Master Slave Network

Abstract

This survey summarises two new Master Slave protocols and how they have a potential to work together soon and then investigates a proposal made for industrial scenario. We will first define Master/Slave Network and correct some misconceptions, then we will start buy introducing how the two protocols, namely MGCP and MEGACO came to be. We will then define and see how they work. Then we will summarise a proposal made to use master/slave protocol used on top of IEEE802.11 wireless LAN, however it only concerns with the lower layers of the communication stack.

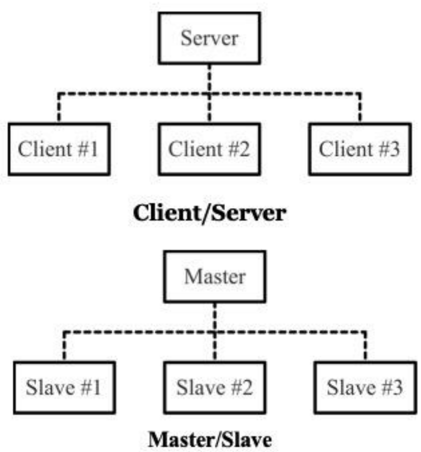
We are going to see the main components of MGCP, how they can be use in internet telephony, it is unique pros. We will see how it can make it easier to use dial by eliminating the gateway in the middle. We will then see how MEGACO differs and how it might work together.

We will then see how we can implement master slave network over wireless lan, here we will investigate the different field busses available, and different ways to implement cyclic and acyclic data.

Introduction

Master/slave is a model of asymmetric communication or control where one device or process (the "master") controls one or more other devices or processes (the "slaves") and serves as their communication hub. In some systems a master is selected from a group of eligible devices, with the other devices acting in the role of slaves.

There seems to be a misconception where the terms Client/Server and Master/slave describe the same data exchange protocol. The master device issues a command and the slave responds, which is no different from a “client” requesting information from a “server.” But as explained earlier, Master issues a unidirectional order or command to one or more than one slave, however in client/server communication, one or more than one clients request service from a server. In essence, A server serves multiple clients and multiple slaves answer to only one master. This following picture found on Copperhill technologies blog explains it perfectly (2). Also, in Client/Server model most of the communication happens between Client and Server whereas in Master/Slave model, most of the communications occur locally, i.e. between Slaves.



https://copperhilltech.com/blog/industrial-ethernet-guide-clientserver-vs-masterslave/

This protocol is employed at the lowest level of communication systems, also known as device level. A good example is industrial plants. At device level, normally fieldbuses are used, they also provide a hostile environment for communication systems. due to the presence of several kinds of electromagnetic noise. Moreover, it must be considered that, often, the environmental conditions are characterized by the presence of dust vibrations, and other adverse factors (1).

Now, due the environment, it can be said that using wireless network in industrial plant would be difficult, however recent advancement in such network in several fields of applications, has improved performance. There is a prototype uses Master/slave protocol over 802.11b LAN network that we will investigate (1).

We will also investigate other master/slave protocols like MGCP and MEGACO.

Master/Slave Protocols

First some introduction on how MGCP and MEGACO were made. In mid 1998, the important RFI (Request for Information) and RFP (Request for Proposal) for building large VoIP networks were sent to vendors. The first proposal came from Bellcore (now Telcordia) and Cisco by the name of SGCP (Simple Gateway control protocol). The second proposal came from ITU-T

SG16, ETSI TIPHON and IETF by the name of IPDC (Internet Protocol Device Control) (3). Eventually the forces behind the two protocols unified their efforts and merging the protocols into one created MGCP or Media Gateway Control Protocol Some time later another protocol by the name of MEGACO was introduced. MEGACO is now a coordinated standard between IETF (MEGACO) and the ITU (H.248).

Both have two main components, the Media Gateway, and Media Gateway Controller. Media Gateways are low intelligence distributed devices, which terminates lines/trunks and provide translation of POTS voice/fax signals for IP transport, essentially the “Slaves”. Media Gateway Controller provides centralized intelligence, the “Master”.

MGCP

MGCP is a text-based protocol and supports centralized call model. MGCP assumes a call control architecture where the call control "intelligence" is outside the gateways and handled by external call control elements, called Call Agents. The MGCP assumes that these call control elements, or Call Agents, will synchronize with each other to send coherent commands to the gateways under their control. MGCP does not define a mechanism for synchronizing Call Agents. MGCP is a master/slave protocol, where the gateways are expected to execute commands sent by the Call Agents (3).

MGCP allows combinations of commands this combination reduces the number of messages necessary to establish a call. However, MGCP still requires at least 11 round trips to establish a phone to phone call. MGCP has seamless PSTN Integration. This makes it a great Internet Telephony Solution. Traditionally the end user requires two stage dialing where gateway number must be number must be dialed prior to dialing the actual destination number. This is cumbersome for the end-user. However, if gateways are made dumb then they will be inexpensive enough for the end-users to buy and place in their home and hence be directly connected to the gateway (3).

MGCP assumes a connection model where the basic constructs are endpoints and connections (3). Endpoints are sources or receivers of data, like an audio source, or and interface on a gateway that terminates a trunk connected to a PSTN switch. They can either virtual or physical. Connections may be either point to point or multipoint. A point to point connection is an association between two endpoints with the purpose of transmitting data between these endpoints. A multipoint connection is established by connecting the endpoint to a multipoint session.

Another network element used in MGCP is called Telephony Gateway. A telephony gateway is a network element that provides conversion between the audio signals carried on telephone circuits and data packets carried over the Internet or over other packet networks (3). An example of this is the trunking gateway that interface between telephone network and VoIP network.

Connections are created on the call agent on each endpoint that will be involved in the "call." Each connection will be designated locally by a connection identifier and will be characterized by connection attributes (3). When two endpoints are managed by the same Call agent, it first askes the first gateway on the first endpoint to “create a connection”, The gateway allocates resources to that connection, and respond to the command by providing a "session description." The call agent then asks the second gateway to "create a connection" on the second endpoint. The gateway allocates resources to that connection and respond to the command by providing its own "session description." The call agent uses a "modify connection" command to provide this second "session description" to the first endpoint. Once this is done, communication can proceed in both directions. If the endpoints are located on different call agents, these two call agents shall exchange information through a call-agent to call-agent signaling protocol, to synchronize the creation of the connection on the two endpoints.

Cal Agents can also use Session Description Protocol that allows for description of multimedia conferences. There are some examples of this on the “MASTER SLAVE PROTOCOL” paper (3).

MEGACO

MEGACO is used between elements of a physically decomposed multimedia gateway, i.e. a Media Gateway and a Media Gateway Controller (3). MEGACO can do every that MGCP can and more, it will be primarily used for the Media Gateway control in the future (3). The protocol provides commands for manipulating theological entities of the protocol connection model, Contexts and Terminations. These commands provide control at the finest level of granularity supported by the protocol. For example, Commands exist to add Terminations to a Context, modify Terminations, subtract Terminations from a Context, and audit properties of Contexts or Terminations. Commands provide for complete control of the properties of Contexts and Terminations.

In general, there is al lot of testing done in MGCP on many networks, we will probably see a commercialisation of MGCP first and soon MEGACO would be integrated to be primarily used for Media Gateway Control.

Implementation of Master-Slave Protocol over Wireless LAN

Here we are going to look at a proposed prototype of a master/slave protocol over 803.11b network. This will be used in industrial environments which comprises of a Controller that will act as a master and sensors and actuators that are slaves. The author of (1) has used only one controller or master as that is the most practical application (1).

In a factory communication, we have two types of data, cyclic and acyclic. The cyclic traffic is due to the periodic exchange of both process states and commands which takes place between controllers and sensors/actuators. The acyclic data, on the other hand, usually correspond to unattended events such as, for example. alarms which, in the most serious cases may compromise the process operations, and which demand a prompt response to drive the system back to normal operation modes (1). Therefore, for efficient behaviour, we need cyclic data with very low jitter and acyclic data with minimum latency.

First let’s see some research done on fieldbuses. Profibus is researched in (4) and an analysis of WorldFIP is reported in (5). Another fieldbus called IEC fieldbus is investigated in (6). Profibus causes the acyclic data to delay the beginning of the next polling cycle causing jittering. Interbus assigns a predefined slot to each slave within a frame which is circulated repeatedly on the network. In this case, the jitter is eliminated, but a certain bandwidth waste is introduced. Also, a recent version of Profibus DP named “synchronous” (7) can operate without jitter. In practice. the cycle time is maintained constant by adding a fixed interval at the end of each polling cycle. Such an interval must be large enough to host, even in the worst case, all the acyclic activities. The author of (1) proposes a few ways to implement cyclic and acyclic activities.

Cyclic data exchange

The cyclic data exchange is realized by means of periodic queries sent by the master to the slaves. To implement such a function, we can use the acknowledged connectionless services of LLC. the exchange starts with a request issued by the Master. carrying the output data. Therefore, a request of an LLC acknowledged service is sent and the output data are encapsulated into an LLC frame passed to the IEEE802.11 MAC. The slave. which is notified of the data arrival by an indication of the LLC service. responds with a frame containing the input data which had been previously prepared by means of the data_upd service that in tum triggered the DL- REPLAY- UPDATE service of LLC. as shown by the primitives Ll. Ciupd. req and Ll.Ciupd.con.

Acyclic data transmission

As this data maybe derived form critical events, it must be received correctly. The author proposes three techniques to handle this traffic.

1. The first technique is where the master, at the end of the current pooling cycle, queries the slaves the signalled first, the presence of acyclic data.
2. The second method, here the slave sends acyclic data directly to the master, the slaves replaces the cyclic data with an acyclic one, the master realises it is acyclic when analysing the received data using some special code written in the LLC SAPs and take appropriate action. with this procedure when a slave transmits acyclic information. the input data of that slave are not updated for one polling cycle. Nevertheless", such a solution is of case implementation and has the advantage of reducing both the update jitter and the acyclic data latency.
3. The third technique, this method uses the decentralized nature of the IEEE802.11 MAC protocol and hence the capability of the devices to autonomously access the network. In this case, a slave station, when acyclic data are generated. immediately tries to send them to the master. This method, however, is slightly different than the normal Master/Slave.

Conclusion

In this survey, we summarised some new master/slave protocols that are being tested, namely MGCP and MEGACO, we saw how these can be used in internet telephony, we saw that there is a possibility in the near future for the two protocols to work together. We then saw a proposal, a model that specifies a simple polling scheme for the exchange of cyclic data, and three different techniques for handling acyclic requests have been considered. There is also a performance analysis in the paper (1).

Reference

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