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Enhanced Television Monitoring System

Technical Proposal: Enhanced Television Monitoring System (ETVMS) for RFoGPON / DTT / IPTV / Mobile TV

This document constitutes a proposal for monitoring the BPT video distribution network including the RFoGPON, DTT, IPTV and mobile TV networks. Some key advantages of this proposal are the following:

- Open architecture based on SkIn DataMiner a true multi-vendor solution, capable of interfacing with any proprietary or standard third-party device or monitoring system, without any compromises. Today over 1750 drivers for equipment from more 300 different leading vendors, have been deployed
- Advanced testing in the digital RF interface including measurement of Carrier Offset, EVM, MER, RF Constellation, Channel Impulse Response, Channel Spectral Response, BER, Post Reed Solomon BER, TEF, drift in input power, graph of impulse response and graph of signal-to-noise trend among others.
- The RF/IP channel polling capability, allows hundreds of channels to be monitored in a repeating cyclical measurement process. Control and setup of the polling is undertaken using flexible XML scripting. This polling ability makes a single probe a broader tool, monitoring large numbers of network points in a time-sampled measurement mode
- Simultaneous monitoring of essential parameters in up to 500 IP flows per probe to ensure IP and TS integrity for all services up to fully loaded GbE link. This analysis includes measurement of continuity metrics, sync byte, packet interarrival time and MDI.
- The industry standard Media Delivery Index (MDI) as defined in IETF RFC 4445 is computed simultaneously in all IP flows. The MDI provides basic understanding of the QoE for the multicast and unicast video channels.

1. MONITORING PROBES AND MANAGEMENT SYSTEM

The monitoring system for the BPT video distribution network is based on the AT-MT-400 and AT-IPM-400 probes.

The AT-MT-400 is a high reliability DVB-T and ASI transport stream monitor and the AT-IPM-400 is a high reliability IP video monitor. Together with the DataMiner (VQNet) Video Service Assurance Management software, the AT-MT-400 and AT-IPM-400 are a complete solution for transmission monitoring of MPEG transport streams delivered over ASI, IP and DVB-T networks. Advanced in depth QoE analysis of video signals is provided by the VQS1000 software, also included in this proposal.

For monitoring packetized IP video streams it is used the AT-IPM-400 probe, while the probe suitable for monitoring of video in the digital RF interface (COFDM) is the AT-MT-400. The AT-MT-400 is also used in all other interfaces where neither a RF interface nor an IP interface is available. In this case it is required connectivity through an standard ASI interface (EN 50083-9).

Monitoring system management is based on DataMiner. DataMiner is the global leading technology for multi-vendor network management in the HFC broadband, satellite, IPTV and broadcast industry. DataMiner has a pronounced open architecture and is based on industry standards. Today, over 1750 products and systems from more than 300 different vendors, including ALBEDO, have been integrated with the DataMiner platform.

Digital RF and ASI Monitoring

The AT-MT-400 will be employed to monitor video over the ASI and digital RF interfaces. The AT-MT-400 will be supplied in two different configurations.

- To monitor video over an Asynchronous Serial Interface (ASI) it is used the TS processing hardware. The signal to be monitored is injected in the ASI input (BNC, 75 Ω)
- To monitor video over the RF interface the signal has to be demodulated before sending it to the TS analysis hardware. The COFDM RF module is used for this purpose. The RF module outputs an ASI signal that is injected in the TS analysis hardware in the same way that is done in any ASI monitoring point. The RF module does not only performs demodulation but it performs advanced RF tests as well.

The AT-MT-400 provides simultaneous connection of multiple remote users and multi-sink SNMP traps for the NMS. These features enable early visibility of problems to key individuals throughout the organization, supporting quicker notification and corrective action.

Other important feature of the AT-MT-400 is the RF channel polling. This capability, combined with the right RF module, allows up to 200 RF channels to be monitored in a repeating cyclical measurement process. Control and setup of the polling is undertaken using flexible XML scripting. This polling ability makes a single AT-MT-400 a broader tool, monitoring large numbers of network points in a time-sampled measurement mode.

The following tables summarize the specifications of the AT-MT-400 related with ETSI TR 101 290 and digital RF metric testing.

Table 1.
ETSI TR 101 290 Tests and Measurements

1st Priority Measurement	• 1.1 Ts_sync_loss • 1.2 Sync_byte_error • 1.3a PAT_error_2 • 1.4 Continuity_count_error • 1.5a PMT_error_2 • 1.6 PID_error
2nd Priority Measurement	• 2.1 Transport Error • 2.2 CRC_error • 2.3a PCR_repetitioin_error • 2.3b PCR_discontinuity_inidcator_error • 2.4 PCR_accuracy_error • 2.5 PTS_error • 2.6 CAT_error
3rd Priority Measurement	• 3.1a NIT_actual_error • 3.1b NIT_other_error • 3.2 SI repetition error • 3.4a Unreferenced PID • 3.5a SDT_actual_error • 3.5b SDT_other_error • 3.6a EIT_actual_error • 3.6b EIT_other_error • 3.6c EIT_PF_error • 3.7 RST_error • 3.8 TDT_error

Table 2.
COFDM Measurement Features

Carrier Offset	• Carrier offset is measured from the tuned channel frequency to a accuracy of measured from th ±10 ppm typical. This includes the ability to set alarms and produce trend graphs over a seven-day period including min, manx, and average.
SNR (Signal to Noise Ratio)	• Display Range: 6 dB to 40 dB for QPSK (4QAM), 11 dB to 40 dB for 16QAM, 16 dB to 40 dB for 64QAM. • Resolution: 1dB. • Accuracy: ±1 dB to 30 dB SNR (measured at -30 dBm in high-resolution mode) typical. • Trend graphs over a serven-day period including min, max, and average.
EVM (Error Vector Magnitude)	• Display Range: 1% to 30% RMS for QPSK, 1% to 20% for 16QAM, 1% to 8.5% for 64QAM. • Resolution: 0.1%. • Trend graphs over a serven-day period including min, max, and average.
MER (MOdulation Error Ratio)	• With Equalizer both MER Peack and Mer Average are displayed as meassured accross all carriers. • Display Range: 6 dB to 37 dB for QPSK (4QAM), 11 dB to 37 dB for 16QAM, 16 dB to 37 dB for 64 QAM. • Resolution: 0.1 dB. • Accuracy: ±1 dB to 30 dB SNR (measured at -30 dBm in high-resolution mode) typical. • Trend graphs over a serven-day period including min, max, and average.
Constellation	• The RF constellation is displayed on the UI.
Channel Impulse Response	• Display of channel impulse response.
BER (Bit Error Ratio)	• Pre FEC, BER and Error Sec BER values are displayed. This includes the ability to set alarms and produce trend graphs over a serven-day period including min, max, and average.
POst Reed Solomon BER	• Post RS BER (Uncorrectable Error Count) displayed. This includes the ability to set alarms and produce trend graphs over a seven-day period including min, max, and average.

IP Monitoring

The AT-IPM-400 is designed for monitoring IP video distribution networks which carry both Multi-Program Transport Streams (MPTS) or Single-Program Transport Streams (SPTS), at either constant bit rate (CBR) or variable bit rate (VBR).

The AT-IPM-400 includes a video processing card and a GbE analysis card with electrical and optical inputs. The preferred input for IP video monitoring over the BPT network is the electrical RJ-45 but optical analysis with the correct SFP will be provided whenever needed (not included in the initial quotation).

One of the essential features of the IPM400P probe is the ability to monitor all essential parameters (continuity count, sync byte, packet interarrival time and MDI) in up to 500 IP flows (sessions) This, enables to ensure IP and TS integrity for all services in a fully loaded GbE link Video/Audio backhaul. Users can also select one single IP flow to perform in depth analysis over it. Analysis capabilities for this flow include capture and forwarding to QoE analysis tools and many others. The optional IP polling feature enables cycling the foreground IP stream to sample statistics from many video flows. Details about AT-IPM-400 features are summarized in the following table.

Table 3.
GbE IP Video Monitoring Features Specifications

Interconnect Port Options	• 10/100/1000Base-T RJ45 electrical port. • 1000Base-SX Short Wavelength Optical port with LC connector for AT-MT-400 Gigabit Ethernet Interface (Multi Mode 850 nm). • 1000Base-LX Long Wavelength Optical port with LC connector for AT-MT-400 Gigabit Ethernet Interface (Single Mode 1310 nm). • 1000Base-ZX Optical port with LC connector for AT-MT-400 Gigabit Ethernet Interface(Single Mode 1550 nm)
Maximum Data Rate	• Line Rate
ASI output	• ASI compliant with specification EN 50083-9 • AIS smoothing can be activated to compensate for bursty IP traffic
Protocol Stack Support	• IPv4 support • IPv6 support • UDP/IP/Ethernet • UDP/IP/VLAN/Ethernet • RTP/UDP/IP/Ethernet • RTP/UDP/IP/VLAN/Ethernet
Multicast and Control Support	• IGMP v2 support • IGMP v3 support • MLD v2 support • ARP • ICMP (Inbound and Outbound ping)
IP Packet Support	• 7 Transport Streamp packets per IP packet (188 byte packets) • FEC (FEC is parsed but is not processed)
Multi Session Monitoring Parameters	Discovery of up to 500 IP sessions, simultaneous monitoring of key parameters including: • MLR and MDI:DF in accordance with RFC 4445 • Continuity Count • Sync Byte • Packet Interarrival Time (PIT) for all sessions • Session Bit Rate • Out-of-Order and Dropped Packet errors (RTP only)

Table 3.
GbE IP Video Monitoring Features Specifications

Statistics	• Static IP header contents • Total bit rate for all Ethernet traffic • Instantaneous TS bit rate for selected IP session • Errored packets rate per minute and absolute count • Dropped packets rate per minute and absolute count • Out-of-Order packets rate per minture and absolute count • TS Continuity Count • Media Delivery Index MDI (RFC 4445)
Graphs	• IP session TS bit rate • Traffic graph for all IP sessions with per session error indication • IP packet interarrival time of the selected IP session Min, Max and Average • IP session lock status trend graph (up to seven days) • IP Dropped Packet Rate trend graph (up to seven days) • IP Out-of-Order Packet Rate trend graph (up to seven days) • IP Corrupted Packet Rate trend graph (up to seven days) • Packet Interarrival Time histogram view, Average and Peak trend graph (up to seven days) • MDI trend displays, delay factor and media loss rate for selected session
Alarms	User-definable threshold for alarms on all sessions including: • Errored packets rate • Dropped packets rate • Packet interarrival time maximum • Out-of-Order packet rate Event alarms on all sessions including • TS Continuity Count Errors • TS Sync Byte • TS Sync Loss • Dropped Session
Control	• Line select (optical, electrical rate) • Filters for MAC, IP, Port • Protocol control for ARP, RTP, IGMP and VLAN • IGMP (single or multiple subscription)

Analogue Signal Monitoring

Verification of Analogue signals will be performed by the Agoldenage TV. This monitoring probe constitutes a powerful and professional yet affordable solution for analog TV monitoring in PAL, SECAM, NICAM, A2 Stereo or NTSC standards. Deployed either at the transmitter site or in the coverage area, the unit sequentially monitors a set list of stations and continuously ensures that your TV network complies with both legislation and your expectations. With its Ethernet interface, the Agoldenage TV can be controlled remotely using the user-friendly software supplied or an SNMP-based network software.

The Goldeneagle TV offers several highly innovative features such as multi-channel monitoring (up to 40 programs), audio/video streaming and recording, video test line analysis, automatic scanning and remote control GPIOs (General Purpose Inputs/Outputs).

Detailed QoE Analysis

Advanced QoE analysis of probe captures will be performed with the VQS1000 software. VQS1000 is a Video Quality application for single ended (no reference) QoE analysis of video and audio content.

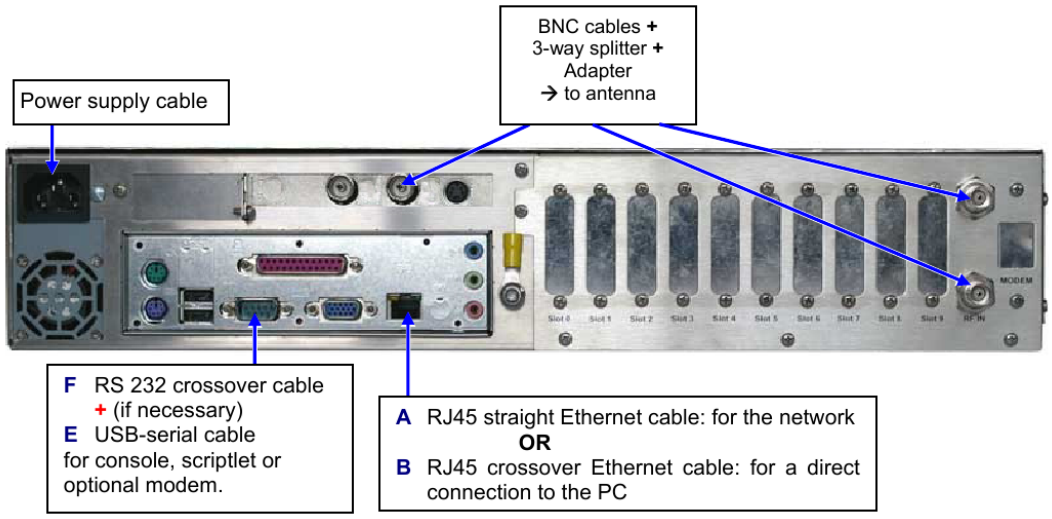

Figure 1. *Agoldeneagle TV back connectors.*

Table 4.
Agoldeneagle TV Features

• • RF monitoring of up to 40 channels
• • Compatible with PAL, SECAM, NICAM, A2 Stereo and NTSC standards
• • Automatic band scanning
• • Video test line analysis
• • Real time measurements, analysis, content display and recording
• • Audio/video streaming and recording
• • Remote application
• • Optional extended transmitter remote control capabilities: 10 slots available for I/O boards (max. 1 metering board)
• • ScriptEasy V2 and MasterView for I/O configuration and status
• visualization
• Using TCP/IP, GOLDENEAGLE is compatible with any SNMP based manager

The application is made for available for installation on a dedicated server and can be used with all DTV monitoring probe configurations, including AT-IPM-400 and AT-MT-400, using robust private backhauled video from the monitoring probes.

Two instances can be run per license to enable service comparison at different network locations and triggered capture of the stream with pre-trigger buffer enables archive of impairments or offline video quality analysis to be performed.

Results from tests performed by the application are reflected in the monitoring probe's remote user interface and in the probes event log. Results are also available to management systems through the probes SNMP MIB. Automated round robin polling can be used to sequentially check services within an MPTS and can be used in conjunction with the probes polling capability to sequentially test multiple different Transport Streams carried on up to 500 IP flows (AT-IPM-400) or up to 200 RF channel presets (AT-MT-400).

The application can be also be used stand alone for offline file analysis with support for MPTS, SPTS and ES files.

Item	*Qty*	*Description*
VQS1000	-	Video Quality Software application for single-ended (no reference) QoE analysis of video and audio content

Server-VQS	-	Rack mountable server for installation of VQS1000 software.

System Management

System management is based in the DataMiner software. DataMiner is the open Video Service Assurance Management System that supports all the monitoring system probes to alert, locate and diagnose video network problems through alarms, logs, trending and reporting of key performance metrics.

It is a software product which will run on a central computer to monitor and report on the status of signals measured by distributed probes across a video distribution network. Up to 500 probes can be supported and placed at any location in the video distribution system. Services impacted can be identified and engineers can drill down for rapid root-cause analysis of video service delivery issues.

The user can manually direct any probe from DataMiner to analyse an IP video flow/session or tune to an RF frequency preset. Thumbnails can be displayed for multiple services from multiple probe locations and selected video services can be backhauled from the remote probes for visual verification by an operator.

Users can easily install, configure and maintain their own monitoring system with Automatic discovery of probe availability, configuration and diagnostic capabilities. Graphical views are created and configured using industry-standard Microsoft Visio® toolset with editing features built into DataMiner user interface.

To enable remote connection of the monitoring system and the probes it is required TCP/IP connection between central server and every probe that makes up the system. This connection will be made through standard electrical Ethernet ports. A1000BASE-T port will be provided by the customer in the central location and 10/100BASE-T will be provided for each probe to be installed.

Hardware for installation of DataMiner will be supplied with the software. All the licenses for connecting the probes to the system are also supplied.

Item	*Qty*	*Description*
VQNET	1	VQNET: Video Service Assurance Management Software for installation on customer's own PC. Includes 5 Monitoring Probe Licenses
MPL	-	Additional Monitoring Probe License to enable monitoring probe to be used with VQNet system. 1 license per probe is required
TF00234LIC	20 - 85	License for analogue RF probe. 1 license per probe is required.
Server-VQN	1	Server for installation of VQNET / DataMiner software. Rack mountable, RAID, double power supply.

2. MONITORING SYSTEM ARCHITECTURE

The system is made up probes (AT-IPM-400, AT-MT-400, Goldeneagle TV) a centralized management system (DataMiner) and a centralized QoE analysis system (VQS1000). BPT requires a monitoring system for four different video service families with dedicated network infrastructure. These video service classes are the following:

- Analogue video (PAL) over dedicated wavelength in GPON network (video overlay). Distribution network is IP/MPLS and the video signal is converted into analogue in the remote HE.
- DTT based on a SDH distribution network. The signal is converted into DVB-T interface (COFDM modulation) and delivered to the end users through transmitting antennae.
- IPTV service with IP/MPLS distribution network. Unlike the video overlay network over GPON, IPTV services reach the end user in (either multicast or unicast) IP and are processed by an special STB before being displayed.
- Mobile video services supplied over a UMTS and GSM cellular networks. The monitoring points are standard Ethernet/IP (distribution network is IP/MPLS) ports but the video signal encapsulation is 3GP rather than MPEG-2 TS.

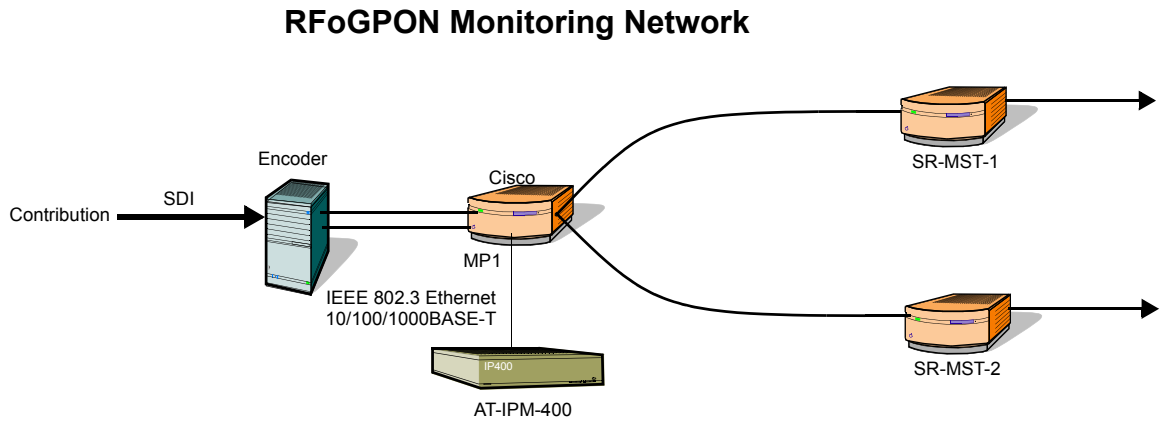

Figure 2. *Monitoring the contribution contents for the RFoGPON network at Monsanto central location.*

The proposal for monitoring the video service for the RFoGPON network in Monsanto is based on a single AT-IPM-400. Connection to the BPT network requires a 10/100/1000BASE-T interface containing the signal to be monitored. This interface could be mirrored from the in service port or link aggregation group (LAG).

Item	*Qty*	*Description*
AT-IPM-400	1	IP Video Monitoring Probe for QoS of up to 500 MPTS or SPTS IP Video Flows Includes: 1RU chassis fifted with GbE interface and Transport Stream processor cards, manual, rack slides, power cord and license key certificate
DIAG	1	Option for AT-IPM-400: • Triggered recording capability up to 160 MB • Template testing (for user-defined service plan testing) • In-depth PCR analysis with graphical result views • Bit rate testing functionality • Service logging • IP/RF Polling functionality

The signal from the Monsanto facilities is distributed to the remote HEs through an IP/MPLS network. This document considers that the number of remote HEs is between 10 and 25. There are two Ethernet / IP and one RF analogue monitoring point per location.

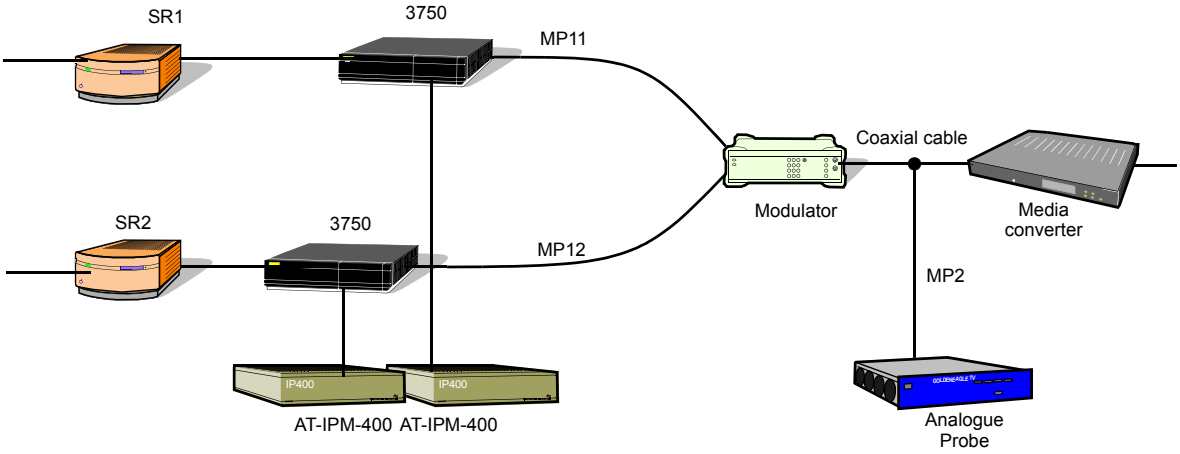

Figure 3. *Monitoring the RFoGPON network at the remote HE.*

Testing in the IP monitoring points is similar than in Monsanto and requirements are equivalent. Connection to the BPT network requires a 10/100/1000BASE-T interface containing the signal to be monitored. This interface could be mirrored from the in service port or link aggregation group (LAG).

The signal is converted to analogue format in the remote HE and injected in an optical fibre. It is required to monitor de signal after being converted into analogue and before being transmitter to the optical fibre. This is accomplished with the Agoldenage TV probes. Signal is directed to the probe with the help of a coaxial T connector (not included).

Item	*Qty*	*Description*
IP400A	20 - 50	IP Video Monitoring Probe for QoS of up to 500 MPTS or SPTS IP Video Flows Includes: 1RU chassis fifted with GbE interface and Transport Stream processor cards, manual, rack slides, power cord and license key certificate
TF00234	10 - 25	Goldeneagle TV PAL/SECAM

The video signal is received in the local exchanges in an optical fibre over a dedicated wavelength (1550 nm). This probe is combined with services carried in other wavelengths and delivered to the subscriber.

This document considers that the number of RFoGPON exchanges to be monitored is a number between 10 and 60.

Item	*Qty*	*Description*
ONT	10 - 60	ONT (model to be determined)
TF	10 - 60	Goldeneagle TV PAL/SECAM

The use of Agoldenage TV probes requires development of a driver for DataMiner. This driver will be supplied to the customer in agreement of terms to be determined.

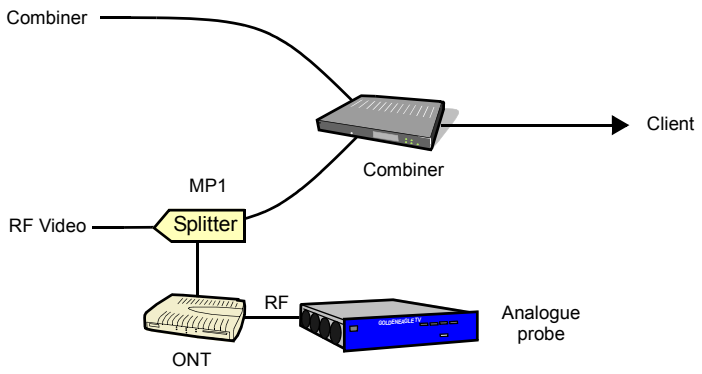

Figure 4. *Monitoring the RFoGPON network at the central.*

DTT Architecture

For DTT, BPT network is fed in the Monsanto site. Here, signal is either transmitted to end users (DVB-T) or distributed to RF transmitters over the country through an SDH network. In Monsanto there are three or four monitoring points. All them are based on the AT-MT-400 probe operating over a DVB ASI interface.

Item	*Qty*	*Description*
AT-MT-400	3 - 4	Digital DTV Monitor. Includes 1RUchassis fitted with Transport Stream processor card, manual, rack slides, power cord, and license key certificate.
DIAG	3 - 4	Option for AT-MT-400: • Triggered recording capability up to 160 MB • Template testing (for user-defined service plan testing) • In-depth PCR analysis with graphical result views • Bit rate testing functionality • Service logging • IP/RF Polling functionality

DTV Probes in Monsanto will be connected in endpoint or through mode using standard 75 Ω coaxial cables. Connector will the BNC. Cables are not included in the quotation.

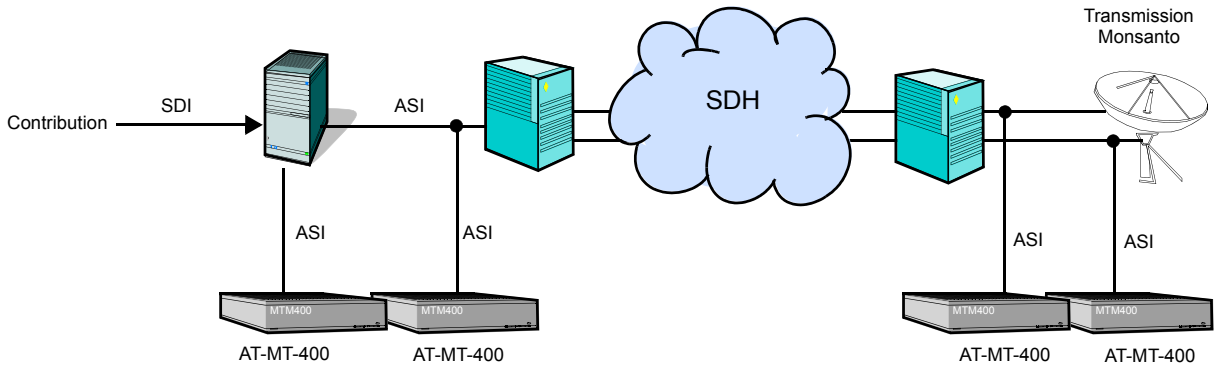

Figure 5. *Proposal for monitoring the DTT network at Monsanto central location.*

DTT signal is distributed to the transmission nodes through 12 SDH redundancy nodes. Monitoring architecture for the redundancy nodes is similar to the Monsanto DTT monitoring architecture. Video signals over SDH will be converted to DVB ASI to enable monitoring. There are two monitoring points per node. Probes are all AT-MT-400.

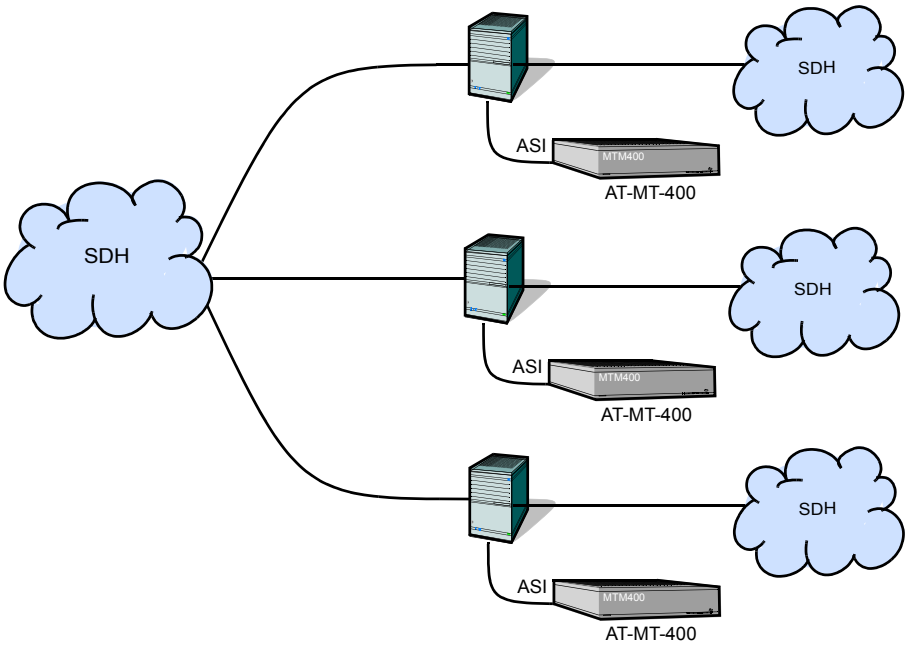

Figure 6. *Proposal for monitoring the DTT network SDH redundancy nodes*

Connection of the ASI signal is done at the ASI/SMTPE Transport Stream input provided by the AT-MT-400. The ASI output is available if the ASI signal is to be reused. Standard 75 Ω coaxial cables will be used. Connector will the BNC. Cables are not included in the quotation.

Item	*Qty*	*Description*
AT-MT-400	24	Digital DTV Monitor. Includes 1RU chassis fitted with Transport Stream processor card, manual, rack slides, power cord, and license key certificate.

The DTT signal is finally delivered to the RF transmission nodes where it is converted to a DVB-T format with COFDM modulation The signal is transmitted through the radio interface. Users receive the COFDM signal with the help of an antenna. It is required to monitor the video signal at the DVB-T transmitter and receiver.

The transmitter has two monitoring points. One of them (ASI) checks the signal before being modulated, the second one monitors the RF signal once it has been modulated. Both monitoring points require AT-MT-400 probes. For the receiver there is a single RF digital monitoring point. Scenarios for up to 150 DVB-T transmitters and 60 DVB-T receivers are considered in this document. This constitutes at most, 210 COFDM monitoring points and 150 ASI monitoring points for the DTT transmission & reception network.

Connection of the ASI signal is done at the ASI/SMTPE Transport Stream input provided by the AT-MT-400. The AT-MT-400 ASI output is available if the ASI signal is to be reused. Standard 75 Ω coaxial cables will be used. Connector will the BNC. Cables are not included in the quotation

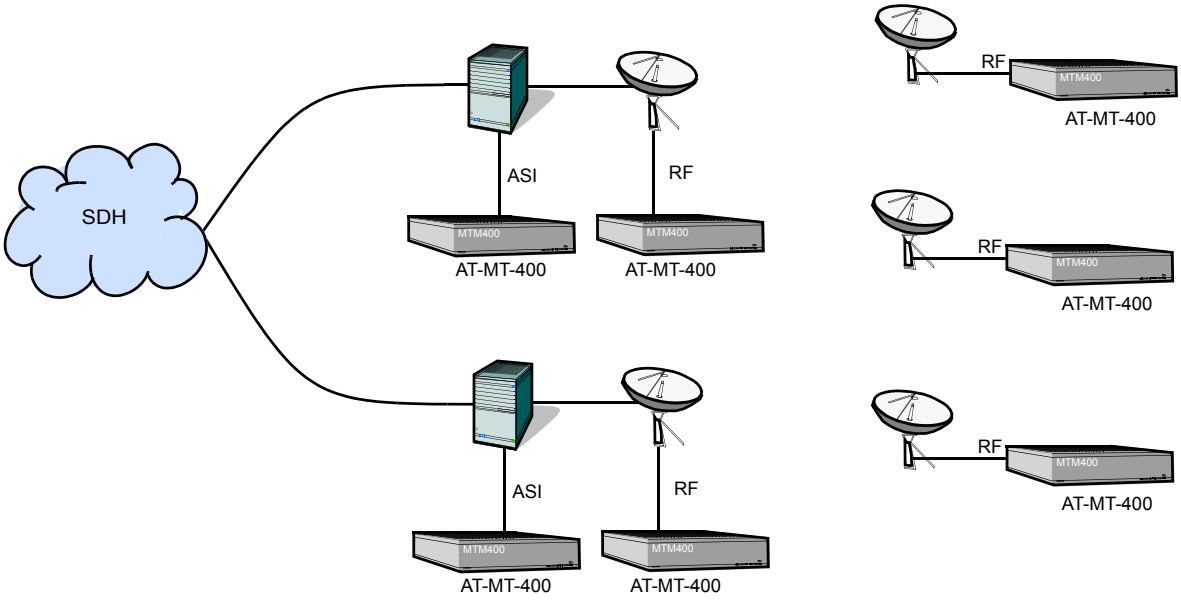

Figure 7. *Proposal for monitoring the DTT radio transmission and reception nodes.*

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Item	*Qty*	*Description*
AT-MT-400	60 - 360	Digital DTV Monitor. Includes 1RUchassis fitted with Transport Stream processor card, manual, rack slides, power cord, and license key certificate.
CF	35 - 210	COFDM Interface

IPTV Architecture

Contents for the IPTV service fed the BBPT network at the Monsanto facilities and it is distributed through an IP/MPLS network to local exchanges. CPEs get access to the video services through the BBPT access network. Multicast and unicast IP video is multiplexed with standard IP services. Video is decoded with the help of a dedicated STB installed in the customer premises.

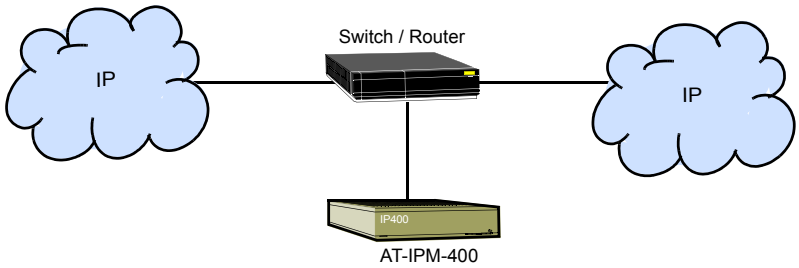

Figure 8. *Generic IPTV monitoring point*

It is understood that monitoring of the BBPT IPTV service will be carried out from Ethernet / IP interfaces. In fact, requirements for the monitoring points are the same that for most of the IP monitoring points already described in this document.

Connection to the BBPT network requires a 10/100/1000BASE-T interface containing the signal to be monitored. This interface could be mirrored from the in service port or link aggregation group (LAG). Under demand, it will be supplied a tap to connect the monitoring probe without the need to configure port mirroring. The electrical 10/100/1000BASE-T physical interface can be replaced by optical 1000BASE-SX, 1000BASE-LX or 1000BASE-ZX if requested by the customer. Neither the tap nor the optical SFPs are included in the initial quotation.

Item	*Qty*	*Description*
AT-IPM-400	31-48	IP Video Monitoring Probe for QoS of up to 500 MPTS or SPTS IP Video Flows Includes: 1RU chassis fifted with GbE interface and Transport Stream processor cards, manual, rack slides, power cord and license key certificate

Mobile TV Architecture

Monitoring video services for the BBPT mobile network is carried out form standard IP/Ethernet ports. Probes will be fed by signals got from the network in the same way that for the IPTV network.

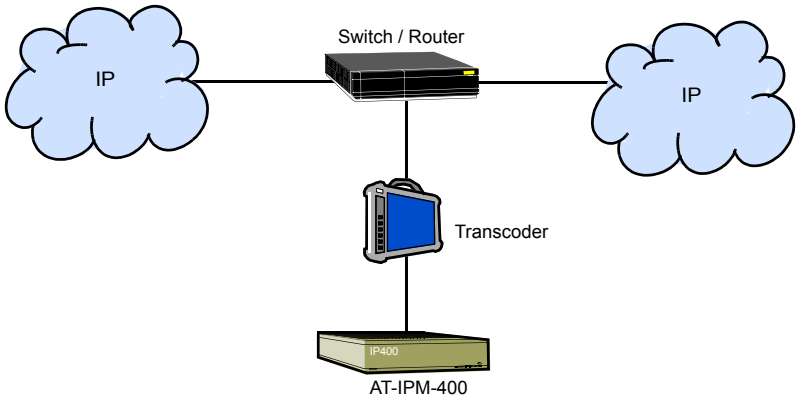

Figure 9. *Mobile TV monitoring point for 3GP encapsulated video signals*

There is however an important difference between the monitoring application for the cellular network and the fixed IPTV service. For IPTV video is encapsulated in MPEG2 TS but mobile video contents has a 3GP encapsulation. Using an AT-IPM-400 for monitoring the mobile video requires transcoding de signal into a format it can receive.

This proposal requires the development of a transcoding device to enable monitoring from the AT-IPM-400. Development will be carried out in terms agreed with the customer.

Item	*Qty*	*Description*
AT-IPM-400	?	IP Video Monitoring Probe for QoS of up to 500 MPTS or SPTS IP Video Flows Includes: 1RU chassis fifted with GbE interface and Transport Stream processor cards, manual, rack slides, power cord and license key certificate
Transcoder	?	To be developed

3. COMPLIANCE MATRIX

Table 5.
Security and user account administration

ID	Desciption	Compliance	Comments
3.2.1.1	Each user can only access the system after introducing his username and password.	YES	
3.2.1.2	The password should be considered secret and must not be available in the system in any form, i.e. a hashing algorithm must be used to protect the password.	YES	
3.2.1.3	Each user must be assigned to one or more classes of privileges or security clearances.	YES	
3.2.1.4	Each class of privileges must be used to protect the password.	YES	
3.2.1.5	Users without any access privileges to a resource, must not be allowed to access that resource.	YES	
3.2.1.6	Any access to a resource must be logged in a non volatile storage format.	YES	
3.2.1.7	There must be a single central repository on which all users and privileges are stored. This repository may have a backup, capable of maintaining the availability of the access control.	YES	
3.2.1.8	Any authentication scheme usedmust not transmit any password on an unencrypted channel.	YES	
3.2.1.9	The number of users or classes stored in the system must only be limited by the hardware, and not any artificial limitation.	YES	
3.2.1.10	Apply all the security measures and good practices to protect the running functionalities of the overall system and the data currently active and logged in the system.	YES	
3.2.1.11	Support administration functionalities.	YES	
3.2.1.12	User logging capabilities to provide user action traceability.	YES	

Table 6.
User interface

ID	Desciption	Compliance	Comments
3.2.2.1	The platform must have a graphical user interface (GUI) for both operation and maintenance tasks.	YES	
3.2.2.2	The plattform may have a non GUI to access. In this case, its specifications must be fully disclosed.	YES	Batch mode or API in DataMiner
3.2.2.3	All operations essential to the operation and maintenance of the platform must be done through its GUI.	YES	
3.2.2.4	The GUI may be one of the following types, by order of preference: (a) pure HTML interface, (b) HTML plus Java applet, (c) pure Java Application, (d) Remote X application	YES	HTML + .NET Components
3.2.2.5	The GUI must be able to process complex operations by means of a higher level scripting language	YES	
3.2.2.6	The GUI must also be compliant to the alarm functionalities	YES	
3.2.2.7	The processing time of the algorithms of the GUI mest be reasonably adequate	YES	

Table 7.
Alarm management and forwarding

ID	*Desciption*	*Compliance*	*Comments*
3.2.3.1	If applied an inherent priority determined by the impact of the alarm. The priority of the alarms shall also be distinguished by colour	YES	
3.2.3.2	It shall be possible to manually alter the priority of an alarm, or an alarm of a specific device or class of devices, if duly authorized	YES	
3.2.3.3	An alarm must have at least three status: active, acknowledged and inactive, which exact names can be altered but it's meaning maintained as following: (a) "Active": the situation which caused the alarm is still happening (b) "Acknowledged: can be applied to an active or inactive alarm, this status can only be set by duly authorized persons (c) "Inactive": the situation which caused the alarm is no longer happening	YES	
3.2.3.4	There must be an exhaustive list of active alarms, acknowledged and inactive alarms	YES	
3.2.3.5	An alarm is always associated with one channel name where the situation occurred, initial date, acknowledgment date (if applice) and the end date (if applied)	YES	
3.2.3.6	All the alarms must be duly stored in a non volatile repository;	YES	
3.2.3.7	It must be possible to disable and enable an alarm monitoring of a particular channel	YES	
3.2.3.8	It must be possible to define that an alarm is only triggered if it remains persistent for a predetermined interval	YES	with VQS1000 software
3.2.3.9	It must be possible to define that an alarm is triggered only if that alarm occur a given number of times in a given time interval	YES	with VQS1000 software
3.2.3.10	General schedule tasks must be available	YES	
3.2.3.11	Dully autorized personnel shall have the ability to see all alarms remotely	YES	
3.2.3.12	Remote clients shall receive alarms notifications without polling	YES	
3.2.3.13	It must be possible to define the visualized alarm parameters	YES	

Table 8.
Alarm forwarding for 3rd party systems

ID	*Desciption*	*Compliance*	*Comments*
3.2.3.1b	The monitoring systemmust be able to forward all the alarm notifications through SNMP.	YES	
3.2.3.2b	It must be possible to configure more than one destination of the SNMP alarm notifications.	YES	
3.2.3.3b	The monitoring system must be able to select which alarms are forward to 3rd party systems.	YES	
3.2.3.4b	Send pre-configurable e-mails under predetermined conditions the recipient must be configurable and associated with a group of equipment and must be able to restrict the amount of emails sent during a configurable time interval.	YES	
3.2.3.5b	It must be possible to send SMS under predetermined conditions by the following means: (a) e-mail (b) USB connected GSM module.	PARTIAL	E-mail is supported SMS is supported by means a mobile gateway but not a USB GSM module
3.2.3.6b	Integration with PT's Performance Management Systems must be achieved using the interfaces above described.	YES	SNMP
3.2.3.7b	Integration with PT's Inventory Management Systems must be achieved using the interfaces above described.	YES	SNMP
3.2.3.8b	Integration with PT's Alarm Management Systems must be achieved using the interfaces above described.	YES	SNMP

Table 9.
Logging

ID	*Desciption*	*Compliance*	*Comments*
3.2.4.1	Log any significat change on the systems it monitors, as well as nay changes on the platfform itself, including, operator login, creation of new alarms, status changes of alarms.	YES	
3.2.4.2	Each item logged must also include its date and time stamps.	YES	
3.2.4.3	The log must be stored on a non volatile storage medium, and its format (or schema) must be made available to PT, so that its data is available for data mining to any other platform.	YES	
3.2.4.4	Cooperate with the Report Engine to make reports from the existing data, and any other stored in the past.	YES	
3.2.4.5	Export/import the Logging database.	YES	

Table 10.
Report Engine

ID	*Desciption*	*Compliance*	*Comments*
3.2.5.1	Access all information in monitoring systems.	YES	
3.2.5.2	Customizable reports, for example by Digital Television technology.	YES	
3.2.5.3	Fault, performance trend reports.	YES	
3.2.5.4	Operator activity reports.	YES	
3.2.5.5	SLA management reports.	YES	
3.2.5.6	Instant reports by template.	YES	
3.2.5.7	Browser based remote access.	YES	
3.2.5.8	Export reports in to the most common applications such as Excel.	YES	
3.2.5.9	One-click report export.	YES	

Table 11.
Configuration, backup capabilities

ID	*Desciption*	*Compliance*	*Comments*
3.2.6.1	All configuration settings, access logs, alarm logs, and any other relevant information shall be placed on a single location.	YES	
3.2.6.2	This location must be configurable so that it may be either on the system itself, or in a separate hardware at PT.	YES	
3.2.6.3	In case the location is outside the monitoring system, the transmission protocol must comply with the requirements regarding security	YES	
3.2.6.4	The backup must also be performed automatically, through a preconfig-ured schedule	YES	

Table 12.
Expandability and scalability

ID	*Desciption*	*Compliance*	*Comments*
3.2.7	The monitoring system architecture shall be designed considering future expandability and scalability. Every aspect of the system must be scal-able to an increasing number of every monitored service	YES	

Table 13.
Dynamic channel line-up

ID	*Desciption*	*Compliance*	*Comments*
3.2.8	Capabity for BPT personnel to easily and quickly change channel line-up without requiring software modifications. This cation includes modifying , deleting and adding channels without any impact on the monitoring system including monitoring backout time.	YES	

Table 14.
Applicable standards, recommendations, regulations and monitoring

ID	*Desciption*	*Compliance*	*Comments*
3.2.9.a	MPEG TS: ETSI TR 101 290 (Measurements and alarms - Annex B), PSI /DVB SI decode (PAT, PMT, NIT, EIT, TDT, TOT, SDT)	YES	
3.2.9.b	RF Analog (RF Level, C/N, CTB and CTO)	Partial	Monitored Parameters are: - RF Parameters: Video RF level, Video/Sound ratio, Stereo Video/sound ratio (dual tone), NICAM RF level, NICAM AF level - Video Parameters: Video synchro, test lines, White level - Sound Parameters: Audio deviation, Audio noise, Analog audio phase opposition
3.2.9.c	RF Digital (DTT) (BER, Signal variations, MER, SFN, Impulse response, MIP, C/N)	YES	Other parameters: Carrier Offset, EVM, MER, RF Constellation, Channel Impulse Response, Channel Spectral Response, BER, Post Reed Solomon BER, TEF, drift in input power, graph of impulse response, graph of signal-to-noise trend
3.2.9.d	SNMP as defined by the following documents: RFC 3410 and dependencies, RFC 3430 and dependencies.	YES	
3.2.9.e	TCP/IP as defined by the following document: RFC 2581.	YES	
3.2.9.f	UDP/IP as defined by the following document: RFC 768.	YES	
3.2.9.3	It should be possible to obtain a graphical view of the monitored values as well as its evolution with time. It must be possible to have reports in an xml format. It also should be possible to have reports on typical formats.	YES	

Table 15.
IPTV specific requirements

ID	*Desciption*	*Compliance*	*Comments*
3.2.10.1	The monitoring solution must be able to monitor SD IPTV Main channels	YES	
3.2.10.2	The monitoring solution must be able to monitor HD IPTV Main channels	YES	
3.2.10.3	The monitoring solution must be able to monitor IPTV PIPs	YES	
3.2.10.4	The monitoring solution must be able to monitor IP Multicast streams	YES	

Table 15.
IPTV specific requirements

3.2.10.5	The monitoring solution must be able to monitor unencrypted MPEG2 Transport streams encapsulated in UDP packets with h264 video and MPEG Layer 2 audio.	YES	
3.2.10.6	The monitoring solution must be able to monitor unencrypted MPEG2 Transport streams encapsulated in UDP packets with h264 video and Dolby AC3 audio.	YES	
3.2.10.7	It must be possible to view the thumbnails of the different channels not encyrpted: (a) Please indicate the maximum number of thumbnails that can be viewed at the same time (b) The thumbnails should be adjustable by picture format, frame rate and bit rate (c) Each thumbnail shall be identificable by the channel name (d) simultaneous alarm and status for each monitored thumbnail should be presented (e) The system shall be able to switch between feeds in a round robin algorithm basis, changing the thumbnails layout.	YES	AT-IPM-400 Supports thumbnails for the IP session selected. There is no limit on umbeer of thumbnails on a MPTS. Round-robin switch between feeds is supported
3.2.10.8	The monitoring solution must be able to monitor encrypted MPEG2 Transport streams encapsulated in UDP and RTP packets with h264 video and MPEG Layer 2 audio.	YES	IP layer, transport layer and PES layer are monitored in encrypted streams
3.2.10.9	The monitoring solution must be able to monitor encrypted MPEG2 transport streams encapsulated in UDP and RTP packets with h264 video and Dolby AC3 audio	YES	IP layer, transport layer and PES layer are monitored in encrypted streams
3.2.10.10	It must be possible to compare and correlate the different parameters analyzed for the same channels for the the different probes, comparing with the reference probe	YES	With VQNet (included)
3.2.10.11	It must be possible to obtain a graphical view of the monitored values as well as its evolution with time. It must be possible to have reports in an xml format. It also should be possible to have reports on typical formats	YES	Reports in HTML
3.2.10.12	It should be possible to execute network captures on a specific probe, download it and have a mean to execute a deep analysis	YES	Optional, included for all probes Optional (included) VQS1000 can do deep video analysis. Optional (not included) TSCA software can do deep TS analysis. Optional (not included) MTS4EA/CC can do deep ES analysis.

Table 16.
Mobile TV specific requirements

ID	*Desciption*	*Compliance*	*Comments*
3.2.11.1	The monitoring solution must be able to monitor Playlist channels (before encoding to 3gp formats)	YES	Channels are supposed to be encapsulated in MPEG2 TS.
3.2.11.2	The monitoring solution must be able to monitor Playlist channels in 3GP formats	-	Upgrade based in transcoder for the future
3.2.11.3	The monitoring solution must be able to monitor Live channels in 3GP formats	-	Upgrade based in transcoder for the future
3.2.11.4	The monitoring solution must be able to monitor IP Unicast streams	YES	
3.2.11.5	The monitoring solution must be able to monitor IP Multicast streams	YES	
3.2.11.6	The monitoring solution must be able to monitor unencrypted MPEG2 Transport streams encapsulated in UDP packets with MPEG2 video and MPEG Layer 2 audio	YES	

Table 16.
Mobile TV specific requirements

3.2.11.7	The monitoring solution must be able to monitor unencrypted (unicast and multicast) 3GP streams encapsulated in RTP packets with h263 video and AMR audio;	-	Upgrade based in transcoder for the future
3.2.11.8	The monitoring solution MUST be able to monitor unencrypted (unicast and multicast) 3GP streams encapsulated in RTP packets with h264 video and AVC audio;	-	Upgrade based in transcoder for the future
3.2.11.9	It must be possible to view thumbnail of the different playlist channels (in MPEG2 Multicast) before encoding to 3GP: (a) Please indicate the maximum number of thumbnails that can be viewed at the same time (b) The thumbnails should be adjustable by picture format, frame rate and bit rate (c) Each thumbnail shall be identificable by the channel name (d) simultaneous alarm and status for each monitored thumbnail should be presented (e) The system shall be able to switch between feeds in a round robin algorithm basis, changing the thumbnails layout.	YES	
3.2.11.10	It must be possible to view thumbnail of the different playlist and live channels in 3gp format (h623/AMR or h264/AVC): (a) Please indicate the maximum number of thumbnails that can be viewed at the same time (b) The thumbnails should be adjustable by picture format, frame rate and bit rate (c) Each thumbnail shall be identificable by the channel name (d) simultaneous alarm and status for each monitored thumbnail should be presented (e) The system shall be able to switch between feeds in a round robin algorithm basis, changing the thumbnails layout.	-	Upgrade based in transcoder for the future
3.2.11.11	It must be possible to obtain a graphical view of the monitor values as well as its evolution with time. It must be possible to have reports in an xml format. It also should be possible to have reports on typical formats (.xls or .htm);	YES	
3.2.11.12	It should be possible to execute network captures on a specific probe, download it and have a mean to execute a deep analysis.	YES	

Table 17.
DTT Specific Requirements (Optional)

ID	*Desciption*	*Compliance*	*Comments*
3.2.12.1	The system MAY allow a remote operator to easily assess the current state of the equipment in the ransmission system and the signal routing through that system (i.e. to enable the remote operator to identify which equipment is currenty carrying “live” transmission). The preference is for the system status information to be presented as a dedicated display on a single “interactive” web page which is laid out to follow the transmission system’s architecture in a form that allows a remote operator to easily assess the current state of the equipment. Depending on the format adopted to display the system status information it may be appropriate to group alarm related to specific equipment together under summary alarms. If this is the case then provisions may be made to allow a remote operator to “drill down” to determinate which alarms are currently active. Where alarms are grouped under summary alarms it may be possible for the user to configure which alarm contribute to a particular summary alarm. In the designing the remote dispaly due consideration may be given to accomodating possible future cahnges in the transmission system.	YES	

Table 17.
DTT Specific Requirements (Optional)

3.2.12.2	Great emphasis must be placed upon reliability and serviceability in the design of the monitoring system. The system shall be maintainable without the need for a shutdown of the broadcast multiplex transmission. The system shall be designed to avoid lockouts due to repeated momentary mains supply fluctuations, and to momentary or prolonged interfuption of the supply. The system shall be designed to operate continuously whilst being unattended, and without manual intervention, for extended period of time.	YES	
3.2.12.3	The contractor shall be responsible for providing all software necessary to enable the monitoring system to meet the requirements of the agreed functional design specification. The system shall as fas as possible use standard commercial software applications which have been designed to be used with the hardware selected by the contractor. The design of the software shall permit a high degreee of user customization, as a minimum it shall be possible for the user to customize: (a) summary alarms for the local and remote operator monitoring interfaces; (b) alarm priority for system chain selection.	YES	

Table 18.
ETSI TR 101 290 Compliance

ID	*Indicator*	*Precondition*	*Compliance*	*Comments*
9.1.1	TS_sync_loss	Loss of synchronization of hysteresis parameters	YES	
9.1.2	Sync_byte_error	Sync_byte not equal 0x47	YES	
9.1.3	PAT_error	PID 0x0000 does not occur at least every 0,5 s a PID 0x0000 does not contain a table_id 0x00 (i. e. a PAT) Scrambling_control_field is not 00 for PID 0x0000	-	
9.1.3.a	PAT_error_2	Sections with table_id 0x00 do not occur at least every 0,5 s on PID 0x0000. Section with table_id other than 0x00 found on PID 0x0000. Scrambling_control_field is not 00 for PID 0x0000	YES	
9.1.4	Continuity_count_error	Incorrect packet order a packet occurs more than twice lost packet	YES	
9.1.5	PMT_error	Sections with table_id 0x02 (i. e. a PMT), do not occur at least every 0,5 s on the PID which is referred to in the PAT Scrambling_control_field is not 00 for all PIDs containing sections with table_id 0x02 (i.e. PMT)	-	
9.1.5.a	PMT_error_2	Sections with table_id 0x02 (i. e. a PMT), do not occur at least every 0,5 s on each program_map_PID which is referred to in the PAT Scrambling_control_field is not 00 for all packets containing information of sectiions with table_ide 0x02 (i.e. a PMT) on each program_map_PID which is referred to in the PAT	YES	
9.1.6a	PID_error	Referred PID does not occur for a user specified period	YES	
9.2.1	Transport_error	Transport_error_indicator in the TS-Header is set to “1”	YES	

Table 18.
ETSI TR 101 290 Compliance

9.2.2	CRC_error	CRC error occurred in CAT, PAT, PMT, NIT, EIT, BAT, SDT or TOT table	YES	
9.2.3	PCR_error	PCR discontinuity of more than 100 ms occurring without specific indication. Time interval between two consecutive PCR values more than 40 ms	-	
9.2.3.a	PCR_repetition_error	Time interval between two consecutive PCR values more thatn 40 ms	YES	
9.2.3.b	PCR_discontinuity_indicator_error	The difference between two consecutive PCR values (PCR_{i+1} - PCR_i) is outside the range of 0...100 ms without the discontinuity_indicator set	YES	
9.2.4	PCR_accuracy_error	PCR accuracy of selected programme is not within ±500 ns	YES	
9.2.5	PTS_error	PTS repetition period more than 700 ms	YES	
9.2.6	CAT_error	Packets with transport_scrambling_control not 00 present, but no section with table_id = 0x01 (i.e. a CAT) present Section with table_id other than 0x01 (i.e. not a CAT) found on PID 0x0001	YES	
9.3.1	NIT_error	Section with table_id other than 0x40 or 0x41 or 0x72 (i.e. not an NIT or ST) found on PID 0x0010 No ssection with table_id 0x40 (i.e. an NIT_actual) in PID value 0x0010 within a specified value 25 ms or lower).	-	
9.3.1.a	NIT_actual_error	Section with table_id other than 0x40 or 0x41 or 0x72 (i.e. not an NIT or ST) found on PID 0x0010 No section with table_id 0x40 (i.e. an NIT_actual) in PID value 0x0010 for more than 10s. Any two sections with table_id = 0x40 (NIT_actual) occur on PID 0x0010 within a specified value (25 ms or lower)	YES	
9.3.1.b	NIT_other_error	Interval between sections with the same section_number and table_id = 0x41 (NIT_other) on PID 0x0010 longer than a specified value (10 s or higher)	YES	
9.3.2	SI_repetition _error	Repetition rate of SI tables outside the specified limits	YES	

Table 18.
ETSI TR 101 290 Compliance

9.3.3	Buffer_error	TB_buffering_error overflow of transport buffer (TBn) TBsys_buffering_error overflow of transport buffer for system information (Tbsys) MB_buffering_error overflow of multiplexing buffer (MBn) or if the vbv_delay methor is used: underflow of multplexing buffer (Mbn) EB_buffering_error overflow of elementary stream buffer (EBn) or if the leak method is used: underflow of lementary stream buffer (EBn) through low_delay_flag and DSM_trick_mode_flag are set to 0 else (vbv_delay method) underflow of elementary stream buffer (Bn) B_buffering_error overflow or underflow of main buffer (Bn) Bsys_buffering_error overflow of PSI input buffer (Bsys)	-	
9.3.4	Unreferenced_PID	PID (other than PAT, CAT, CAT_PIDs, PMT_PIDs, NIT_PID, SDP_PID, TDT_PID, EIT_PID, RST_PID, reserved_for_future_use PIDs, or PIDs user defined as private data streams) not referred to by a PMT within 0,5 s	YES	
9.3.4.a	Unreferenced_PID	PID (other than PMT_PIDs, PIDs with numbers between 0x00 and 0x1F of PIDs user defined as private data streams) not referred to by a PMT or a CAT within 0,5s	YES	
9.3.5	SDT_error	Sections with table_id = 0x42 (SDT, actual TS) not present on PID 0x0011 for more than 2 s Sections with table_ids other than 0x42, 0x46, 0x4A or 0x72 found on PID 0x0011	-	
9.3.5.a	SDT_actual_error	Sections with table_id = 0x42 (SDT, actual TS) not present on PID 0x0011 for more than 2 s Sections with table_ids other than 0x42, 0x46, 0x4A or 0x72 found on PID 0x0011 Any two sections with table_id = 0x42 (SDT_actual) occur on PID 0x0011 within a specified value (25 ms or lower).	YES	
9.3.5.b	SDT_other_error	Interval between sections with the same section_number and table_id = 0x46 (SDT, other TS) on PID 0x0011 longer than a specified value (10s or higher).	YES	
9.3.6	EIT_error	Sections with table_id = 0x4E (EIT-P/F, actual TS) not present on PID 0x0012 for more than 2 s Sections with table_ids other than in the range 0x4E - 0x6F or 0x72 found on PID 0x0012	YES	
9.3.6a	EIT_actual_error	Section ‘0’ with table_id = 0x4E (EIT-P, actual TS) not present on PID 0x0012 for more than 2 s Section ‘1’ with table_id = 0x4E (EIT-F, actual TS) not present on PID 0x0012 for more than 2 s Sections with table_ids other than in the range 0x4E - 0x6F or 0x72 found on PID 0x0012. Any two sections with table_id = 0x4E (EIT-P/F, actual TS) occur on PID 0x0012 within a specified value (25ms or lower).	YES	

Table 18.
ETSI TR 101 290 Compliance

9.3.6b	EIT_other_error	Interval between sections '0' with table_id = 0x4F (EIT-P, other TS) on PID 0x0012 longer than a specified value (10s or higher) Interval between sections '1' with table_id = 0x4F (EIT-F, other TS) on PID 0x0012 longer than a specified value (10s or higher)	YES	
9.3.6.c	EIT_PF_error	If either section ('0' or '1') of each EIT P/F subtable is pressent both must exist. Otherwise EIT_PF_error should be indicated	YES	
9.3.7	RST_error	Sections with table_id other than 0x71 or 0x72 found on PID 0x0013. Any two sections with table_id = 0x71 (RST) occur on PID 0x0013 within a specified value (25 ms or lower).	YES	
9.3.8	TDT_error	Sections with table_id = 0x70 (TDT) not present on PID 0x0014 for more than 30 s Sections with table_id other than 0x70, 0x72 (ST) or 0x73 (TOT) found on PID 0x0014. Any two sections with table_id = 0x70 (TDT) occur on PID 0x0014 within a specified value (25 ms or lower).	YES	
9.3.9	Empty_buffer_error	Transport buffer (TBn) not empty at least once per second or transport buffer for system information (TBsys) not empty at least once per second or if the leak method is used multiplexing buffer (MBn) not empty at least once per second.	-	
9.3.10	Data_delay_error	Delay of data (except still picture video data) through the TSTD buffers superior to 1 second; or delay of still picture video data through the TSTD buffers superior to 60s	-	

Table 19.
Video Quality Measurements Compliance

ID	*Name*	*Description*	*Compliance*	*Comments*
10.1	Aspect ratio (integer)	The horizontal/vertical ration of the image, e.g. 4/3 (also called 12/9), for standard TV, or 16/9 (letterbox)	YES	
10.2	Average Size Received (bytes)	Average packet size received per sample	-	
10.3	B-frame Count (integer)	Number of "B" (bi-directional) frames for this sample period	-	
10.4	B-frame Rate (bits/sec)	Calculated rate of B-frames in bits per seconds bsed on the B-frame percentage of the MPEG stream	-	
10.5	CAT Error (integer)	Conditional Access (CA) Table not sent on schedule	YES	
10.6	Compression Ratio (float, range 0-1)	I-frameCount / (I-frameCount + B-frameCount + P-frameCount)	-	

Table 19.
Video Quality Measurements Compliance

10.7	Continuity Count Error (integer)	Lost or mis-ordered packet in transport stream	YES	
10.8	CRC error (integer)	Number of errors observed while sending Program ID tables	YES	
10.9	Frame Rate	Video frames receiver per second (24 for USA-NTSC, 30 for World-PAL/SECAM)	YES	
10.10	Freezes (integer)	Number of times per sample that the image froze	YES	With VQS1000 (included)
10.11	Horizontal Size (integer)	The left-right size of the image, in pixels	YES	
10.12	I-frame Count (integer)	Number of “I” (Intra) frames for this sample period	-	
10.13	In Sequence (packets)	Number of properly ordered frames delivered	YES	Out of order packet count and rate is measured
10.14	Jitter Maximum (milliseconds)	The highest (usually positive) value for jitter of all packets received during the sample period	YES	
10.15	Jitter Minimum (milliseconds)	The lowest (usually positive) value for jitter of all packets received duringg the sample period	YES	
10.16	Jitter (milliseconds)	Estimated inter-arrival jitter as computed by RFC1881 section A.8	YES	
10.17	Jitter Discards (integer)	Number of frames discarded due to jitter	-	
10.18	Multi-cast First Time (seconds)	Relative time the first data arrived in the stream, in milliseconds, used for calculations, this is not referenced to a real time clock.	-	
10.19	Multi-cast Join Time (seconds)	Relative time the stream was joined, in milliseconds, used for calculations, this is not reference to a real time clock.	-	
10.20	Network Loss Probability (float)	Statistically accurate predictive calculation of frame loss (Note: “1” indicates complete loss)	-	
10.21	Number Packets Received (integer)	Number of packets (frames) received during the sample period.	-	
10.22	Out Of Sequence (integer)	Number of miss-ordered frames delivered	YES	
10.23	PAT Error (integer)	Program Association Table was not sent on schedule	YES	
10.24	PAT Error2 (integer)	Program Association Table extras were not sent on schedule	YES	
10.25	Payload Type (Text)	The commonly accepted code for the type of data contained in a Real Time Protocol frame (MP2T) represents a frame containing a MPEG-2 Transport Stream. The list is contained in RFC 3555	YES	
10.26	PCR Accuracy Error (integer)	Program Clock Reference (PCR) variation out of range constant bit rate only	YES	
10.27	PCR Discontinuty Indicator Error (integer)	PCR rate variations above specified value	YES	
10.28	PCR Error (integer)	Loss of PCR for more than 100 milliseconds	YES	
10.29	PCR Overall Jitter (integer)	Jitter of synchronization stream in microseconds	YES	
10.30	PCR Repetition Error (integer)	PCR inidicator not sent within 40 milliseconds	YES	

Table 19.
Video Quality Measurements Compliance

10.31	P-frame Count (integer)	Number of "P" (Predictive) frames for this sample period	-	
10.32	P-frame Rate (integer)	Calculated rate of P-frames in bits per second, based on the P-frame percentage of the MPEG stream	-	
10.33	PID (text)	Program ID, reflects the decimal equivalent of the Program information in the Program Association and Program Map Tables (PAT/PMT)	YES	
10.34	PID Error (integer)	Program ID not sent on schedule	YES	
10.35	PID Type (text)	Text representation of the Program Type, usually PAT/PMT (indicates program data tables), or Packetized Elementary Stream (PES) (indicates audio or video content)	YES	
10.36	PMT Error (integer)	Program Map Table was not sent on schedule	YES	
10.37	PMT Error2 (integer)	Program Map Table Extras were not sent on schedule	YES	
10.38	Program Rate (Kbps)	Transport stream rate in kilobits per second as observed	YES	
10.39	PTS Error (integer)	Presentation Time Stamp Repetition period exceeded 700 milliseconds	YES	
10.40	Quant Scale Average	For MPEG-2, range is 1-31 and specifies the scale factor of the reconstruction level of the received DCT coiefficients. The decoder uses this until it receives a new value at the slice or macroblock level. Used to determine codec impairments - a higher Quant reflects a lower image quality For H264: ranges is 0-99 percent, and specifies the number of macroblocks with a QUANT value greater taht a specified threshold (this can be set by teh user in the Tunable Parameter Settings)	-	
10.41	Receive Rate (Kbps)	Speed of frames received in kilobits per second	YES	
10.42	Stream Type (text)	Text representation of the PID stream, PROGRAM (for PAT/PMT data tables), or the content codec type, e.g., MPEG-1 Audio, MPEG-2 Video, H.264 / AVC Video	YES	
10.43	Sync Byte Error (integer)	Synch byte not sent after specified number of bytes	YES	
10.44	Transport Error (integer)	Transport header indicated an error	YES	
10.45	TS Sync Loss (integer)	Occurrences of stream synchronization loss	YES	
10.46	Vertical Size (integer)	The top-bottom size of the image, in pixels	YES	
10.47	Video Coding Info (text)	For H.264, text representation of the coding profile, level and type used for the video stream	YES	

Table 20.
RTP Measurements Compliance

ID	*Name*	*Description*	*Compliance*	*Comments*
11.1	Average Size Received (bytes)	Average packet size received per sample	-	

Table 20.
RTP Measurements Compliance

11.2	Average Size Sent (bytes)	Average packet size send in this sample	-	
11.3	Djitter (milliseconds)	Includes fractional portion	-	
11.4	Jitter Maximum (milliseconds)	The highest (usually positive) value for the jitter of all packets recevied during the sample period	YES	
11.5	Jitter Minimum (milliseconds)	The lowest (usually positive) value for the jitter of all packets received during the sample period	YES	
11.6	Jitter (milliseconds)	Estimated inter-arrival jitter as computed by RFC1889 section A.8. Calculation is based on RTP timestamp, and the RTP time stamp according to RFC is the sampling instance.	YES	AT-IPM-400 measures packet inter-arrival jitter and MDI delay factor. MDI jitter (RFC 4445) and packet inter
11.7	Jitter Discards (integer)	Number of packets discarded due to jitter	-	
11.8	Max Loss Episode Length (integer)	Maximum number of lost frames per episode, this count will always reflect the highest mumber observed in this sample	-	
11.9	Max Loss Episodes (integer)	Count of loss episodes in this sample.	-	
11.10	Multi-cast First Time (seconds)	Relative time the first data arrived in the stream, used for calculations, this is not referenced to a real time clock.	-	
11.11	Multi-cast Join Time (seconds)	Relative time the stream was joined, in milliseconds, used for calculations, this is not referenced to a real time clock.	-	
11.12	Multi-cast Last Time (seconds)	Relative time the last data arrived in the stream, in milliseconds, used for calculations, this is not referenced to a real time clock.	-	
11.13	Multi-cast Leave Time (seconds)	Relative time the stream was left (unjoined), in milliseconds, used for calculattions , this is not referenced to a real time clock.	-	
11.14	MOS (float)	Mean Opinion Score derived from E-model	-	
11.15	Network Loss Probability (float)	Statistically accurate predictive calculation of frame loss (Note: “1” indicates complete loss)	-	
11.16	NumPacketsRcvd (packets)	Total numbeer of RTP data packets received. Calculated after validation of RTP packets is performed	-	
11.17	Out of Sequence (integer)	Number of miss-ordered frames delivered	YES	
11.18	Payload Type (text)	For RTP, the type of traffic contained in each packet. The payload types are described in RFC 3555.	YES	
11.19	Receive Rate (bits/sec)	Current receive RTP data rate calculated by receiver	YES	
11.20	R-factor (float)	factor computed as specified in E-model	-	
11.21	Send Rate (bits/sec)	Current send RTP data rate calculated by sender.	-	
11.22	Sent Packets (packets)	Current sent packets as calculated by sender.	-	
11.23	Total Delay (integer)	Delay including Network + codec encoding + lookahead + jitter buffer	-	

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