New technologies applied to Carrier Monitoring Software Systems

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Introduction

This white paper describes the evolution of satellite carrier monitoring systems (CMS) during the latest years and how the new technologies can provide now solutions to the emerging scenarios.

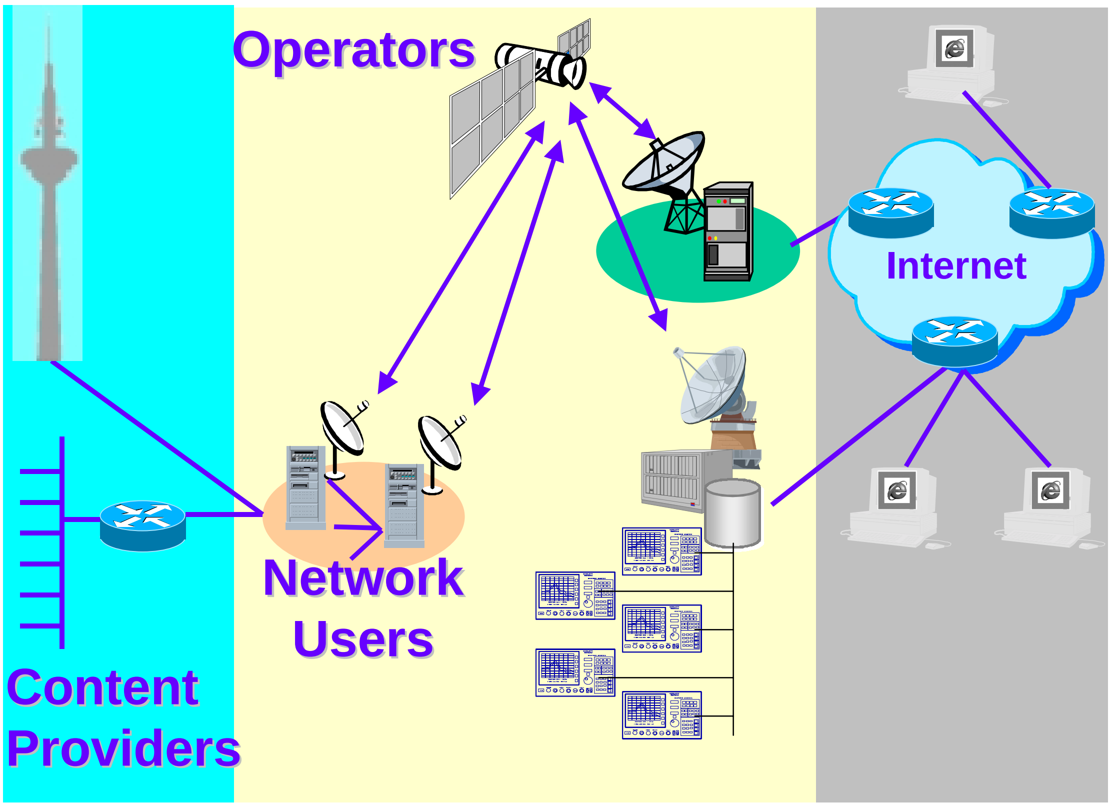

Fig 1.- Current satellite environment of work: Broadcasting and Interactive Services

Although the first approach to the problem domain was constraint to the teleports or control centers, where it is necessary to have real-time measurement data and spectral evolution of each one of the (TX & RX) Stations, the evolution of broadcasting DBS services at a global level, soon required distributed systems with centralized management capabilities (introducing advanced concepts as global operator, full station–level spectral activity recordings, information-sharing, booking of satellite resources to third parties, etc ...).

As far as the telecom systems required end-user interactivity and more and better contents provisioned by other actors (content-providers, ISP’s, ...), the fact is that currently monitoring systems need to be accessible and globally operable, independently of their location.

1.- Evolution of Carrier Monitoring Systems: functionalities and technologies.

The first generation of Carrier Monitoring Systems [1985-1995] had, as a basis requirement, the resolution of the problem regarding to the physical location of the instrumentation equipment (Spectrum Analyzers, switching matrix, microwave cable and accessory instrumentation from shelters) and the distance between shelters and the control center.

Either by proprietary solutions or by introducing innovative standards and techniques (i.e. protocol converters), the solutions were intended to enable the access to the mentioned instrumentation from the control room for the typical monitoring tasks and measurements (Carrier level, Carrier Center Frequency, Transmission Bandwidth, Carrier to Noise ratio, Carrier Power) over a definable number of analog or digital modulated carriers, just in a manual form (directly operated by a operator) or in an automated or scheduled way.

Technically, these types of solutions were based on proprietary or pseudo-proprietary technologies (master-slave schemes, centralized multi-process machines, ...) whose scalability and performance were questionable. The absence of information-sharing and external interfaces with other systems had been also demonstrated, along the time, a frontier difficult to pass through.

From that time only the systems whose techniques were based on standards (IEEE 488, SQL databases, TCP/IP) survive. These are known nowadays as legacy carrier monitoring systems.

The second generation (figure 2) [1995-2000] introduced, in the one hand the “global operator” concept, with the feasibility of real-time access to any remote station and the achievement of not only typical functions (spectrum monitoring tasks and measurements) but also more advanced ones (signal spectrum recording, life reporting on alarms occurred, event distributed databases, analysis tools and mechanisms to information-sharing with office tools such as e-mail, internet, etc...)

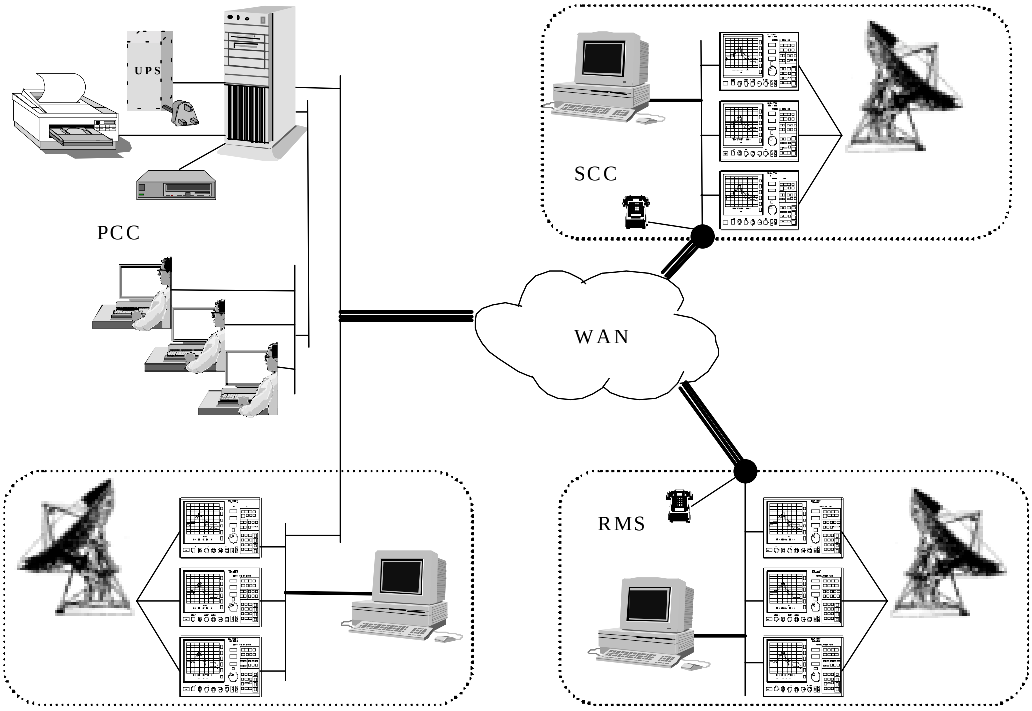

Fig 2.- Global Satellite Operator environment: real-time multisite operation.

From the technical point of view, getting real-time information on the signal Spectrum Analyzer required standard and well-known communication technologies (LAN/WAN, TCP/IP, ISDN, ...) and distributed application techniques (sockets, remote procedure calls RPC, etc...) that enable scalability, reliability and, mainly, performance (exploiting the bandwidth to transmit the useful data and not the application itself).

It is well-known that at this time the huge differences of efficiency among solutions. To reach the same real-time performance some systems required a 2 Mbps dedicated transmmision line bandwidth while others require just a 20 Kbps standard line.

Nevertheless, this was not the worst of these old technologies. The absence of support to "Read-Only"[1] modes and the lack of "Multi-tasking"[2] was a consequence of the monolithic nature of these solutions that didn't enable the multisite operation and closed the doors to any kind of external integration (information-sharing, analysis, external interfaces, etc...).

The third generation of CMS systems [2000, -] is global by definition (normally specified as a main system requirement, see figure 1). Functionally, for these systems generation not only different operation modes are demanded (Manual, Automated and Scheduled), but also Automated Calibration functions, Antenna Hub Temperature control and, mainly,

[1] This situation is given when the system is being operated and other user wants operate from another site.

[2] Instrumentation sharing with system management support.

integration with all other existing systems (Telemetry & Radiometer systems, Time servers, Network monitoring servers, ...).

The new technical requirements mean access and location transparency, full standardization and security in the communications, SQL-standard databases use, and, more important, instrumentation transparency (fully integrable and re-configurable).

These requirements are feasible by introducing web technologies that ease the access to the system in a multi-user way (from control room, transportable station (SNG,s), remote operator in another site) and multi-level (different modes of operation).

This generation of systems had formerly the uncertainty in the performance that might be achieved. This uncertainty is nor longer relevant as far as the cable, DSL and the satellite-inherent technologies have been deployed.

Among the value-added functions offered by these kind of systems, highlights the full re-configuration support, being the re-configuration able not only at the back-end (instrumentation equipment, switching matrices, etc...) but also at the front-end, providing real-time access from different types of devices (Laptops, Palm, Cellular phones) as far as today´s commonly used standards are supported (HTTP, TCP/IP).

2.- Beyond today's monitoring technology: Study Case

New satellite broadband interactive services deployment means a lot to satellite operators. These interactive services address a mass market as broadcasting services did in the last two decades, but their setting up in the field require high quality procedures, so that the former monitoring tools at the customer site and antenna installers expertise for broadcast received-only services are not enough now.

Up to date up-linking was performed mainly by high-quality uplink stations and teleports and the number of occasional line ups was limited and manageable for satellite control centers. Even though these tasks are already complex, the satellite operator is moreover undergoing these newborn Sat Broadband Interactive Services. This means that hundreds of antenna installers need to adjust outdoor units of satellite interactive terminals (SIT,s) at a time and from many sites in the globe. The adjustment of the return channel via satellite at any of these SIT,s would require supervision from the operator at the Hub Station for 24h/365d. This represents a new scenario to service operators and also a new scenario to the Outdoor Units installers. Installations of the user terminal´s Outdoor Units, both due to the expertise required and the regulatory concerns dealing with the installation of a transmitter, will require a trained technician, where there is a need for new tools to manage risk less installation of terminals efficiently.

Integrasys, a Satellite Signal Monitoring supplier has developed with SatMotionPocket (figure 3) a way for installers to perform the high quality line up in the field without needing to carry expensive equipment to monitor the signal downlink at the Hub when performing a line-up in the field.

Figure 3: Line up in the field with a cellular phone

The measurement facilities are hosted at the Control Center / Hub Station. Installers dial into the measurement system at the Hub Station using a PDA cellular phone to get the calibrated amplitude versus frequency spectrum information of the downlinked counterpart of the signal they are currently up-linking. The installer´s PDA cell phone behaves as a remote display and control front panel of the spectrum analyzer & switching matrix located at the Hub Station.

Because of the multi-user nature of web based technologies and the high operational speed of today´s measurement instrumentation, the spectrum analyzer at the Hub Station can be shared independantly by concurrent installers located at different sites. A significant advantage of the procedure is that it does not require hub station personnel involved in coordination activities with the installer´s line up process.

Meanwhile, some efforts are being done by manufacturers of satellite interactive terminals to simplify the adjustment of their outdoor units in the field. Antenna co-boresight design for the adjustment of the transmitter in the field based on the pointing indication obtained through reception only, is a clear example. Spatial missalignment between Tx and Rx antenna patterns (squint error) is one of the problems to line-up the transmitter in the field.

Ensuring a 30 dB cross-polatization isolation in the return path trasmitted signal can be a problem for the installer at the customer site without the coordination with hub station personnel or taking with him extensive measurement equipment.

All these difficulties inherent to a massive number of outdoor unit set-ups, require performing a quality installation that would provide the promised quality on the satellite interactive service to the end user.

Integrasys Monitoring Lab is investigating now on new technologies that will provide software monitoring solutions to services beyond current broadcast and broadband interactive satellite systems. Internet monitoring services over broadband satellite networks and Mobility are the scenarios for the next generation of Carrier Monitoring Systems. The support of Internet technologies combined with quality measurement procedures might be the guideline for the next step.

Summary

Carrier Monitoring Systems are evolving to keep track of the Satellite services evolution. Integrasys Monitoring Lab is investigating now on new technologies that will provide solutions beyond current broadcast and interactive satellite broadband services.

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