly above 10K corrections/hour downstream — may indicate physical degradation, line noise, or excessive interference that exceeds the system's error-handling capacity.

Quantitative Metrics

2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	1 FEC/h	1 FEC/h
Max	438991 FEC/h	590362 FEC/h
Average	28828 FEC/h	10092 FEC/h
P90	88164 FEC/h	4493 FEC/h

Qualitative Distribution

3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	21,72%	82,35%
Medium	45,70%	8,60%
Bad	32,58%	9,05%

Interpretation

- **Downstream FEC** shows significant activity: nearly one-third of samples fall in the *Bad* zone, with an average correction rate well above 20K/hour. This confirms line impairment, likely caused by external noise, long copper loops, or aging infrastructure.
- **Upstream FEC** remains mostly within the *Good* range, suggesting that user-side transmission is stable. However, occasional spikes (max > 500K/h) reveal short bursts of severe correction load, possibly linked to transient crosstalk or internal cabling issues.
- The **P90 values** reinforce that error correction is highly active and sustained during peak instability, especially downstream.

📌 Although FEC mechanisms are functioning effectively, their workload points to nontrivial signal disruption on the line—especially downstream—requiring attention for long-term service reliability.

Header Error Control (HEC) Analysis

Overview and Technical Relevance

Header Error Control (HEC) errors occur at the ATM (Asynchronous Transfer Mode) layer in ADSL transmissions. They indicate corruption in the header of ATM cells — essential components in DSL packet transport.

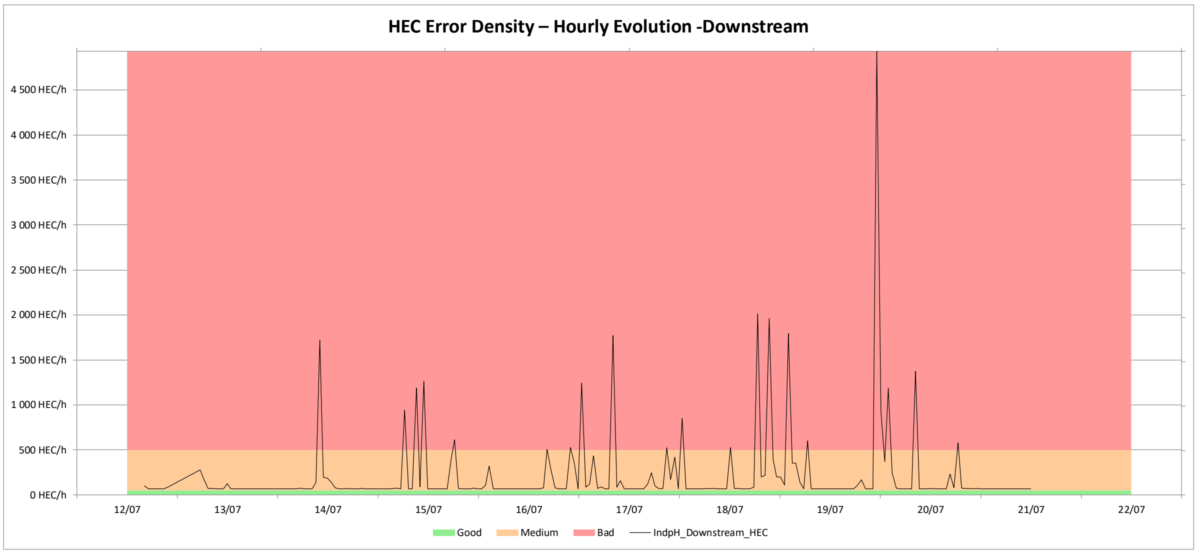
Unlike FEC mechanisms, HEC is limited to 1-bit correction capacity. When a corrupted header is detected, the system attempts to correct it; if unsuccessful, the corresponding cell is discarded, which may trigger retransmissions or impact higher-layer protocols.

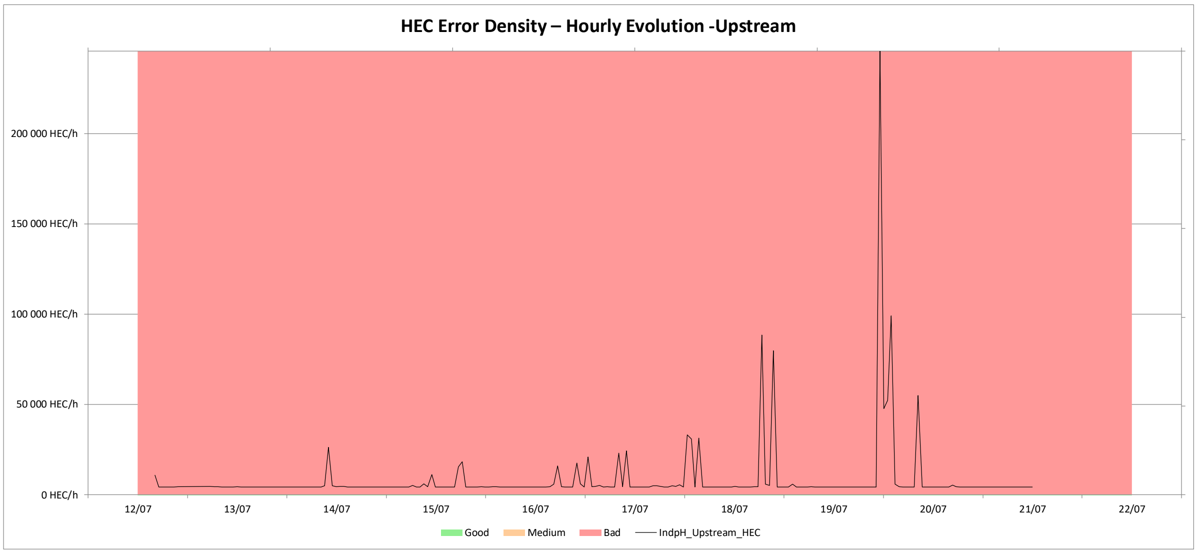
Downstream HEC errors reflect instability in the DSLAM-to-modem path, usually affected by longer cable distances, environmental noise, or degraded copper infrastructure.

Upstream HEC errors occur in modem-to-DSLAM traffic and are typically linked to local interference, poor wiring, or internal electrical activity.

📏 Unit of Measurement: HEC errors per hour (HEC/h)

HEC Error Frequency – Time-Based Analysis





📊 Signal Quality Thresholds

📊 1. Quality Metric threshold- Downstream		
Signal Quality	**threshold (HEC/h)**	**Range**
Good	50 HEC/h	< 50 HEC/h
Medium	500 HEC/h	[50 - 500] HEC/h
Bad	> 500 HEC/h	> 500 HEC/h

📊 1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (HEC/h)**	**Range**
Good	30 HEC/h	< 30 HEC/h
Medium	300 HEC/h	[30 - 300] HEC/h
Bad	> 300 HEC/h	> 300 HEC/h

Threshold Note

These thresholds are moderately strict, especially on the upstream path. Typical DSL implementations tolerate low bursts of HEC errors; however, consistent values over 300–500 errors/hour are indicative of underlying noise, hardware degradation, or EMI exposure — making these boundaries suitable for diagnostic precision.

📊 Quantitative Metricsh

📊 2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	1 HEC/h	5 HEC/h
Max	4931 HEC/h	245636 HEC/h
Average	144 HEC/h	4079 HEC/h
P90	358 HEC/h	1664 HEC/h

📈 Qualitative Distribution

📊 3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	77,38%	71,95%
Medium	14,93%	11,76%
Bad	7,69%	16,29%

🔍 Interpretation

Downstream HEC rates remain stable: over 77% of samples are Good, with only 7.69% showing critical error levels — suggesting manageable transmission quality on reception.

Upstream HEC behavior is less consistent, with 16.29% Bad samples and rare but extreme spikes (up to 245K errors/hour), pointing to episodic disturbances—potentially local EMI or transient crosstalk.

The asymmetry between upstream and downstream error trends reflects distinct physical exposure profiles and supports the hypothesis of internal rather than remote signal instability.

📌 The presence of upstream HEC spikes, despite overall good performance, warrants further correlation with user-side wiring and error event timelines to assess whether corrective measures are required.

🧪 Cyclic Redundancy Check (CRC) Analysis

Overview and Technical Relevance

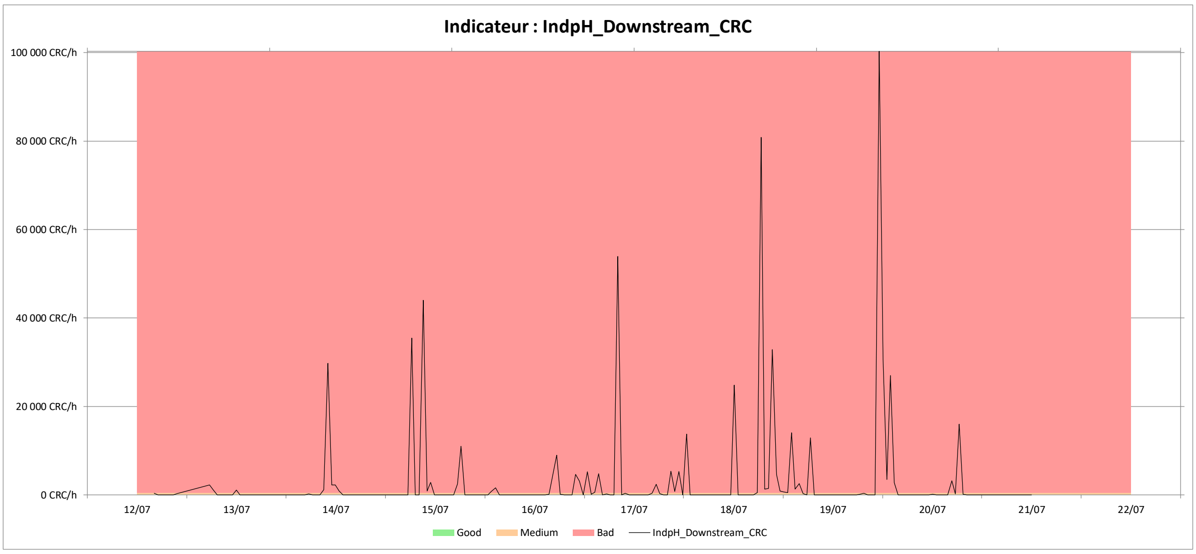
CRC errors reflect failure in data integrity verification during DSL transmission. Operating at the **ATM layer**, CRC checks are designed to detect errors at the packet level. Unlike FEC mechanisms, **CRC errors are not correctable**: affected packets are discarded, often resulting in retransmissions, latency, or dropped connections.

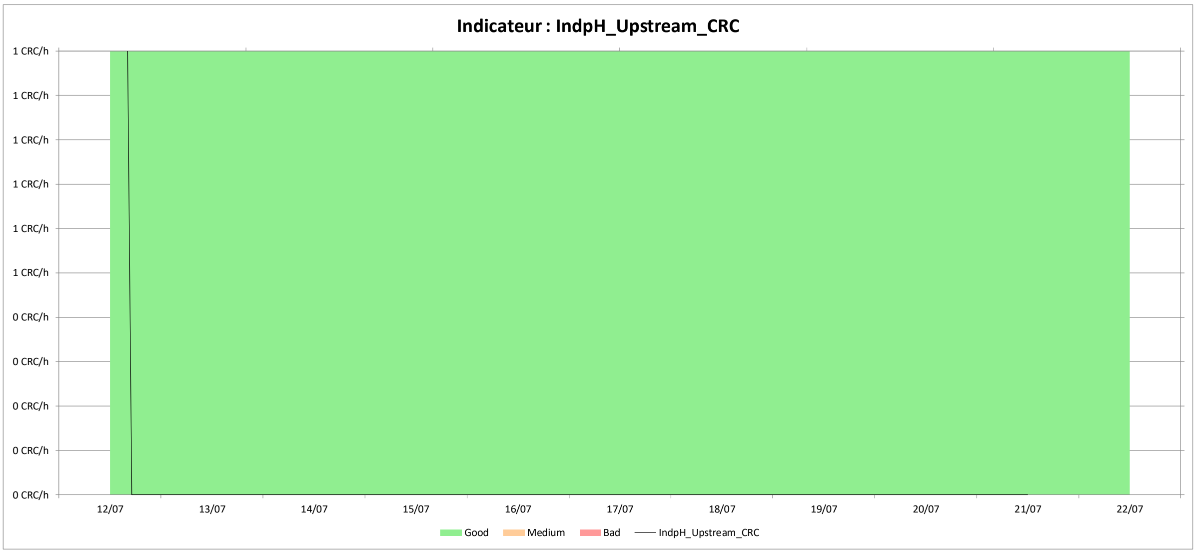
CRC monitoring is a valuable tool to assess link stability, particularly when correlated with real-time service disruptions (e.g. freezes, buffering, sync loss).

- **Downstream CRCs** (DSLAM → modem) often arise from long copper loops, external interference, or infrastructure wear.
- **Upstream CRCs** (modem → DSLAM) tend to originate from household electrical noise, poor local cabling, or modem-side anomalies.

📏 **Unit of Measurement: CRC errors per hour (CRC/h)**

📉 CRC Error Frequency – Time-Based Analysis





Signal Quality Thresholds

1. Quality Metric threshold - Downstream		
Signal Quality	**threshold (CRC/h)**	**Range**
Good	50 CRC/h	< 50 CRC/h
Medium	500 CRC/h	[50 - 500] CRC/h
Bad	> 500 CRC/h	> 500 CRC/h

1. Quality Metric threshold - Upstream		
Signal Quality	**threshold (CRC/h)**	**Range**
Good	30 CRC/h	< 30 CRC/h
Medium	300 CRC/h	[30 - 300] CRC/h
Bad	> 300 CRC/h	> 300 CRC/h

📌 **Threshold Note**

CRC error thresholds presented here are intentionally strict, especially on the downstream path. While isolated CRC bursts may occur sporadically without immediate impact, sustained or repeated CRC events exceeding 500 errors/hour typically reflect significant physical layer degradation, environmental interference, or long-loop signal attenuation.

On the upstream path, the tolerance is even lower — persistent CRC activity above 300 errors/hour often indicates local wiring faults, transient EMI exposure, or modem-side instability. These boundaries provide a reliable diagnostic baseline for identifying abnormal transmission patterns and guiding corrective actions when standard DSL signal quality parameters fail to explain service disruptions.

Quantitative Metrics

2. Quantitative Analysis		
Signal	**Downstream**	**Upstream**
Analysis period: from 12/07/25 17:13 to 22/07/25 08:43		
Sample size: 25391 – interval: 30 seconds		
Min	1 CRC/h	1 CRC/h
Max	100323 CRC/h	1 CRC/h
Average	2811 CRC/h	0 CRC/h
P90	4585 CRC/h	0 CRC/h

Qualitative Distribution

3. Qualitative Analysis		
Signal Quality	**Downstream**	**Upstream**
Good	68,78%	100,00%
Medium	8,60%	0,00%
Bad	22,62%	0,00%

Interpretation

- **Downstream CRC levels** indicate noteworthy line instability. Over 22% of samples qualify as "Bad", with peak values exceeding 100K CRC/h — consistent with noticeable service impact.
- **Upstream CRC behavior** remains nominal throughout, suggesting line faults are likely not internal.

- The sharp contrast in CRC activity between directions points toward **remote infrastructure degradation or EMI exposure** as primary contributors.

📌 Further analysis is recommended to correlate CRC spikes with timestamps of disconnections and application-layer errors, offering insight into the failure chain and potential escalation paths for mitigation.

6. 🧠 Conclusion & Recommendations

The findings of this technical investigation highlight recurring degradation and instability across multiple DSL performance indicators. These issues are not isolated but show consistent patterns of line impairment, resynchronization events, and elevated error activity. Based on the evidence gathered, a deeper follow-up is advisable across three key stakeholders:

🏢 **Free as (Internet Service Provider)**

- **Disconnection Frequency:** With 26 documented sync losses, Free should evaluate whether DLM (Dynamic Line Management) policies are too aggressive, causing premature renegotiation.
- **Line Monitoring Strategy:** Request clearer insight into Free's real-time diagnostics and thresholds — especially regarding SNR, attenuation, and FEC limits triggering resync.
- **Support Escalation Path:** Ensure the open incident is escalated internally with the inclusion of end-user-provided diagnostics, as it clearly correlates service degradation with measurable signal instability.

🛠️ **Free as (Physical Infrastructure Owner)**

- **Copper Line Integrity:** Downstream attenuation above 45 dB, coupled with low SNR and frequent CRC/FEC bursts, strongly suggest physical line degradation — possibly related to cable length, age, or exposure.
- **Local Loop Audit:** Recommend a targeted inspection of the physical loop, including junction boxes, line shielding, and potential exposure to electromagnetic interference.
- **Upstream Stability Events:** Although generally more stable, the occasional spikes in upstream HEC and FEC error rates hint at internal wiring vulnerabilities or crosstalk zones — which Orange should assess directly.

👤 **Personal Follow-Up (User Perspective)**

- **Session Management:** Due to systematic disconnection of remote sessions during sync loss, consider implementing resilient protocols (e.g., autossh, VPN auto-reconnect) or scheduling critical tasks outside unstable time windows.
- **Environmental Factors:** Investigate possible domestic interference sources (e.g., powerline adapters, unshielded cables) that may exacerbate SNR degradation.
- **Data Continuity Monitoring:** Maintain ongoing logging of signal metrics post-incident to validate corrective measures and support potential escalation.

📌 This report aims not only to document the symptoms experienced, but also to equip all involved parties with actionable diagnostics — serving both troubleshooting and future infrastructure reliability.

7. Annotated Bibliography: Erratic Behavior of Freebox Routers

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