



HFC Network Monitoring System

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#monoliti10rebranding

System description

Analytical monitoring system for HFC network elements :

- CMTS concentrators
- MAC domains, Cable Downstream and Upstream Interfaces
- cable modems
- Real-time alerting
- Real-time CPE monitoring and troubleshooting
- The system collects and shows historical data on monitored elements from HFC plant
- Allows operators to proactively detect service impairments and trends

Business value

- Improve Customer Experience by refining network quality
- Reduce MTTR through reduction of time spent searching of network issues
- Reduce trouble calls and increase subscriber Quality of Experience by finding and resolving plant problems before service is affected

System Genesis

- Long-term experience in HFC Infrastructure management and monitoring
- Meet the market demands
 - Complexity
 - High performance
 - Multiplatform (support for all HFC vendors)
 - Author's algorithms for processing collected data
 - Monitoring and managing through own independent system
 - Unique functionalities
 - Intuitive data presentation

System features

- High performance and scalability: The system is tested on the infrastructure, which contains about **1 000 000** cable modems
- High system stability and availability
- System ergonomics is created based on long-term experience with major cable operators
- Can be used for bandwidth planning and overbooking
- The system is tested with CMTS controllers manufactured by: **Cisco, Arris, CASA**
- The system can be integrated with external CRM

System architecture

The system has modular architecture and it's highly efficient.

The system consists of the following components:

- Application
- Data collectors
- Primary database
- Historical data database

Implementation models

We perform 2 implementation models:

- **CLOUD-BASED** model
 - Proposed mainly for small and medium-sized cable operators
 - VPN direct channel is set between our Cloud and customer management network
- **ON-PREMISE** model
 - Proposed mainly for medium and large cable operators
 - on-site Data Center

Application areas

The system in a typical environment is implemented for the following groups of users:

- Help Desk / Call Center
- Provider's technical service, technical team in the field
- NOC (Network Operation Center)
- Infrastructure and HFC facility administrators
- Marketing and Planning

Application areas

Help Desk

HelpDesk staff can use features that allow them to check the operating parameters of the customer's cable modem:

- Downstream Power, Downstream SNR
- Upstream Power, Upstream SNR
- Error correction on the modem (SigCorr, SigUncorr)
- Uploaded and downloaded data volume
- Hosts (CPEs)
- Other functions dependent on operator requirements

Application areas

Help Desk

HelpDesk staff can use features that allow them to:

- Perform basic operations on the modem, such as:
 - modem restart
 - ping
 - flow verification
 - error removal
- Perform expanded operations on the modem
 - Wi-Fi management
 - Providing MTA information
- Connection to CRM gives possibility to combine customer data with particular cable modem. The system can find the modem by customer's data e.g. contract number

Application areas

Technical team in the field

The System allows users to check cable network performance and modems parameters. Also it was designed to work on mobile devices to help technicians in the field.

For technical team in the field the following information are provided:

- Upstream SNR (also online readings), Downstream SNR, Upstream Power, Downstream Power
- Error correction on the cable interfaces
- Registered modems number per interface and per CMTS

Application areas

NOC – Network Operation Center

NOC module provides all statistic data. The most important are:

- Providing alarms after exceeding values beyond the established thresholds. Thresholds were established based on DoCSiS/HFC network operation standards
- Upstream and Downstream statistics/parameters
- MAC-Domain movement and saturation , Downstream and Upstream
- For MAC-Domain also an average rate per physical interface is calculated
- Number of registered modems
- Errors correction on the Upstream interfaces
- Interfaces where number of CMs with errors exceeds 20%

Application areas

Marketing and Planning

The system presents data that can be also used for investment planning. Particularly, the system:

- Shows internet plans for all customers also divided into CMTS devices
- Calculates the average flow rate for each plan divided into the CMTS or globally across an operator's network
- Shows Number of downloaded/uploaded data per user/cable interface
- It is an ideal tool for forecasting bandwidth (overbooking)
- Heavy Users – show customers who generates most bandwidth usage relative to whole traffic
- Traffic statistics – shows customers exeeding 80% of bandwidth

System design

System is built of 6 main modules:

- Dashboard Module
- CMTS Module
- HFC Modem Module
- Statistics Module
- Alert Module
- Search Module

System Design

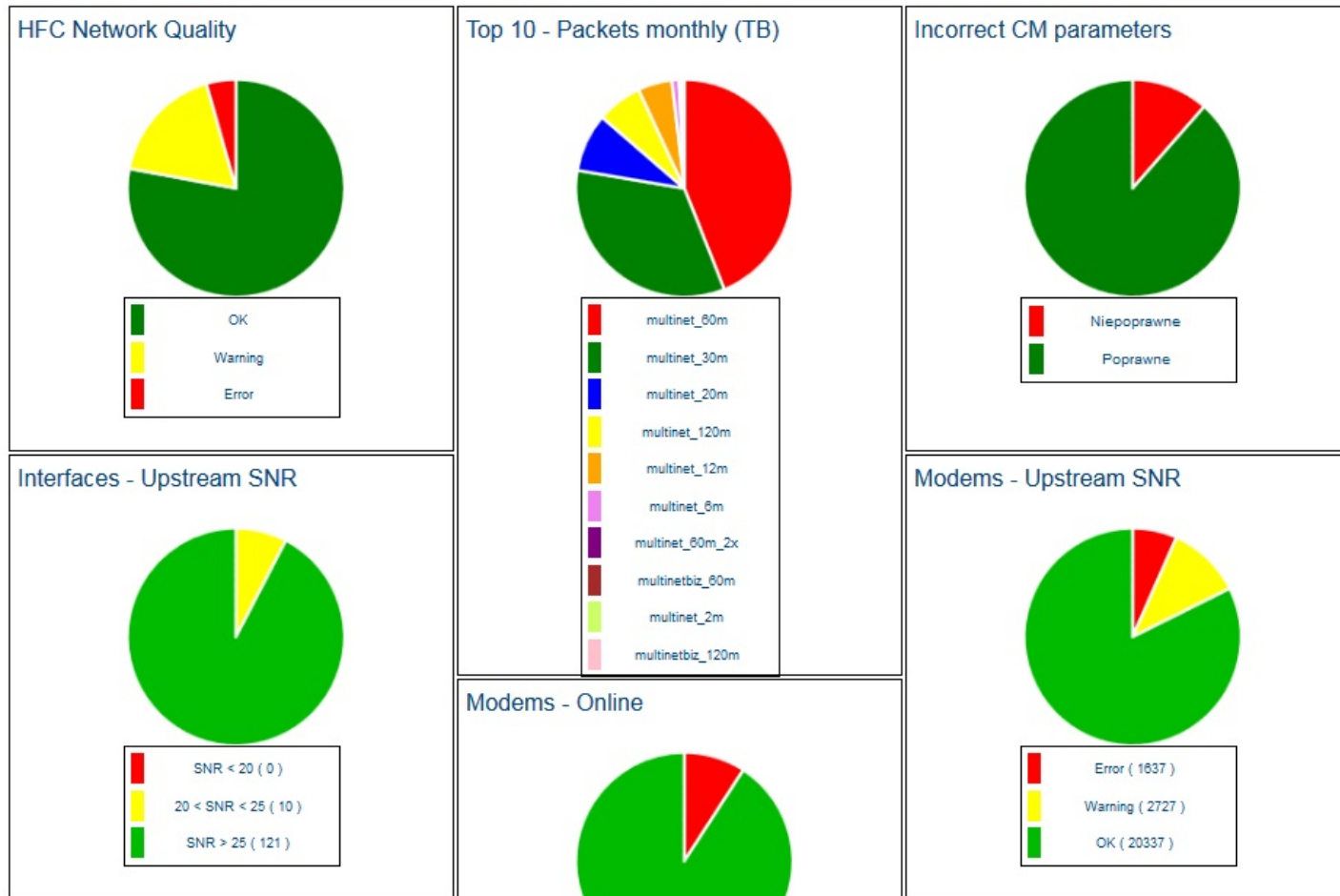
Dashboard Module

This module shows basic information about individual CMTS or the entire HFC network in graphical forms:

- SNR Statistics for CMTS interfaces and modems
- Number of CMs with incorrect parameters
- Number of CMs DoCSiS 2.0 vs 3.0(3.1)
- Upstream, downstream and MAC domain saturation
- Number of CMs logged on each CMTS/interface
- Cable interfaces with the largest error correction
- Active CMTSes
- Top 10 Internet packages, which generate the largest traffic

System Design

Dashboard Module



System Design

CMTS Module

CMTS Module presents information about the device:

- CMTS software version, uptime
- List of cable interfaces and MAC-Domains with dependencies
- Parameters of all cable interface
- A list of cable modems with information about the current firmware and cable interfaces, on which modems are logged
- List of CMs with incorrect parameters

System Design

CMTS Module

CMTS				Cable modems		Upstream SNR Statistics			Parameters Statistics	
CMTS	Firmware	Uptime	Model			<25	<28	>28	Warning	Error
Gliwice	08.02.00.97	32 dni	ARRIS_C4	other	558	4	14	3347	367	68
Downstreams: 96 / 96 Upstreams: 118 / 120 MAC-Domains: 11				online	3356	0.12%	0.42%	99.47%	11%	2%
				All modems	3912					

MAC-Domains list

MAC-Domain	Interface name	ID	Frequency	Channel width	DoCSis	Downstream Power	Modulation	Modems Online	Interface description
cable-mac 1	cable-downstream 14/0	1	385 MHz	6 MHz	DoCSIS	49	4	33	
cable-mac 1	cable-downstream 14/6	7	421 MHz	6 MHz	DoCSIS	49	4	21	
cable-mac 1	cable-downstream 14/1	2	391 MHz	6 MHz	DoCSIS	49	4	69	
cable-mac 1	cable-downstream 14/7	8	427 MHz	6 MHz	DoCSIS	49	4	81	
cable-mac 1	cable-downstream 14/2	3	397 MHz	6 MHz	DoCSIS	49	4	23	
cable-mac 1	cable-downstream 14/3	4	403 MHz	6 MHz	DoCSIS	49	4	25	
cable-mac 1	cable-downstream 14/4	5	409 MHz	6 MHz	DoCSIS	49	4	18	
cable-mac 1	cable-downstream 14/5	6	415 MHz	6 MHz	DoCSIS	49	4	42	

Interface	ID	Frequency	Channel width	Modulation	Signal Unfiltered	Signal Corrected	Signal Uncorrected	SNR	Micro Reflections	Online Modems	Description
cable-upstream 10/0.0 (QAM: 1)	1	30 MHz	3.2 MHz	20	100%	0%	0%	36.5	0	90	Perkoza 2-12,Czajki 7,11-

System Design

CMTS Module

CM list from specific interface

Interface: Modular-Cable1/1/0-downstream6												
HFC	IP	Status	Firmware	Model	RX Power	Timing Offset	Upstream SNR	Upstream Interface	Address/Customer Number	Update		
1	e448c75b2114	10.153.0.182	other	epc2425-E10-5-v202r12812-130715cs-TYA	EPC2425	0.5	6370	34.7	Cable5/0/0-upstream5 Ca5/0/0-upstream5	ul. Magazynowa 3/4 Etk 4571910	2017-05-05 20:03:24	
2	e448c75ae94c	10.153.16.202	online	epc2425-E10-5-v202r12812-130715cs-TYA	EPC2425	0.5	6888	33	Cable5/0/0-upstream1 Ca5/0/0-upstream1		2017-05-05 19:56:01	
3	c0c522f1d02a	10.153.54.251	online	9.1.103V.EURO	TG2492S-85	-0.5	34.7 34.7		Cable5/0/0-upstream4 Ca5/0/0-upstreamB	ul. Magazynowa 3/12 Etk 212893	2017-05-05 20:37:09	
4	c0c5225086ba	10.153.58.71	online	9.1.103V.EURO	TG2492S-85	-0.5	35.1 33.6		Cable5/0/0-upstream5 Ca5/0/0-upstreamB	Etk-ul. Jarostawa Dabrowskiego 16A/26 6639694	2017-05-05 20:37:14	
5	bccab5ff02f5	10.153.24.25	online	9.1.103S	CM820S	0	31.7 31.4 29.1		Cable5/0/0-upstream0 Ca5/0/0-upstreamB	ul. Jana Pawla II 1A./5 Etk 26594	2017-05-05 20:37:14	
6	bccab5fe8c47	10.153.13.213	online	9.1.103S	CM820S	-0.5	33.6 33		Cable5/0/0-upstream4 Ca5/0/0-upstreamB	Etk-ul. Armii Krajowej 47/18 3015099	2017-05-05 20:37:19	
7	9c3426511d2a	10.153.39.201	online	9.1.103V.EURO	TG2492S-85	0	33.2 32.3 30		Cable5/0/0-upstream0 Ca5/0/0-upstreamB	ul. kard. Stefana Wyszyńskiego 27/15 Etk 7877666	2017-05-05 20:37:13	
8	80c6aba777b0	10.153.45.59	other	ST52.05.73	TCM420	0	6403	33.9	Cable5/0/0-upstream4 Ca5/0/0-upstream4	ul. Jarostawa Dabrowskiego 10/14 Etk 3858408	2017-05-05 20:17:30	

System Design

CMTS Module

CMs with incorrect parameters

Lp.	HFC	IP	Status	Firmware	Model	RX Power	Timing Offset	Upstream SNR	Upstream Interface	Update
1	fc94e376f4b2	10.150.243.132	online	STB2.01.72	TWG870	0.5	1879	36.1 37.4 33.4 39.1	Logical Upstream Channel 13/1.2/0	2017-01-18 15:27:47
2	f44b2abaeaa6	10.150.209.222	online	e3928-E15-5-E11F-c5200r55113-160720c	EPC3928	0.7	1951	34.4 34.4 35.1 35.6	Logical Upstream Channel 13/1.1/0	2017-01-18 15:27:48
3	f44b2aba8e28	10.150.224.250	online	e3928-E15-5-E11F-c5200r55113-160720c	EPC3928	0.2	1915	36.7 36.7 38.2 34.4	Logical Upstream Channel 13/1.1/0	2017-01-18 15:27:47
4	f44b2aba72f8	10.150.223.203	online	e3928-E15-5-E11F-c5200r55113-160720c	EPC3928	0	1927	34.4 39.1 35.6 37.4	Logical Upstream Channel 13/1.2/0	2017-01-18 15:27:50
5	e448c7b68a1e	10.150.212.231	online	epc3010-v302r12901-100511c	EPC3010	0	1876	39.1 35.6	Logical Upstream Channel 13/1.1/0	2017-01-18 15:27:48
6	e448c7b566a2	10.150.200.232	online	epc3010-v302r12901-100511c	EPC3010	0.5	1902	34.4 35.1 35.6 36.7	Logical Upstream Channel 13/1.0/0	2017-01-18 15:27:47
7	e448c76dbc54		other	e3925-E10-5-c1100r5593-160720c	EPC3925	0	0	37.4	Logical Upstream Channel 13/1.3/0	2017-01-18 00:53:57
8	e448c76c4ef6	10.150.226.229	online	e3925-E10-5-c1100r5593-160720c	EPC3925	-0.2	1890	33.7 37.4 36.7 35.6	Logical Upstream Channel 13/1.0/0	2017-01-18 15:27:46

System Design

CMTS Module

online CM check module

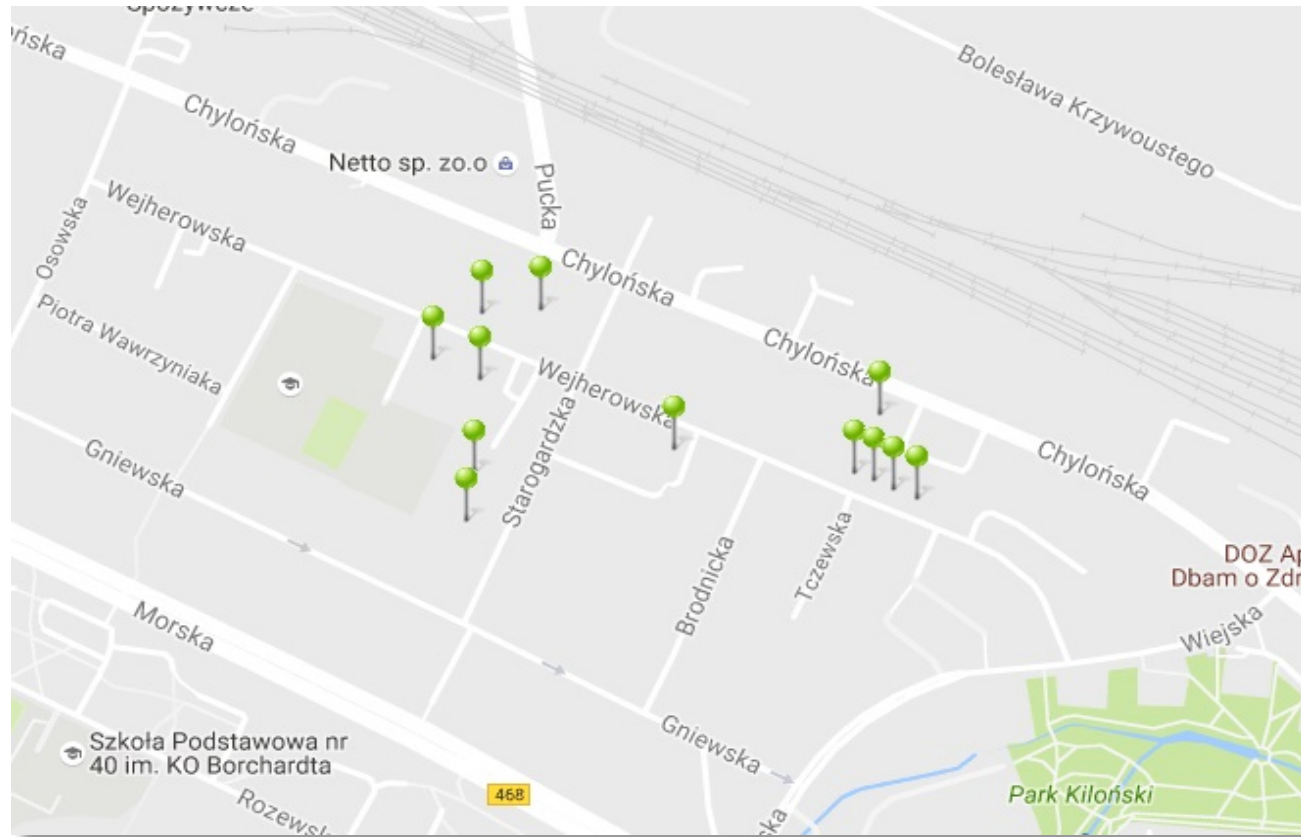
HFC	Model	Upstream Power	Upstream SNR	Downstream Power	Downstream SNR
bccab5fe59d5	CM8205	42.8	36.12	-7.2	37
7cb21bc0864c	EPC3008	43, 43	36.12, 36.12	-6.7, -6.7, -6.9, -7, -7.5, -6.9, -6.5, -6.7	39.8, 39.9, 39.9, 39.5, 40.3, 40.3, 40.5, 40.8
7cb21bbfe38c	EPC3008	46.5, 46.5	36.12, 36.12	-1.2, -1.1, -0.8, -1, -2.3, -2.1, -1.7, -1.2	40.4, 40.8, 41, 40.8, 40.5, 41, 41.2, 41.9
7cb21bbf9a26	EPC3008	49.5, 49.5	36.12, 36.12	-3.8, -4.8, -4.3, -3.8, -5.6, -5, -4.8, -4.5	40.8, 40.3, 40.5, 40.8, 40.4, 40.9, 40.8, 41.4
7cb21bbf9754	EPC3008	38, 38	36.12, 36.12	-0.6, -0.9, -0.4, -1, -1.4, -1.2, -1.3, -0.9	40.3, 40.3, 40.3, 40.1, 40.8, 40.8, 40.7, 41.4
7cb21bbf7e38					
7cb21bbac528					
6863592aedcb	STMicroelectronics CM	40.7	36.12	-5.5	34.8
686359254eae	STMicroelectronics CM	38.7	36.12	-2.2	37
68635921c2fd	STMicroelectronics CM	42.2	36.12	0	36.9
68635921c2b9	STMicroelectronics CM	42.7	36.12	-2.3	36.5
68635921be12	STMicroelectronics CM	47.2	36.12	0.4	37.1
68635921b8fe	STMicroelectronics CM	45.7	36.12	-4.7	36.5
68635921b8a1	STMicroelectronics CM	42.7	36.12	-6.5	36.4
68635921b817	STMicroelectronics CM	45.7	36.12	-5	31.1
68635921b78e	STMicroelectronics CM	43.7	36.12	-5.3	37
6863591c473d	STMicroelectronics CM	41.7	36.12	-6.7	36
54d46f13b162		47.7	36.12	4.3	39.4

allows to query on demand all CM on specific cable interface

System Design

CMTS Module

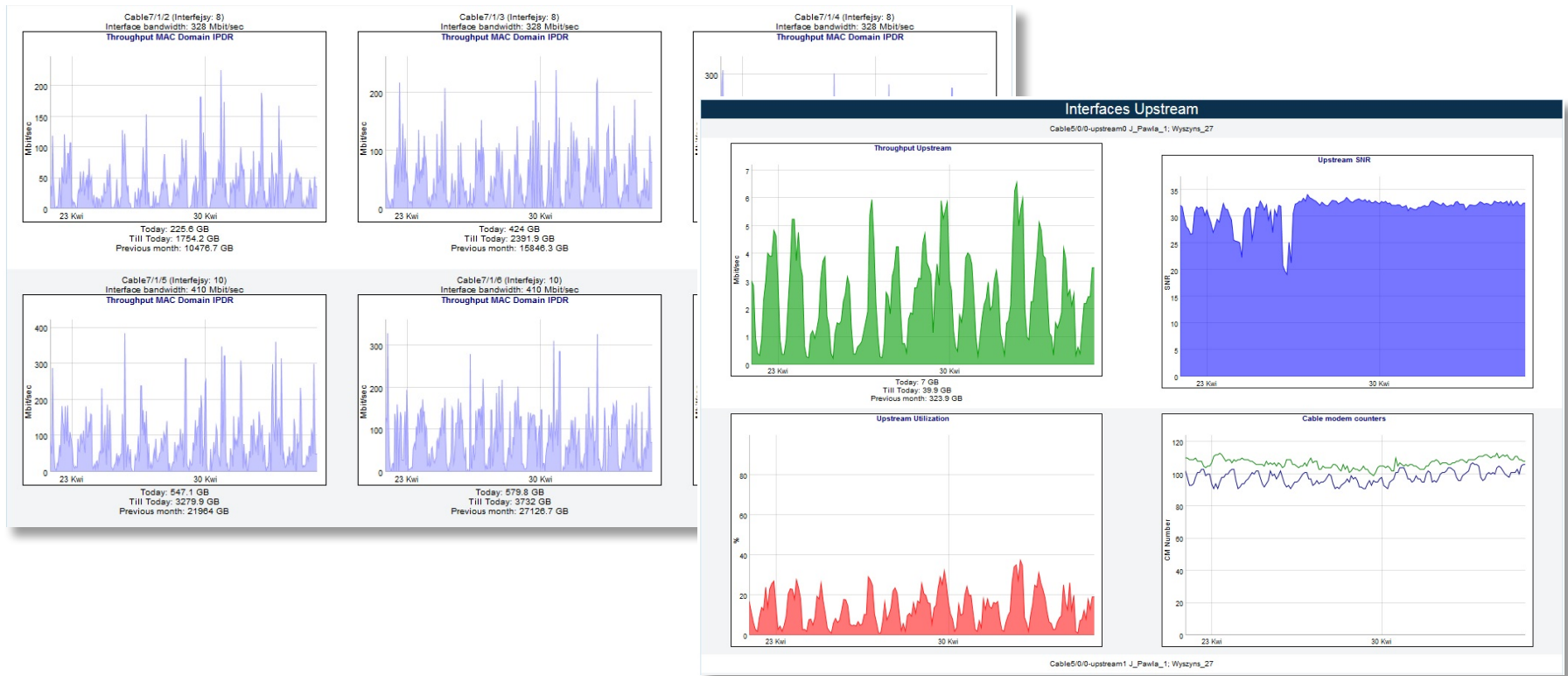
Google Maps CM identification.



System Design

CMTS Module

Upstream throughput, SNR, upstream use, number of modems



System Design

Cable modem module

- Online Reading Module presents the current status of cable modem
- Each cable modem is under monitoring for main operating parameters. Data collection frequency is matched to customer requirements.
- Each cable modem can be added by the operator for individual monitoring. Each operator has its own modems list which are currently monitored.

System Design

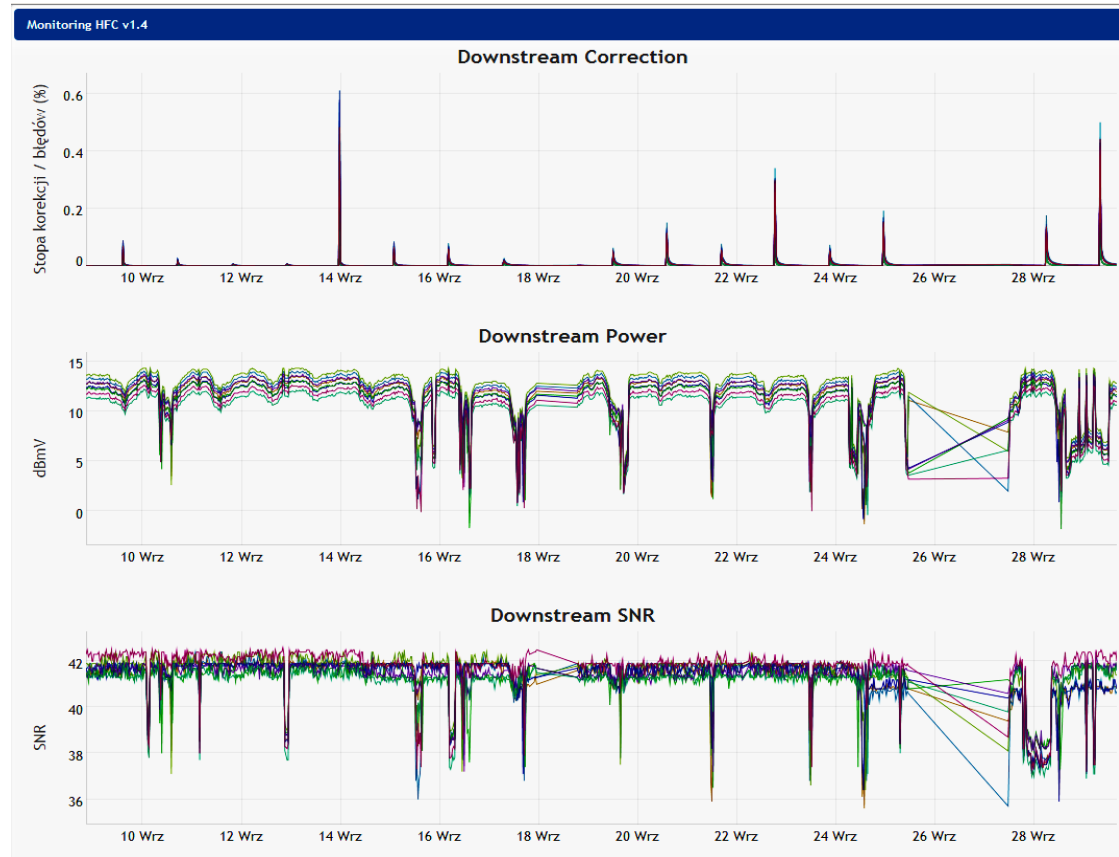
Cable modem module

Cable Modem Online Informations									
Cable modem informations									
Cable Modem							Cisco EPC3008 EuroDocs 3.0 Data Modem HW_REV: 1.0 VENDOR: Cisco BOOTR: 2.3.1_R3 SW_REV: e3000-c1000r5593-151110c MODEL: EPC3008		
IP Address	HFC MAC	Serial number	Firmware Version	Current Time/Date	Current Status				
10.157.8.112	c8fb263ce7a0	265523839	e3000-c1000r5593-151110c	2016/09/14 19:38:11	Active				
Current informations									
Ethernet		USB		Configuration file			CPE MAC		
95.37 Mbit/sek		0bit/sek		^1/4E0BB4C9/			00095bedda02 Netgear, Inc. a42bb0d39f63 c8fb263ce7a0 Cisco SPVTG		
Parameters (from CM)									
UPSTREAM									
Upstream Power	Resety Upstream	Sync Loss	Upstream ID	Frequency	Channel Width	Upstream SNR	Interface		
51.5	0	0	2	54	6.4	31.76	Cable8/0/1-upstream1		
52.5	0	0	1	61	6.4	28.63	Cable8/0/1-upstream0		
Comment									
DOWNSTREAM									
Downstream Power	Downstream SNR	Frequency (MHz)	Channel Width	Modulation	Interleave	Frames Corrected	Frames Uncorrected	Interface	
-2.7dBmV	41.8	842	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream15	
-2.4dBmV	42.1	786	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream8	
-2dBmV	42.5	794	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream9	
-2.3dBmV	41.9	802	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream10	
-2dBmV	42.1	810	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream11	
-2.2dBmV	31	818	8	qam256	taps12Inc17	8.534%	1.358%	Modular-Cable8/0/0-downstream12	
-2.8dBmV	41.4	826	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream13	
-2.8dBmV	41.4	834	8	qam256	taps12Inc17	0.000%	0.000%	Modular-Cable8/0/0-downstream14	

System Design

Cable modem module

Cable modem parameters diagrams



System Design

Statistic Module

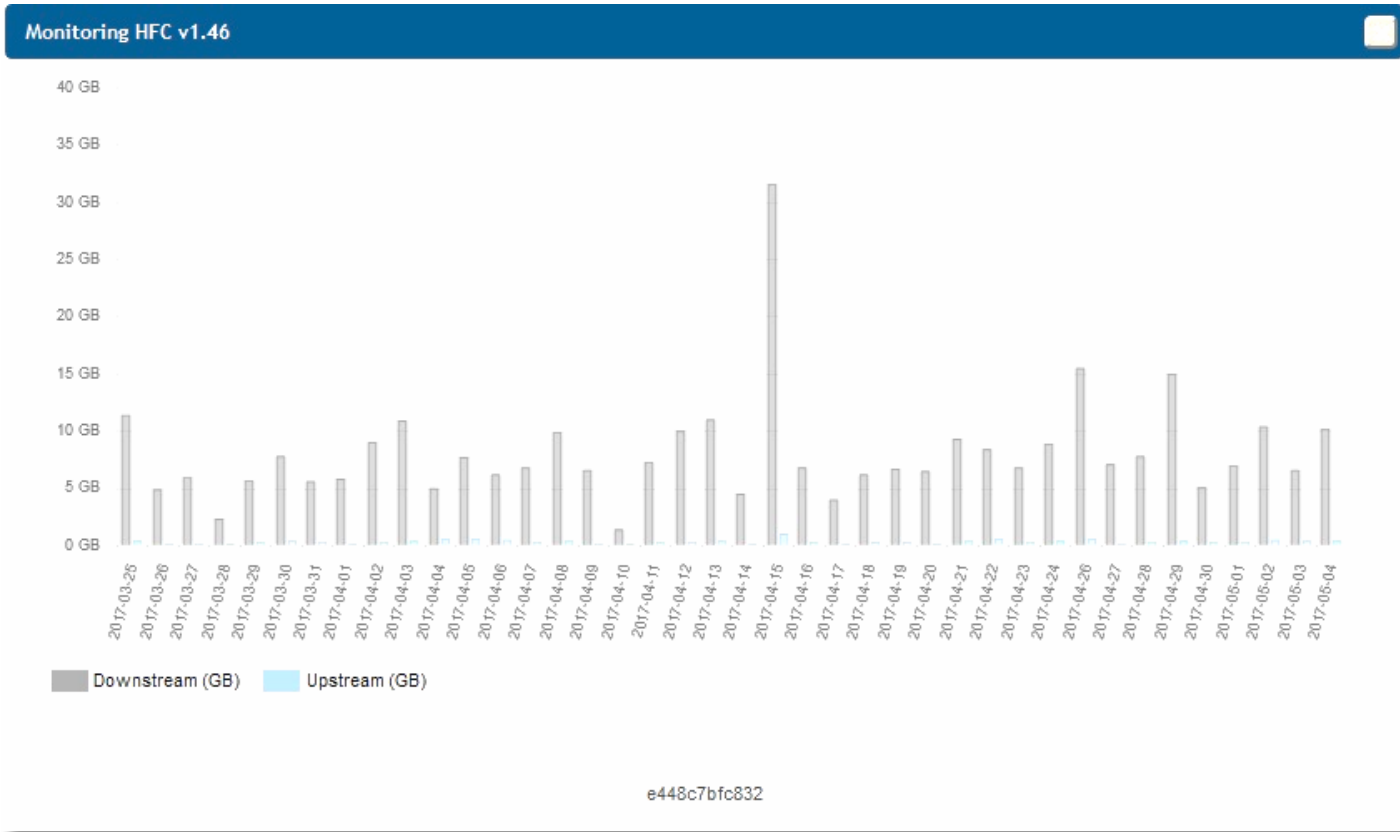
Statistics Module contains information about:

- Downloaded/Uploaded data by each cable modem, divided into CMTS and MAC-Domains
- Average flow rate for individual internet plans, CMs
- Firmware versions (with modems reset function)
- Number of logged CMs
- CMs' models
- Overbooking for each internet plan / total traffic per plan / CMTS
- CMs Gauss parameters distribution
- Heave Users
- Hourly user traffic statistics
- DoCSiS 3.0 CMs working in D2.0 mode
- Cable modem parameters statistics – gather every day
- MAC-Domain interfaces bandwidth overbooking

System Design

Statistic Module

Cable modem traffic history



System Design

Statistic Module

Traffic schedule for respective internet plan

Rozkład pakietów																-- Wybierz urządzenie --	
Nazwa pakietu	Ilość pakietów	Downstream TB (dzisiaj)	Upstream TB (dzisiaj)	Downstream Gb/sek (dzisiaj)	Upstream Gb/sek (dzisiaj)	Downstream TB (obecny miesiąc)	Upstream TB (obecny miesiąc)	Downstream Gb/sek (obecny miesiąc)	Upstream Gb/sek (obecny miesiąc)	Downstream TB (poprzedni miesiąc)	Upstream TB (poprzedni miesiąc)	Downstream Gb/sek (poprzedni miesiąc)	Upstream Gb/sek (poprzedni miesiąc)	Downstream Średnia pakiet (Mbit/sek)	Upstream Średnia pakiet (Mbit/sek)		
30m	115508	47.7266	5.9108	6.5	0.8	4481.4135	497.4021	15.2	1.7	4540.3506	512.0442	13.9	1.6	0.123	0.014		
12m	141887	41.53	3.0955	5.7	0.4	3779.412	265.9877	12.8	0.9	4009.1934	280.8483	12.3	0.9	0.088	0.006		
80m	43720	28.5029	4.8256	3.9	0.7	2597.8654	358.9326	8.8	1.2	2593.5238	363.7542	7.9	1.1	0.186	0.026		
20m	44041	15.6287	1.3529	2.1	0.2	1486.4879	118.2562	5	0.4	1558.1474	122.8961	4.8	0.4	0.111	0.009		
6m	35990	8.6786	0.5505	1.2	0.1	753.1088	49.126	2.6	0.2	828.084	53.1042	2.5	0.2	0.072	0.005		
Rezerwa	0	2.3141	0.3395	0.3	0	214.4544	28.8289	0.7	0.1	77.5089	12.88	0.2	0	0	0		
2m	10612	1.6171	0.0905	0.2	0	127.4083	8.123	0.4	0	142.9611	8.7882	0.4	0	0.042	0.003		
120m	1432	1.135	0.3745	0.2	0.1	100.1624	25.1373	0.3	0.1	93.8414	25.2388	0.3	0.1	0.205	0.055		
1m	4721	0.4758	0.0394	0.1	0	37.6356	3.1758	0.1	0	42.2432	3.4648	0.1	0	0.028	0.002		
15m	996	0.3561	0.0254	0	0	32.1067	2.6788	0.1	0	34.4353	2.8809	0.1	0	0.108	0.009		
4m	1438	0.3158	0.0243	0	0	31.0196	2.3639	0.1	0	35.2538	2.6428	0.1	0	0.077	0.006		
18m	824	0.2481	0.017	0	0	25.4567	1.7182	0.1	0	28.2209	2.092	0.1	0	0.107	0.008		
60m	128	0.4804	0.0614	0.1	0	23.2474	3.2132	0.1	0	25.2296	2.9731	0.1	0	0.617	0.073		
80m_2s	57	0.2409	0.1368	0	0	15.2589	4.6075	0.1	0	14.8481	3.0158	0	0	0.816	0.166		
8m	407	0.1267	0.0134	0	0	12.5014	1.2718	0	0	13.6544	1.3199	0	0	0.105	0.01		
25m	125	0.2778	0.0371	0	0	10.3054	1.488	0	0	11.3089	1.6453	0	0	0.283	0.041		

System Design

Statistic Module

Overbooking and traffic summary

Service Packets																	
-- Select device --																	
Service Packet	Quantity	Today				Current month				Previous month							
		DS TB (today)	US TB (today)	DS Gb/sec (today)	US Gb/sec (today)	DS TB (current month)	US TB (current month)	DS Gbit/sec (current month)	US Gbit/sec (current month)	DS TB (previous month)	US TB (previous month)	DS Gbit/sec (previous month)	US Gbit/sec (previous month)	DS Average packet GB	US Average packet GB	DS Average packet (Mbit/sec)	US Average packet (Mbit/sec)
multimed_30s	130226	106.6391	10.8865	20.7867	1.358	5635.0385	386.1336	29.6825	2.034	100672864.1019	623.9646	307912.2249	1.9084	756749.9075	4.6903	2314.552	0.0143
multimed_30s	82507	135.1073	12.1287	16.8534	1.5129	4888.3969	420.9737	25.7496	2.2175	134226102.4936	675.1963	410536.2275	2.0651	1665889.3058	8.3799	5095.193	0.0256
multimed_10s	100975	73.6718	4.3342	9.1899	0.5407	2563.1322	150.5415	13.5013	0.793	8392957.5468	251.0241	25670.2166	0.7678	85114.0236	2.5457	260.325	0.0078
multimed_30s	47093	42.9746	2.7144	5.3607	0.3386	1556.3736	95.9909	8.1982	0.5056	2595.2428	159.1466	7.9377	0.4868	56.4315	3.4605	0.173	0.0106
multimed_10s	13027	31.1375	4.9754	3.8841	0.6206	1073.3558	165.698	5.6539	0.8728	50333408.5354	245.44	153946.8648	0.7507	3956506.5127	19.293	12101.143	0.059
multimed_30s	24947	11.9801	0.6559	1.4944	0.0818	402.5059	23.1172	2.1202	0.1218	680.0346	39.0966	2.0799	0.1196	27.9134	1.6048	0.085	0.0049
multimed_30s	5447	1.8076	0.1042	0.2255	0.013	60.5395	3.6769	0.3189	0.0194	101.4191	6.0972	0.3102	0.0186	19.0661	1.1462	0.058	0.0035
Unknown	0	1.0176	0.1737	0.1269	0.0217	33.4111	4.7803	0.176	0.0252	16777421.3917	17.2865	51314.4549	0.0529	0	0	0	0
multimed_10s	873	0.8754	0.0631	0.1092	0.0079	27.9651	1.5179	0.1473	0.008	46.2365	2.5634	0.1414	0.0078	54.2338	3.0068	0.166	0.0092
multimed_30s_3s	232	0.8328	0.1933	0.1039	0.0241	25.1501	6.266	0.1325	0.033	46.2351	10.5513	0.1414	0.0323	204.0722	46.5713	0.624	0.1424
video_30s	856	0.5302	0.0371	0.0661	0.0046	17.4729	1.2398	0.092	0.0065	28.6186	1.9446	0.0875	0.0059	34.2353	2.3262	0.105	0.0071
multimed_10s	495	0.5128	0.031	0.064	0.0039	16.8962	0.9178	0.089	0.0048	28.4458	1.6285	0.087	0.005	58.8455	3.3688	0.18	0.0103
multimed_10s	2305	0.5309	0.0402	0.0662	0.005	16.7949	1.3615	0.0885	0.0072	29.066	2.3891	0.0889	0.0073	12.9126	1.0614	0.039	0.0032
multimed_30s	128	0.7519	0.1503	0.0938	0.0187	14.9435	2.8654	0.0787	0.0151	24.2615	4.4414	0.0742	0.0136	194.0924	35.5309	0.594	0.1087
multimed_30s	321	0.5081	0.0503	0.0634	0.0063	14.543	1.2063	0.0766	0.0064	25.0519	1.9809	0.0766	0.0061	79.9164	6.3191	0.244	0.0193
multimed_30s_3s	78	0.2656	0.0309	0.0331	0.0039	9.9632	1.3792	0.0525	0.0073	19.72	2.2792	0.0603	0.007	258.8882	29.9223	0.792	0.0915
multimed_10s	98	0.4256	0.1565	0.0531	0.0195	8.352	2.8314	0.044	0.0149	14.0113	2.2005	0.0429	0.0067	146.4033	22.9926	0.448	0.0703
multimed_30s	261	0.1998	0.0107	0.0249	0.0013	5.9727	0.3266	0.0315	0.0017	9.1906	0.5609	0.0281	0.0017	36.0581	2.2006	0.11	0.0067
video_30s	208	0.1676	0.0145	0.0209	0.0018	5.4405	0.5571	0.0287	0.0029	9.1395	0.8149	0.028	0.0025	44.9945	4.0117	0.138	0.0123
multimed_30s_10s	3740	0.1231	0.0186	0.0154	0.0023	3.9159	0.6655	0.0206	0.0035	7.1885	1.1273	0.022	0.0034	1.9682	0.3087	0.006	0.0009
video_30s	226	0.1393	0.0107	0.0174	0.0013	3.8104	0.3182	0.0201	0.0017	6.6299	0.5212	0.0203	0.0016	30.0399	2.3615	0.092	0.0072

System Design

Statistic Module

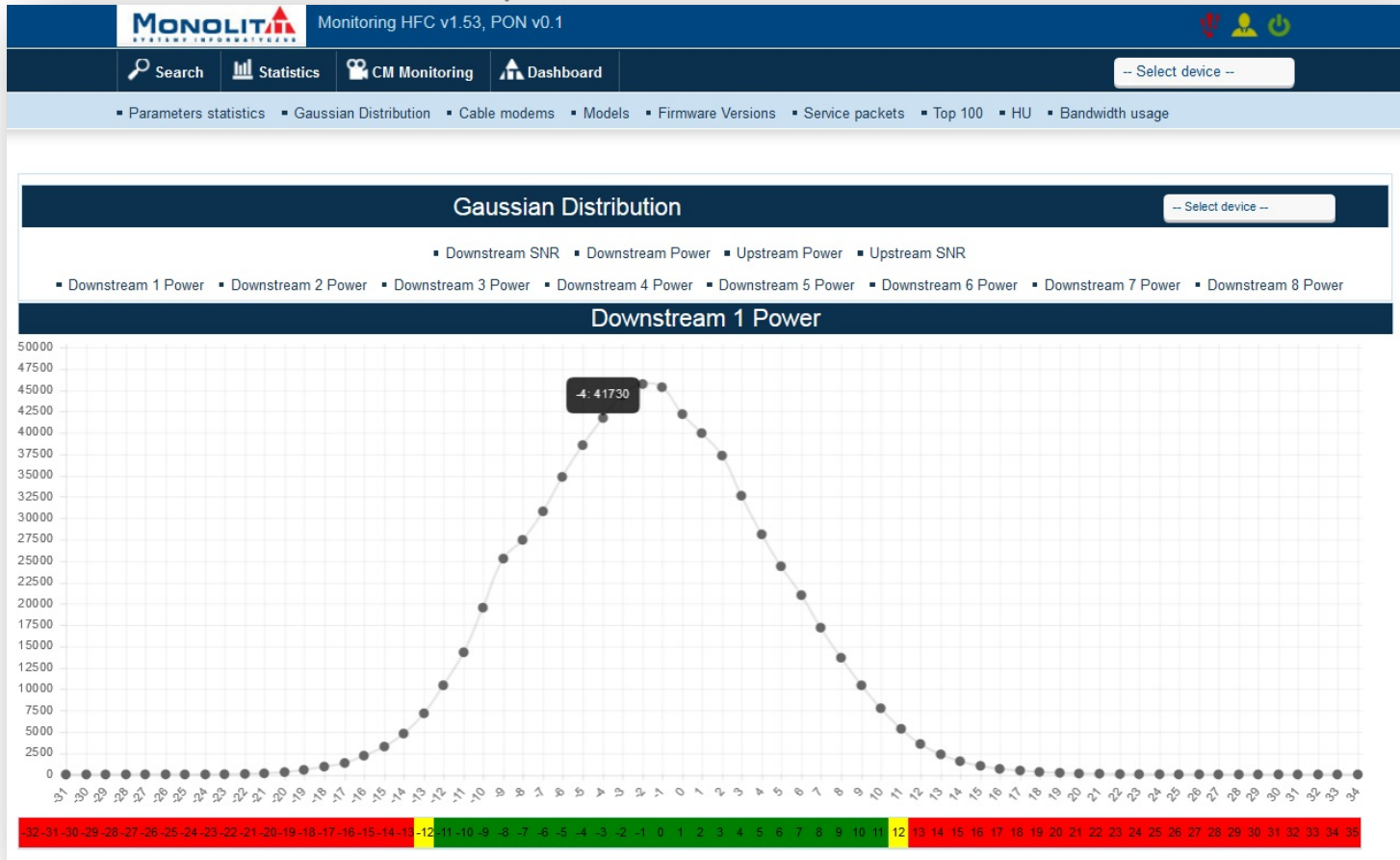
Top 100 statistic, firmware version inventory

Top 100													
											Quota	-- Select device --	>>
HFC	Interface	Model	DS Today (GB)	DS Till today (GB)	US Today (GB)	US Till today (GB)	Average bandwidth current month (Mbit/sec)	Delays SLA	DS Previous month (GB)	US Previous month (GB)	Average bandwidth DS previous month (Mbit/sec)		
1	24767d4e0e40	Modular-Cable8/0/1-downstream15 Wi8/0/1:10 Stargard	EPC3925	82.189	72215.43	0.038	1.666	228.2	0	157644.215	2.766	498.2	
2	3c7a8a82660a	Modular-Cable8/0/0-downstream22 Wi8/0/0:2 Stargard	TG2492S	120.481	70109.405	0.034	3.227	221.6	0	1217.121	2.775	3.8	
3	a4a24a3e03b6	Modular-Cable8/0/1-downstream4 Wi8/0/1:0 Stargard	EPC3212	2.422	54264.704	0.105	6.766	171.5	0	91133.552	14.385	288	
4	c8fb263f034c	Modular-Cable8/0/0-downstream6 Wi8/0/0:0 Stargard	EPC3008	0.141	49344.624	0.008	1.762	156	0	105315.038	4.654	332.8	
5	c8fb265fe7f6	Modular-Cable8/1/2-downstream15 Wi8/1/2:3 Elk	EPC3208	6.256	27210.994	0.113	19.499	86	0	229.934	10.364	0.7	
6	c8fb26f5c944	Modular-Cable8/0/0-downstream23 Wi8/0/0:10 Stargard	EPC3925	6.313	26113.984	0.006	3.988	82.5	0	17763.573	6.166	56.1	
7	c8fb263cd8a2	Modular-Cable8/0/1-downstream7 Wi8/0/1:12 Stargard	EPC3008				CM550B			6.1.127		1203	
8	bc0ab5fe6f41	Modular-Cable8/0/0-downstream20 Wi8/0/0:2 Stargard	CM820S				CM820A			9.1.103S		1	
9	c8fb263dbd38	Modular-Cable8/0/0-downstream11 Wi8/0/0:1 Stargard	EPC3008				CM820B			9.1.103S		719	
							CM820S			9.1.103S		35959	
							CM900S			7.10.71.EURO		9	
							CSM571B			CM.06.00.0X.042107D		1	
							DPM			DPM-4.4.9.0_03.11_NA		10	

System Design

Statistic Module

Gauss parameters distribution



System Design

Statistic Module

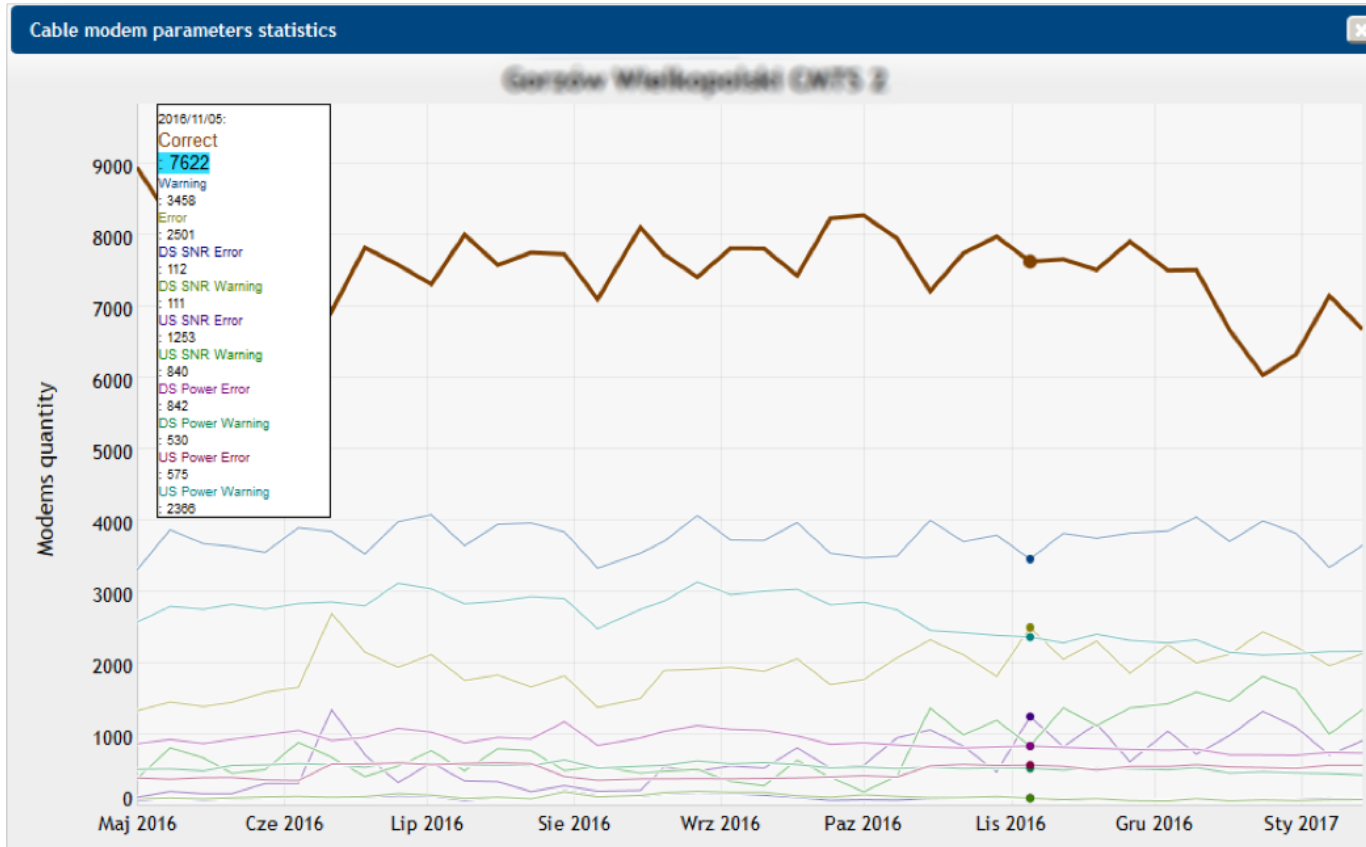
Cable modem parameters

Cable modem parameters statistics (generated : 2017-01-14 20:00)							
Overall HFC Network Quality. Warnings: 21.03% Errors: 5.17%							
DS Power/US Power All parameters	CMTS	Correct parameters		WARNING		ERROR	
		Modems	%	Modems	%	Modems	%
1	Laba CMTS	15	19.23%	24	30.77%	39	50%
2	Czarna Woda	6	37.5%	4	25%	6	37.5%
3	Skarszewy	210	38.75%	188	34.69%	144	26.57%
4	Radzionków	46	42.59%	35	32.41%	27	25%
5	Karłowice	1445	36.08%	1630	40.7%	930	23.22%
6	Bielko Biela	1206	47.74%	812	32.15%	508	20.11%
7	Kwidzyn	3627	41.14%	3672	41.65%	1518	17.22%
8	Gorzów Wielkopolski CMTS 2	6672	53.57%	3650	29.31%	2133	17.13%

System Design

Statistic Module

Cable modem parameters



System Design

Alert Module

Alert Module shows real-time information about:

- SNR Upstream interfaces
- traffic volume on MAC-Domains and upstream/downstream interfaces, together with a saturation forecast
- Interfaces on which number of logged CMs is changing abnormally
- Errors correction on upstream interfaces
- Interfaces with large amount of modems with errors

The performance levels have been selected with „Best practice” knowledge.

System Design

Alert Module

Downstream interfaces, MAC-Domains load

Downstream utilization						
-- All CMTSes --						
Export						
>>						
CMTS	Interface	Throughput rate MAX Mbit/sek	Throughput rate AVG Mbit/sek	Saturation (days)	Saturation 80% (per/24h)	Saturation 100% (per/24h)
Elk	Modular-Cable8/0 /0-downstream12	33.98	19.153	211	6	0
Warszawa	Integrated-Cable6/1 /2-downstream2	44.833				
Olsztyn	Modular-Cable6/1 /1-downstream16	34.187				
Elk	Modular-Cable8/0 /0-downstream6	34.303				
Elk	Modular-Cable8/0 /0-downstream3	34.169				
Elk	Modular-Cable8/0 /0-downstream2	34.982				
Gorzew-2	Modular-Cable5/0 /1-downstream9	44.543				

Upstream utilization						
-- All CMTSes --						
Export						
>>						
CMTS	Interface	Utilization MAX (%)	Utilization AVG (%)	Saturation (days)	Saturation 80% (per/24h)	Saturation 100% (per/24h)
Czeszów	Cable8/1 /0-upstream4	76	42	A downward trend	10	0
Ostroda	Cable6/0 /1-upstream0	71	40	538	10	0
Olsztyn	cable-upstream 4/11.0	73	26	114	8	0
Olsztyn-2	Cable7/0 /0-upstream0	76	37	64	5	0
Malbork	cable-upstream 3/10.0	72	32	108	5	0
Olsztyn-2	Cable7/0 /0-upstream1	74	33	73	5	0

System Design

Universal Search Module

CM search

Cable modem / Customer Search

Customer Number / Phone number / Address / STB MAC

-- Any device -- ?

HFC

?

Search

System Design

Alert Module

- A single collector is able to query 500 to 1000 modems per second collecting complete set data depending on customers' network
- The system can easily gather, process and store 50 million data records per twenty-four-hour (tested on actual customer)
- The system has very good scalability.



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