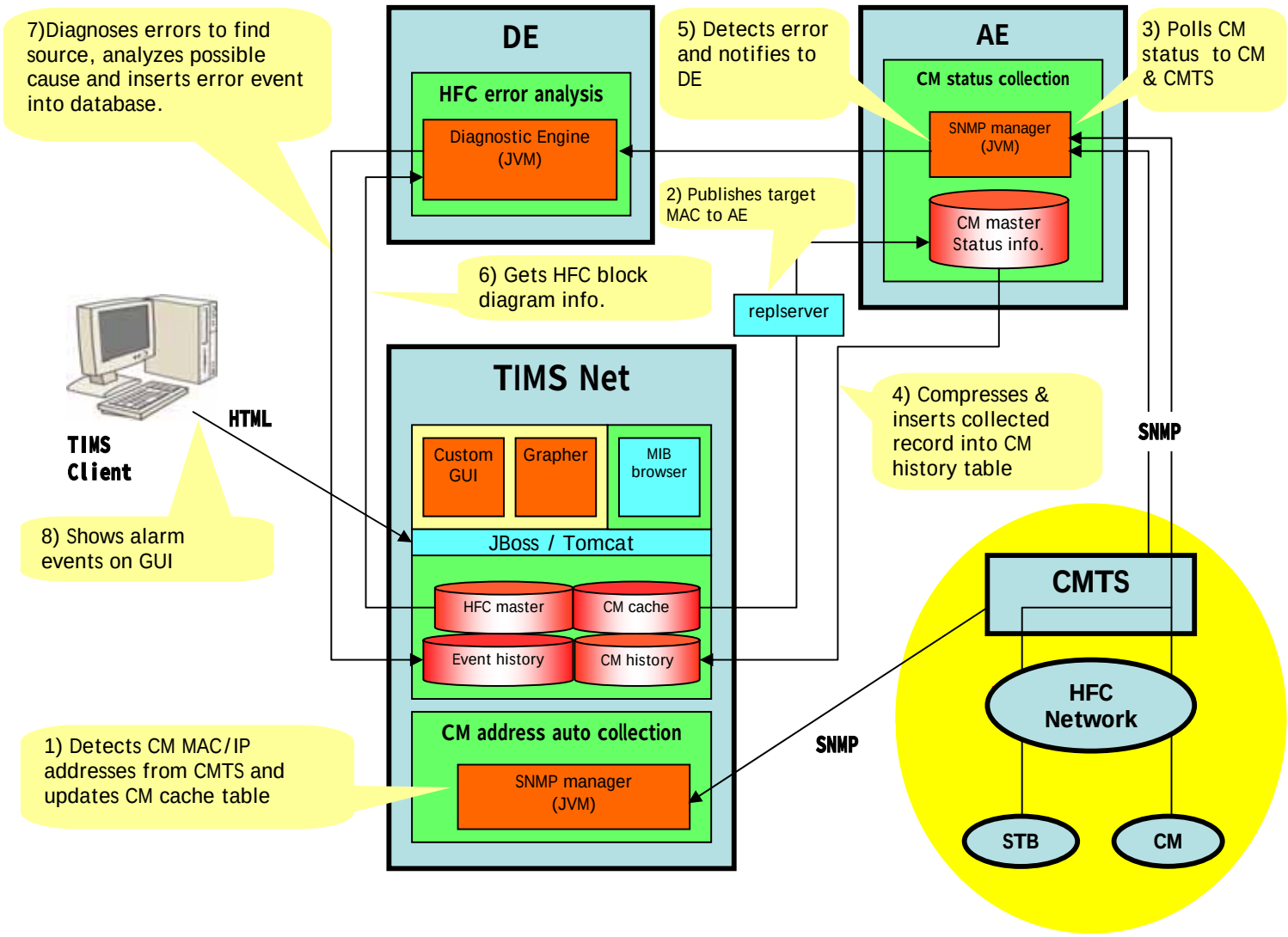
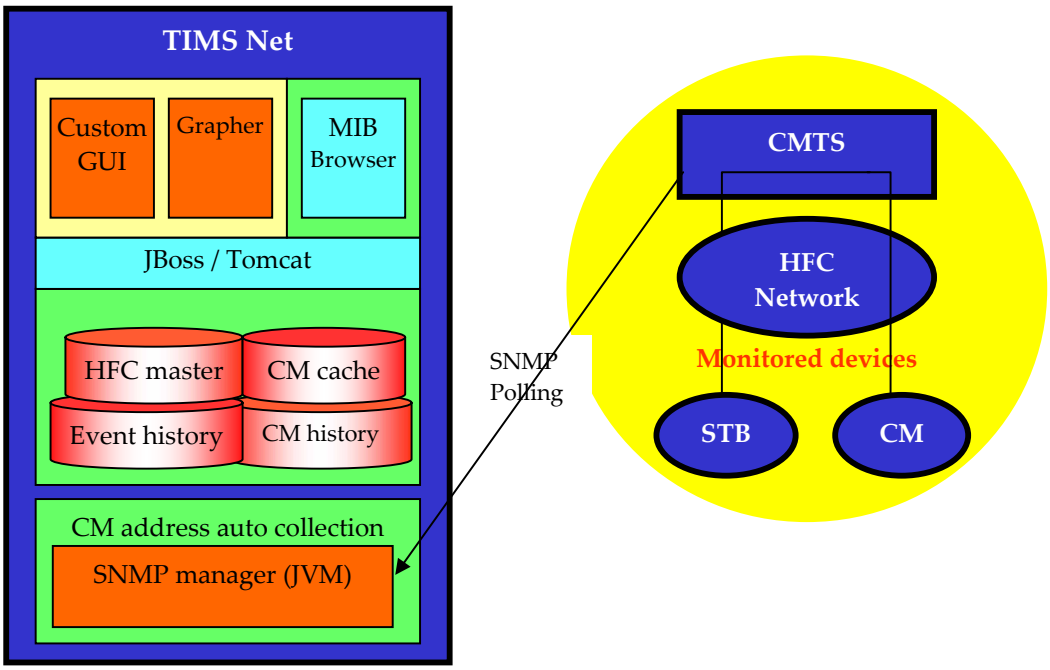
OPEN STM
TIMS Net/AE/DE server suite

OPEN ADMIN / STM is an integrated network monitoring system which does not rely on any proprietary features of transmission equipment vendor. OPEN ADMIN/STM uses software to analyze the transmission quality information, periodically collected from cable modems, detects failures/recovery in the HFC/RF networks, and logically estimates the failure location as well as the cause. OPEN STM supports a multi-vendor environment, for monitoring the RF and IP transmission status using DOCSIS technology.

OPEN STM TIMS Net/AE/DE-Role of each server



TIMS Net



TIMS Net: stands for "*Terminal Information Management System Network*".

OPEN STM TIMS Net is the core server with web application that utilizes the cable MSOs existing DOCSIS devices, and offers an integrated monitoring solution of HFC network. TIMS Net automatically detects online CMs/STBs through the CMTS and requests the execution of high-speed polling to AE and analysis to each lower level server such as AE and DE. In addition, since TIMS Net is equipped with a MIB browser, which is a simplified NMS, TIMS Net itself can be used to monitor and manage network equipments such as routers and servers. TIMS Net also has web server functionality and client PC can utilize various services of TIMS Net via an HTML browser. Also, if the system is configured as an independent OSTM station without integrating with any north bound systems, TIMS Net can also function as an integration interface with CAD/Mapping (HFC/RF networks design/mapping information system) and SMS/Billing (Subscriber Management System/Billing).

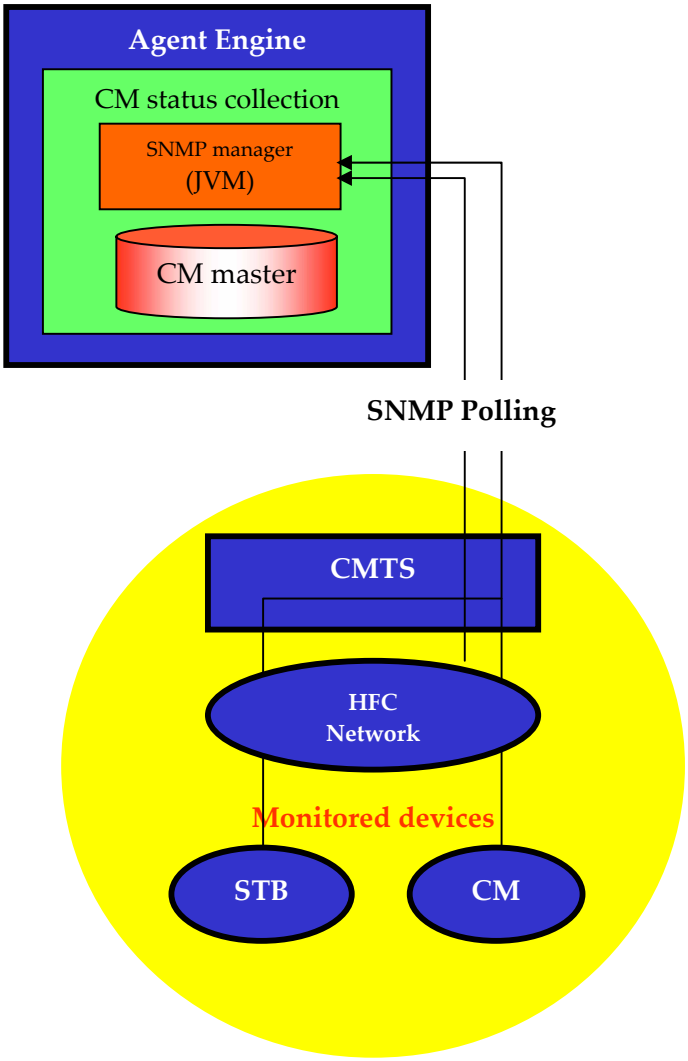
TIMS Net uses unified criteria for offline determination of CM using its own cache. If a particular CM is offline for a defined period of time, then it will be declared as permanently offline and its MAC/IP will be deleted from the CM cache.

Through integration with the SMS, it is possible to retrieve information from existing SMS/Billing and conduct advanced searches combining subscriber information.

Summery of TIMS Net

- **OPEN ADMIN series platform server**
  - Terminal Information Management System with Network functionality. Here "Terminal" means in-house two way DOCSIS device with transmission and reception functions.
  - CM address and status information management. It has a CM cache to store the IP/MAC and status information of various CMs.
- **CM information auto-collection from CMTS**
  - Online CM auto-detection from CMTS by SNMP polling. The moment a CM becomes online, it will be detected by TIMS Net and will be automatically registered in the CM cache in the TIMS Net,
  - Manual registration of CM from GUI or DHCP integration is not required. As it is auto registration, work of entering the CM list into the database is no more required.
  - Unify offline rate between CMTS venders by its own CM cache in TIMS. Using its own CM cache, it unifies the offline rate of any CM which is offline for a user defined hours of time.
- **CM status log**
  - Keeps/stores upto 60 months of CM status log collected by AE (option)
  - HFC proactive maintenance by Grapher (option). For this the status log is used for proactive maintenance of the transmission network.
- **MIB browser included**
  - Easy access to any network node by SNMP protocol using the MIB browser.

Agent Engine (AE)



AE stands for "*Agent Engine*".

AE or Agent Engine is a low load/high performance SNMP polling server, which periodically collects information from 2-way in-house DOCSIS devices and CMTS. In general-purpose NMS products and similar products of other vendors, polling is executed sequentially, so if the number of monitored equipments increases, the polling period also increases (typically, several minutes to several hours).If there is a timeout, the period becomes even longer, and it may take more than ten hours for one cycle, significantly lowering the failure detection rate. In AE, multi-thread technology is used for polling multiple cable modems in parallel and simultaneously, and information can be collected at a fixed polling period (minimum period is 20 seconds).

Parallel / high-speed polling enables a higher detection rate of the various fluctuations occurring in the HFC/RF networks, and the contents can be rapidly displayed. Usually AE polls for DS-Rx, US-Tx at CM, US-Rx at CMTS.

When OPEN STM is installed, it monitors/saves the initial 20minutes or 24hrs data as history log. Then thereafter, comparing with the average of last 20minutes, initial diagnostic (AE level) monitoring is performed. AE detects communication failures in CMTSs on a chassis basis and synchronizes failure information between AE and DE in each polling cycle. AE uses Multiple Variable binding technology (Protocol datagram unit (PDU) with packet of information. Data is send through router and large size packets are sent with multiple variable binding of 1500 bytes) which aggregates multiple SNMP data and transmits it using one packet, reducing the number of generated IP packets to approximately 1/20 of a general-purpose NMS product.

Through the Multiple Variable binding technology, the routing load is substantially reduced and unnecessary load is not generated in CMTS. In addition, by optimizing the parameters for DOCSIS, the generated traffic amount has been reduced by 30% compared to general-purpose NMS products and similar products of other vendors. While the generated SNMP polling traffic is around 350kbps per AE when the number of agents is 1,200, the SNMP packet length is optimized in OPEN STM so the number of packets drops to around 1/50 (one fiftieth) of the general-purpose NMS on average, and thus only a miniscule routing load is generated.

OPEN STM AE runs on Linux OS, and consists of the following components: Java server which provides the SNMP polling to CM/STB and fault evaluation functions, and Firebird database which efficiently stores the relevant data.

Summery of Agent Engine (AE)

- **OPEN STM series platform server**
  - Agent Engine: SNMP polling server tuned for mass agents. Polls the agent process inside the CM and CMTS.
  - High performance, low resources consumption, low CMTS burden because of parallel and multi variable binding polling and doesn't cause traffic to CMTS
  - Quick polling: within 1 min. /2,400CM, within 5 min. /9,600CM, within 20 min. /19,200CM with parallel and synchronized polling
- **Multi-threaded parallel synchronous polling**
  - Parallel polling ensures a configured polling rate in any case (bulk timeouts etc.)
  - UDP reliability is improved by individual timeout & retry control per thread
- **Reduce CMTS traffic and IP processing cost**
  - Reduce # of IP datagram by multi variable bindings SNMP Get PDU
  - Traffic dispersion by advanced thread timing management: Traffic dispersion because when there is heavy traffic, AE doesn't send packets to CMTS to make it more complicated.
- **Accuracy improvement by software processing**
  - Dynamic threshold allocation algorithm eliminates wrong threshold sensing caused by temperature fluctuation or conditions of individual CM
  - Subscriber-powered-off CMs are automatically filtered in its error detection process to avoid wrong detection of service suspension

Diagnostic Engine (DE)

DE stands for "*Diagnostic Engine*".

DE or Diagnostic Engine is an analysis server which checks and analyzes status information collected by the AE against the transmission route block diagram database to identify failed areas and estimate the causes. 1 DE can be registered per TIMS Net.

In DE, among all of the DOCSIS CMs/STBs in the HFC/RF networks, 2 or more CMs/STBs for each Bridger line, which relatively have less subscriber-powered-off are selected as "agents" for monitoring the HFC/RF networks and are allocated to the output port of the transmission equipment. By leveraging the redundancy features of the CM/STB, the effects of power shutdown by the subscriber are eliminated. At the same time, through the software determination processing of the collected multiple information, the status information of each individual CM/STB is converted to status information common to the bridger line.

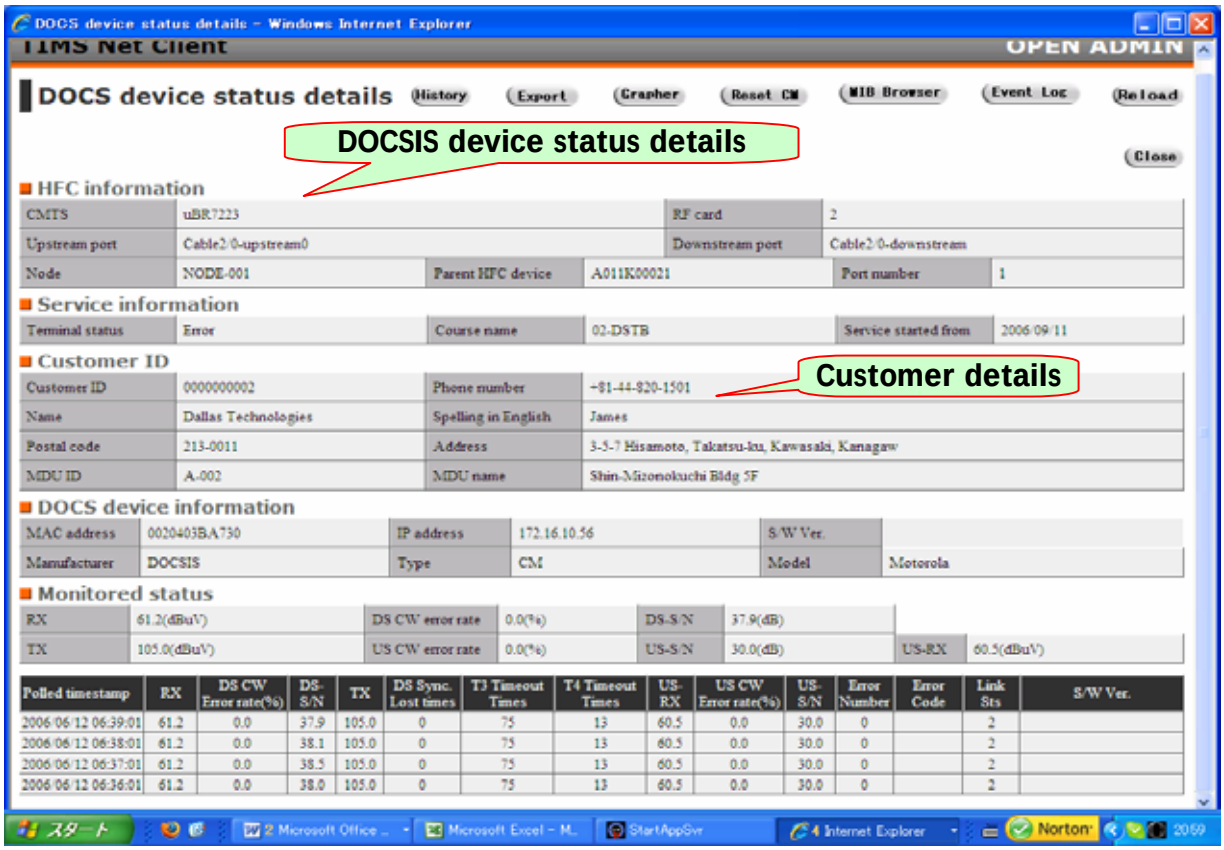
The cable HFC/RF network is configured in a tree-like structure, and in principle, events occurring upstream are propagated downstream. DE matches the type and connection information of transmission equipments which have been pre-registered in the database with the failure distribution status per distribution line collected according to the above principle, in order to find and estimate the cause of the failure in each transmission equipments from the PS, optical node to LE. DE if combined with optional hardware such as outdoor-type inline cable modems, it is possible to build a more effective monitoring system. In addition, by combining it with the ingress monitoring systems, the system can be enhanced in various ways such as by adding an automatic detection feature for ingress.

After converting various status information such as the level, S/N, error rate, etc. that AE has collected from CMTSs, cable modems, and digital STBs into failure information for each bridger line, DE cross-checks this information with the cable HFC/RF networks tree information to rapidly determine the failure source and the symptoms.

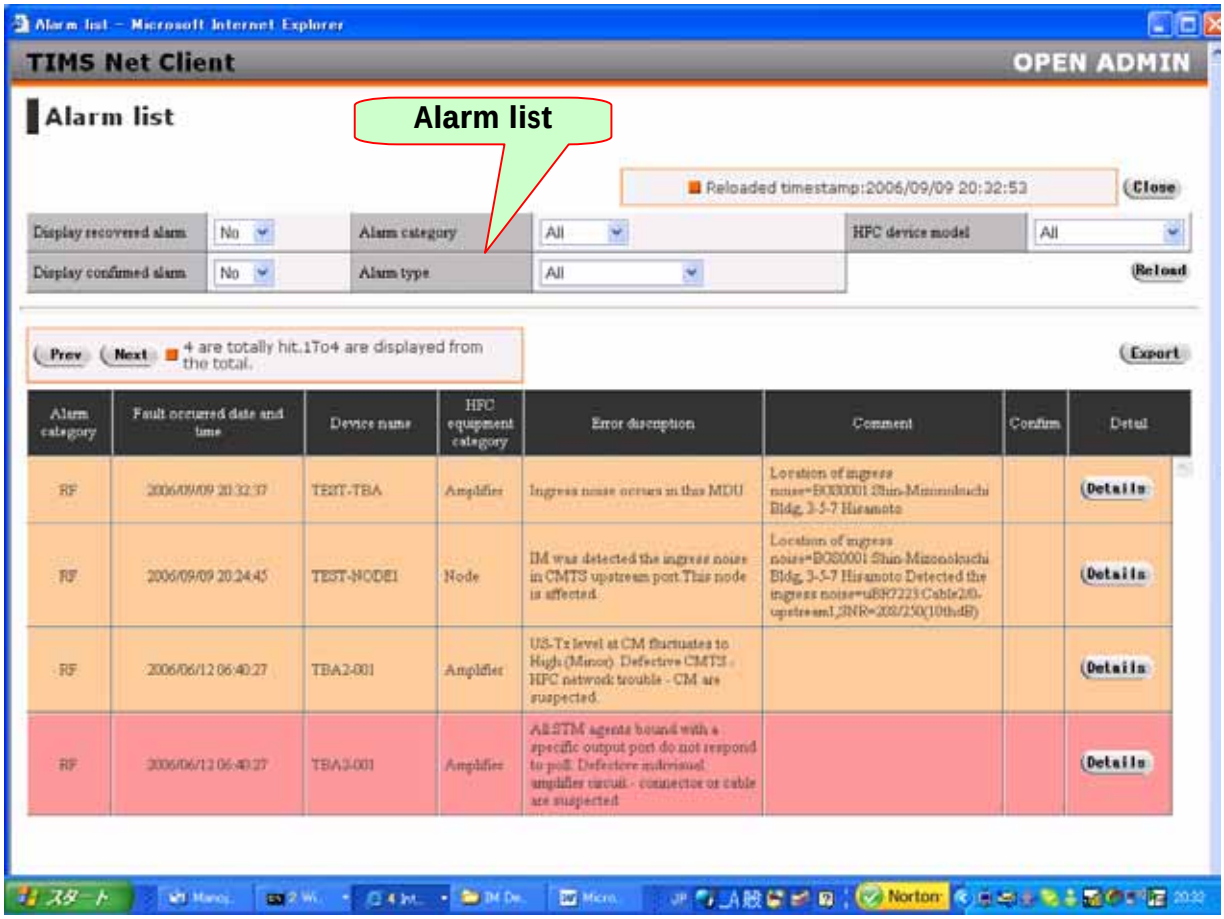
Failures are identified on a transmission equipment port basis, and the details, together with the equipment type, installed location, estimated cause, recovery measures, etc. are displayed on the HTML monitoring screen.

Summery of Diagnostic Engine (DE)

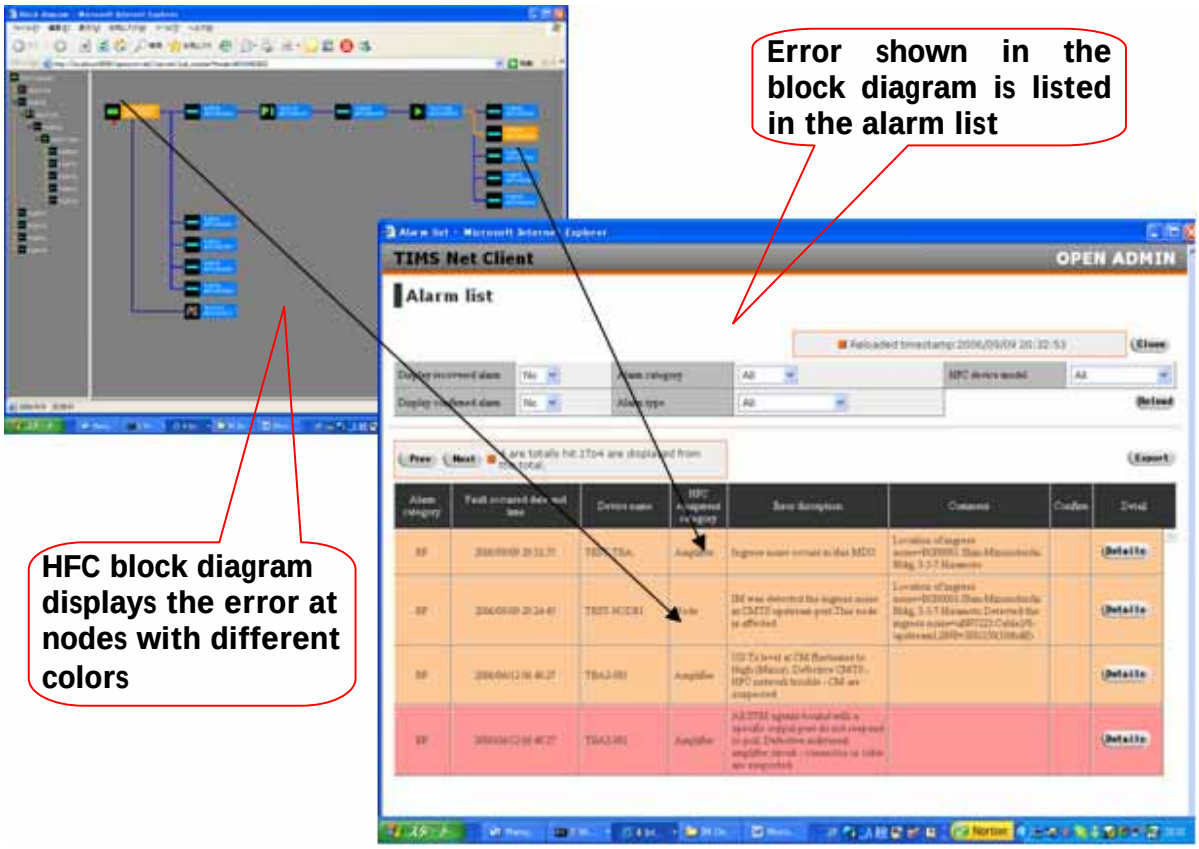
- **OPEN STM series HFC monitoring application**
  - Diagnostic Engine : Diagnose HFC error events on a HFC tree-map
  - Seek source of CM errors, analyze possible cause and recommendable treatment
  - Patented search algorism improves sensing accuracy to commercial level, so far from just a offline/degrade ratio base judgment per TBA
  - Support up to 4,000 HFC devices
  - Support up to 4 AEs
- **HFC knowledge base**
  - Alarm navigator advices technicians how to proceed troubleshooting
- **Ingress monitoring option**
  - Integration with Locator, Real Works or Path Track
  - Ingress source is searched by optional bridger gate switch controller JVM

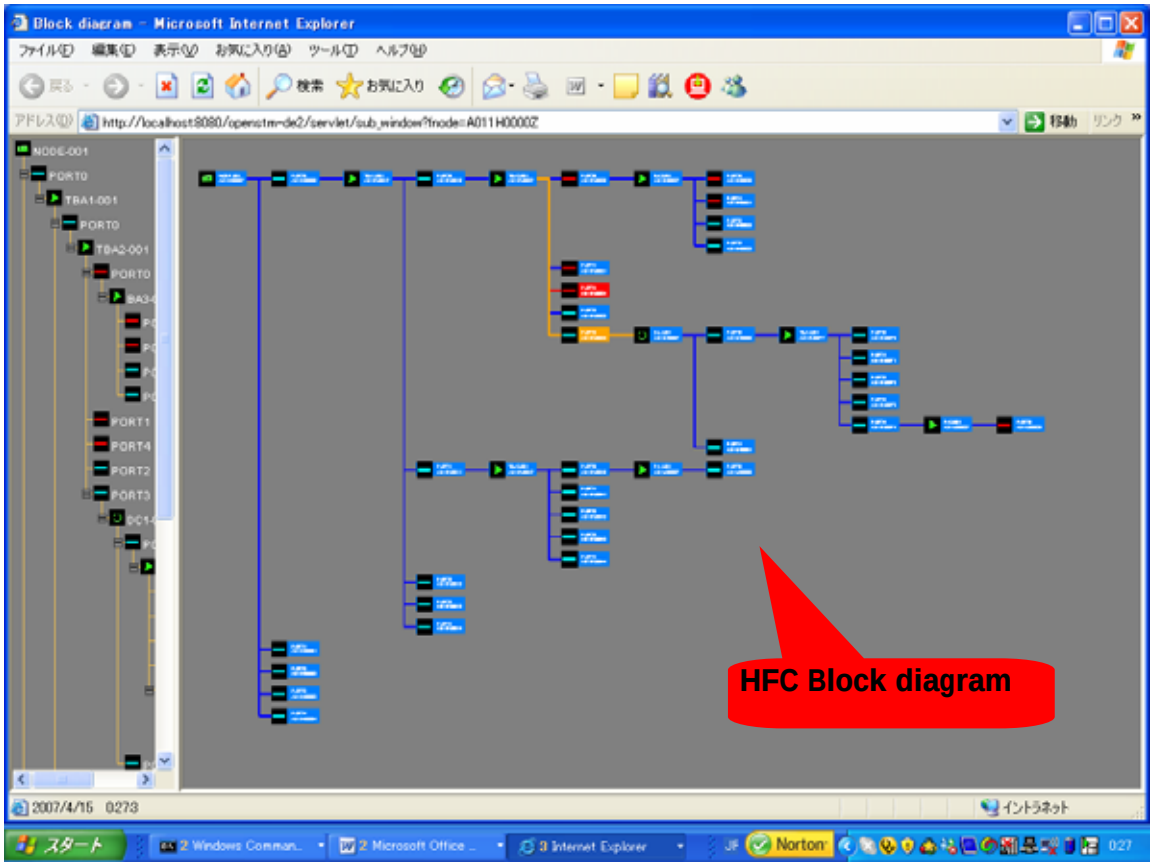


DOCSIS device details and customer details in TIMS Net



Alarm list and error description details in TIMS Net


Error shown in the block diagram is listed in the alarm list
TIMS Net Client
OPEN ADMIN
Alarm list
HFC block diagram displays the error at nodes with different colors


Block diagram - Microsoft Internet Explorer
HFC Block diagram

The system requirements for TIMS Net server:

Component	Specification
CPU	Xeon 3.06GHz or higher / Dual CPU configuration
RAM	3GB or more
HDD	200GB or more of effective storage capacity in RAID5 configuration
NIC	100Base-Tx * 4 or more ports
CD-ROM drive	ATAPI; Linux-compatible
Others	Must arrange for UPS, etc depending on installation environment.

The system requirements for AE and DE servers:

Component	Specification
CPU	Pentium**IV** 2.4GHz or higher
RAM	2GB or more
HDD	20GB or more (40GB x 2 RAID1 configuration recommended)
NIC	100Base-Tx * 3 or more ports
CD-ROM drive	ATAPI; Linux-compatible
Others	Must arrange for UPS, etc depending on installation environment

- Open source platform
  - OS: Linux kernel 2.4.18 or later (Cent OS is recommended)
  - DBMS: Firebird 1.5.x Classic
  - JDBC: J-Bird 1.5.x
  - Language: Java (J2SDK 1.4.2)
  - Application server: Tomcat / JBoss
- Distributed architecture by PC server
  - x86 architecture
  - Dell Power Edge is recommended.

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