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Integrated SCADA Solution Using MDLC and DNP 3.0 Protocols

Motorola has added the DNP 3.0 protocol option to its MOSCAD family of Supervisory Control and Data Acquisition (SCADA) products. Availability of this option allows to integrate systems with MOSCAD Remote Terminal Units (RTUs) side-by-side with other vendors' DNP 3.0 capable RTUs and Intelligent Electronic Devices (IEDs). Customers may continue to integrate MOSCAD based systems, knowing that these RTUs comply with variety of industry accepted protocols and provide the highest level of performance that has been consistently demonstrated in all Motorola products and systems.

Background

The origins of the DNP 3.0 (Distributed Network Protocol) are rooted in the preliminary work performed by the International Electrotechnical Commission (IEC). An IEC working group defined the IEC-870-5 protocol for open inter-operability between RTUs, IEDs, and Master Control Centers (MCC), primarily for the utilities.

The DNP 3.0 was initiated by the Harris Corporation in parallel to development of the IEC 870-5 protocol. In 1993, following the introduction of the DNP 3.0, Harris established the DNP User Group and transferred to them its intellectual property rights for further development and market introduction.

Other SCADA protocols that "compete" with the DNP 3.0 are: Utility Communications Architecture (UCA) led by the USA Electric Power Research Institute (EPRI), and the IEC 870-5 suite, which is mostly supported by European SCADA vendors.

MDLC

Since 1991 Motorola has been promoting the ISO 7498 based seven layer Motorola Data Link Communications (MDLC) protocol for SCADA applications. Throughout the years we learned, that customers sometimes refrain from specifying a solution that is supplied by a single vendor, no matter how good and suitable it is.

However, we also realized that by offering DNP 3.0 based MOSCAD RTUs, this unique product might become a "me-too" type device, "stripped" of features that makes it the best-in-class RTU. To avoid such unfortunate loss for many satisfied users, so we created a concept which allows to combine both the DNP and MDLC features.

DNP 3.0

As the DNP 3.0 currently defines only the RS-232 and RS-485 type physical layers. This protocol is applicable only for modems with a serial port and for the Multiple Address System **(MAS)** radio. The proposed concept combines features offered by the DNP 3.0 and the MDLC protocol. **For compatibility purposes**, the combined system uses the same DNP 3.0 **channel access mechanism** and the **time synchronization** methods also for MOSCAD RTUs. Features such as: ***remote diagnostics*** *and* ***monitoring*** of applications, ***upload*** *and* ***download*** of programs and updated parameters and Peer-to-Peer sessions use the MDLC concepts.

MOSCAD RTUs in a DNP 3.0 type System

This example involves MOSCAD RTUs added to a DNP 3.0 system. Their CPUs are loaded with the DNP Slave software, which allows sending/receiving DNP 3.0 type messages. The MOSCAD ToolBox may be connected to the CPU of any MOSCAD RTU, and via that port it communicates with other RTUs.

All MOSCAD RTUs use the MDLC protocol while communicating with other MOSCAD RTUs, and talk DNP 3.0 while communicating with the DNP 3.0 based MCC. Both protocols operates simultaneously over the same RF infrastructure. See Figure 1 below.

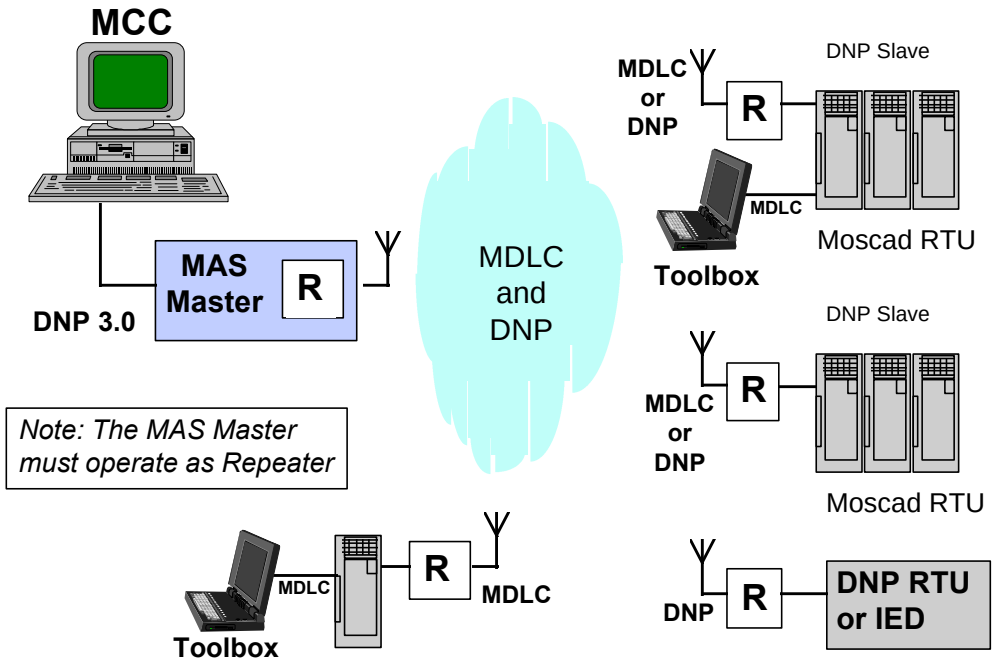

Figure 1. Implementation of the DNP-3.0 concept using MAS radios.

Note: In a MAS type systems (UHF and 900 MHz), there is no direct Peer-to-Peer (RTU-to-RTU) link. All communications between the field units and the MCC go transparently via the MAS Master, which also act as a repeater.

DNP 3.0 units in a MOSCAD System

The configuration in Figure 2 below shows adding of DNP 3.0 type RTUs or IEDs to a MOSCAD based system. In this system, the MCC is equipped with a MOSCAD FIU and the TCP/IP Gateway. The FIU send and receive MDLC type messages while talking with MOSCAD RTUs, and via the same CPU port (MAS radio or line), it communicates DNP 3.0 messages while talking with DNP capable units. To allow simultaneous communications over the RF network, both the MDLC and the DNP 3.0 sessions uses the **same channel access mechanism**)

IN the example below, the MOSCAD CPU(*) is connected via RS-485 to all DNP 3.0 capable RTUs and IEDs (including DNP 3.0 capable MOSCAD RTUs). Communication with all DNP 3.0 capable devices over the RS 485 network is done via that MOSCAD CPU(*), acting as a "DNP 3.0 Master".

Communication among MOSCAD RTUs linked to the same RS-485 port may be done on the Peer-to-Peer basis, using the MDLC protocol. If similar communication is required over the RF network, it must be done via an MAS master radio (not directly).

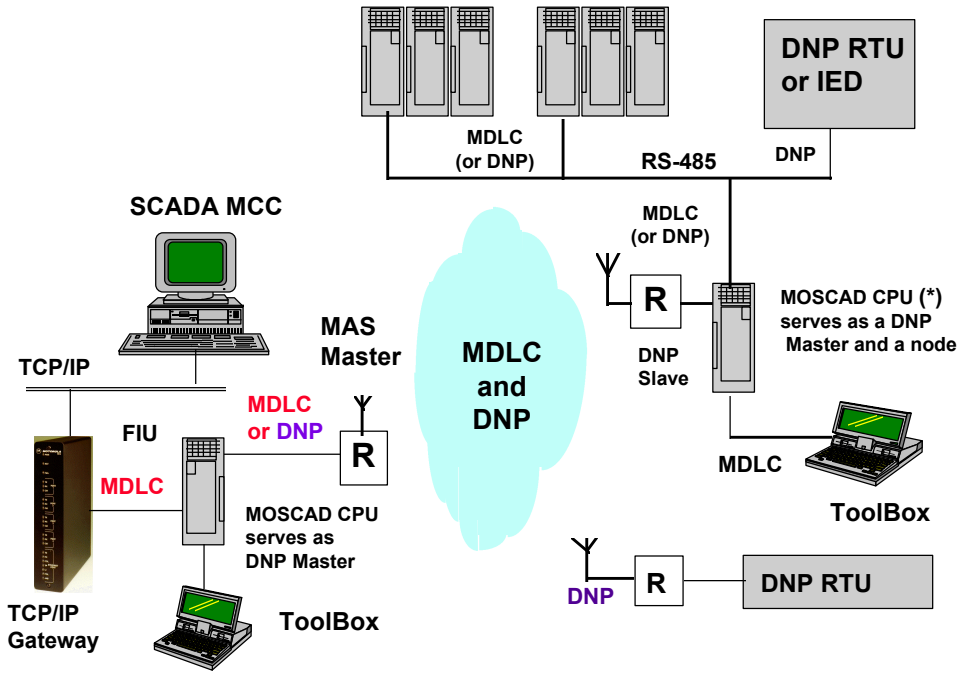

Figure 2. DNP capable RTUs in MOSCAD Environment

Note: The MOSCAD RTU equipped with the DNP Master Driver performs S&F function (Routing) via the RS-485 port to other MOSCAD RTUs using the MDLC protocol. During communication with the DNP type RTUs/IEDs, that MOSCAD CPU performs message forwarding by its application program using the same port.

SCADA System Expansion

Integration of MOSCAD RTUs with DNP 3.0 based SCADA systems allows expanding a MAS network (UHF & 900 MHz) with a voice-grade RF network or other communication media. In this case, the MOSCAD CPU serves as a communications node for expanding the MAS network, with MOSCAD RTUs using the selected communication media.

Using the MDLC protocol, a expanded SCADA system may use Motorola trunked radio (Smartnet, SmartZone). Alternatively the system may use with conventional radio channels (VHF, UHF) which requires no special infrastructure, and the same voice graded frequency may also serve MOSCAD RTUs.

Data Collision Handling

In a contention based SCADA systems using an RF network, or the RS-485 link, a collision can occur if two stations start transmitting data exactly at the same moment. When such event occurs, the data protocol initiates a process which avoids a second collision to occur. MOSCAD RTUs and the MDLC protocol are designed to cope with such situations, and capable to avoid system problems resulted in from such an event.

Summary

Introduction of the DNP 3.0 solution by Motorola represents a winning situation for all parties involved in a SCADA project: Consultants, customers, system integrators and Motorola.

a) Customers can now specify the MOSCAD RTU and the MDLC protocol knowing that whenever they wish, the same RTU hardware may also communicate using the industry accepted DNP 3.0 protocol. In such meshed system MOSCAD RTUs may communicate using both the DNP 3.0 and the MDLC protocols.

c) MOSCAD RTUs can be used as an expansion to an already installed DNP 3.0 based system, using line modems and MAS type RF communications. In this case, the customer will benefit from availability of the MDLC features for those sites that use the MOSCAD platform.

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