ELECTROLINE

HFC Network Management Tools from Electroline

HMS Transponder with Embedded DOCSIS® Modem

I. Introduction

In this document, Electroline will describe its approach to transponder design and the application of DOCSIS® technology for monitoring and control of HFC access network equipment. It is an introduction and description of Electroline's HMS Transponder with Embedded DOCSIS® Modem product line. This technology incorporates certain attributes from the HMS suite of specifications as well as from the DOCSIS® suite of specifications. This unique marriage of technology results in a more robust and cost effective approach to monitoring, control and management of HFC outside plant equipment.

From the network management software perspective, the Electroline solution for transponders is identical to that of an HMS transponder. The difference is in the application of a more robust DOCSIS® PHY layer and MAC layer protocol, which replaces the HMS PHY and MAC protocols.

The benefits and advantages of the DOCSIS® HMS solution are highlighted in the *Executive Summary Section*.

II. Executive Summary of HMS Transponder with Embedded DOCSIS® Modem Technology

Electroline is offering a new HMS Transponder with Embedded DOCSIS® Modem (DHT) technology for managing, monitoring and controlling HFC network devices. Transponders are installed into HFC equipment such as standby power supplies, fiber nodes, optical amplifiers, and also can be implemented as stand-alone independent network test points (or otherwise known as end of line monitors). This design is based on three standards:

1) DOCSIS® for the PHY and MAC layer protocol;
2) SNMP;
3) SCTE HMS.

Never before have these standards been integrated together. The combination of these standards forms a technology that provides significant advantage over the more traditional proprietary and evolving HMS transponders.

Transponders enable the communications of status and performance indicators from devices in the outside plant

portion of an HFC subscriber access network. Furthermore, a transponder can receive instructions for the control of functionality in the devices in which it is installed. Devices not having transponders cannot report critical information needed for management back to a remote or centralized manager. Likewise the devices without transponders cannot hear instructions from the manager and react as instructed.

Proprietary Transponders and Management Systems

Prior to this development at Electroline, the industry applied proprietary transponders to manage these network devices. Proprietary transponders were not compatible with standards-based software systems and therefore the cable network operator was locked into expensive and sometimes inadequate software systems and poor support from the vendors. Once committed to the proprietary system, the network operator had little leverage with the vendor when needed.

DHT Enables Choice

Standards-based DHTs enable network operators to choose the most appropriate NMS or EMS solution. This new transponder product frees the cable operator from the constraints of proprietary network management software systems. It even enables multiple management layers to communicate directly or via proxies to network devices.

SCTE HMS standards

The Hybrid Fiber and Coax Management Sub layer (HMS) committee of the Society of Cable Telecommunications Engineers (SCTE) has been working for more than three years writing a standard for managing HFC network devices. Effort is continuing at present. There are several components that have been finalized and available for implementation in products, however work is ongoing. More effort is needed for truly interoperable products.

The SCTE basically invented a new PHY and MAC layer protocol for this purpose and applied existing SNMP protocol to implement the specification. It is also specifying a set of required and optional Management Information Base(s) (MIB) as part of the standard.

The DHT from Electroline applies the applicable device side MIBs from the SCTE HMS suite of specifications.

DHT Technology Description

This product is differentiated from proprietary and HMS transponders because it uses the existing DOCSIS® cable modem facilities as the communications channel and eliminates the need for specialized hardware controllers (HEC or HMTS) and modems in the headend, thereby saving capital costs and reducing headend maintenance issues. Additionally, it eliminates the need to reserve a downstream and upstream RF channel to carry the communication between the managed device and the headend. The DHT communications are carried in-band with cable modem traffic.

HFC networks that carry data services, such as Internet access, already have the necessary headend hardware to complete the communications channel to the transponders. The same DOCSIS® Cable Modem Termination System (CMTS) that has been installed to support high-speed data, is all that is needed in the headend. Because no specialized and dedicated headend equipment, such as headend controllers, are needed when Electroline's DHT solution is used, there are significant savings in the implementation cost as well as ongoing maintenance. This conserves headend real estate too. HMS headend controllers are known as HMTS and are not required with Electroline's approach.

The DHT is a transponder installed in a cable plant and coexists with DOCSIS® cable modems. From a CMTS perspective, the DHT is not different from a regular cable modem. From the NMS point of view, the trans-

ponder runs an SNMP agent that drives all the DOCSIS® MIBs plus additional HMS MIBs. The DHT complies to the relevant subset of the HMS standard. The idea is to have a management station not being able to tell the difference between an HMS transponder and a DHT in systems where both transponders coexist. Although the SNMP packets coming out the NMS take different routes, the end result is the same; power supply parameters are monitored using HMS MIBs.

The DHT follows the DOCSIS® standard and relevant attributes from the HMS standard

An HMS Transponder with Embedded DOCSIS® Modem is a relatively simple piece of hardware because it uses a proven PHY and MAC layer protocol that is already implemented in available, integrated silicon. DOCSIS® modem chips are available from at least three significant semiconductor vendors and are manufactured in the millions per year. This makes the technology available at very cost effective rates. The component count and power consumption are minimized because of the high level of integration in single chip DOCSIS® silicon. There are DOCSIS® devices specifically designed for low power and outdoor applications. The proprietary and initial HMS solutions are built from discrete components and are more complicated to design and manufacture. Some vendors are planning an integrated circuit to implement HMS, but this is not proven like DOCSIS®. HMS silicon will not have the volumes to compare to DOCSIS®. HMS silicon will be manufactured in approximately one hundred thousand per year quantity as compared to the millions per year of DOCSIS® chips. The cost of DHT devices is more likely to decrease because of higher DOCSIS® volumes that are driven by the cable modem deployments now underway.

Proven in field interoperability of the DOCSIS® PHY and MAC layer protocol is a major feature in Electroline's implementation of the DHT. There are millions of interoperable cable modems that contain the same modem chip technology as in Electroline's transponder. Alternative transponder products based on HMS PHY and MAC protocols as yet have not been proven in actual field operation. Many tests have been conducted on HMS interoperability with varying degree of success.

Transponders based on DOCSIS® will provide a significantly higher communications reliability. Cable modem channel allocations are selected in a less noisy environment than an HMS communication channel. Generally, the HMS channel will be implemented in the return band below 15 MHz. This is a very harsh environment from a C/N perspective, much harsher than the frequency bands above 20 MHz where DOCSIS® channels are typically located. DOCSIS® channels are also maintained so as to maximize the high quality of service level demanded by competitive data services. It is difficult and probably impossible to keep the band below 15 MHz clean. DOCSIS® also implements error correction protocols that are not specific in HMS. The bottom line is that an HMS transponder may be sending alarm traps that may take an hour or more to be received by the Management System because of high levels of ingress noise in the communications channel.

The DHT is Really HMS

There have been significant and valuable contributions from the efforts of the SCTE HMS work in the area of the HMS MIB definitions for HFC devices. The Electroline DHT implements all of the device side MIBs as defined by HMS. Some of the HMS MIBs related to the HFC network side PHY layers have been substituted for similar DOCSIS® MIB objects.

In summary, the DHT is really an HMS transponder when viewed from the Network Manager. However, the DHT provides features and benefits that HMS or proprietary alternatives cannot. When HMS MIBS are loaded into the network manager, the manager is able to communicate with and manage the DHT as if it were an HMS transponder. This is why we refer to the transponder as an HMS Transponder with Embedded DOCSIS® Modem.

Eliminate proprietary EMS

When applying the DHT, the cable operator can take steps towards unifying the network management facilities. Historically, multiple management systems are found in cable system operations. For example, one for set-tops, one for cable modems, one for headend equipment, one for the digital backbone, one for the power supplies, nodes, and amplifiers, one for the ingress monitoring, and possibly more. This product enables the operator to use an existing SNMP enabled management software solution to monitor the HFC outside plant. For example, if an operator already has an element management solution for the DOCSIS® cable modem plant, then it could be applied to manage additional devices in the HFC network. Electroline will cooperate with the providers of these management solutions to enable them to implement the value added by management of the DHT connected devices. This added functionality to the cable modem management software can aid in better identifying the root cause of network degradations. Investments in SNMP based management software can now be applied to the access portion of the HFC infrastructure and the expense of dedicated, poorly supported proprietary solutions is eliminated.

*The information contained herein is subject to change without notice.

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