**T Semiconductor Test Division**

Dragon SMC Network

Revision History

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# Introduction

The UltraFLEX-Plus SMC system incorporates Ethernet based PSUs and CDUs (as opposed to the former LON based nodes controlling these devices). In addition, the Latch Control Logic (LCL) board also uses Ethernet communication. These components will share a network subnet as outlined in this document.

## Abstract

This document applies to the UltraFLEX-2 Zero-Pin Infrastructure and describes the SMC networking sub-system.

## References

**Dragon MAC/IP Map:** [DragonMacIP.docx](https://share.teradyne.com/project/SemiEng2/dgninf/Prod/HW/Board%20Support%20Package%20(BSP)/DragonMacIP.docx)  
**Dragon DHCP/TFTP/RDATE Server:** [DragonDhcpTftp.docx](https://share.teradyne.com/project/SemiEng2/ari/Prod/SW/Design/DragonDhcpTftp.docx)  
**Dragon SMC System Node:** [DragonSMC-SystemNode.docx](https://share.teradyne.com/project/SemiEng2/dgninf/Prod/HW/SMC/Process/System_Node/DragonSMC-SystemNode.docx)

## Glossary

**DHCP** Dynamic Host Configuration Protocol – provides IP addresses to devices  
**MAC** Media Access Control address - Ethernet hardware address of a device  
**NIC** Network Interface Card – network adapter  
**OUI** Organizationally Unique Identifier – first three octets of MAC address  
**RDATE** Remote Date – sets time and date from a network server  
**SMC** System Monitor and Control – tester safety system  
**TFTP** Trivial File Transfer Protocol – provides downloading of files from host PC

# Overall description

The UltraFLEX-Plus infrastructure incorporates multiple Ethernet based components within the SMC sub-system. This requires a networking configuration to allow communication between these devices and the controlling components. Although the UltraFLEX-Plus architecture also supports multiple independent testhead systems, the SMC network is shared.

A simple (unmanaged) network switch links all SMC Ethernet devices together into a single subnet. The components associated with a given testhead are identified by their IP address and/or are “discovered” by the SMC System Node during initialization. Only the host PCs have pre-configured static IP addresses. Other components are assigned an IP address by a DHCP server running on the host PC for testhead A.

The following section provides a graphical representation of the SMC network showing a dual-headed test system.

## SMC Network Diagram

System Node - A

Tester PC - A

SMC Ethernet Switch

System Node - B

Tester PC - B

PSUs 20-22

PSUs 23-25

Shared CDU

SB

SCN

Instruments

**LON Bus**

On/Off

SCN

Instruments

**LON Bus**

On/Off

SB

DHCP

## Background

Previous (UltraFLEX-1) SMC systems used a simple direct-link between the host PC and the SMC System Node, each with statically assigned IP addresses (10.0.0.1 and 10.0.0.2, respectively).

# IP Assignment Scheme for SMC Components

All Ethernet based SMC components (System Nodes, PSUs, CDU ...) require an IP address for operation. To avoid network conflicts, these IP addresses are assigned by a custom DHCP server running on the host PC of the first testhead (A) that uses MAC addresses and hostnames to identify the devices.

The SMC subnet is assigned by the static IP address of the host PC NIC named ‘Teradyne\_SMC’, and is typically configured as 10.0.0.xxx for familiarity, but may be assigned to any private subnet.   
[NOTE: It is important in a multi-head configuration that all host PCs use the same IP subnet and the correct last octet when assigning their static IP address for the ‘Teradyne\_SMC’ NIC.]

The IP address map for the SMC subnet is presented below:

#### SMC Subnet IP Address Map

.1, .3, .5, .7 - Host PCs (for testhead A, B, C, D) – statically assigned  
.2, .4, .6, .8 - System Nodes (for testhead A, B, C, D)  
.10 - CDU controller  
.20 - .83 - Instrument Nodes (future)  
.100 - .111 - PSU controllers (for 24-slot “Legacy” systems)  
.116 - .119 - PSU duplicates (used if any PSU in a group of 3 has a duplicate ID)  
.120 - .131 - PSU controllers (for 6/12-slot “Gemini” systems)  
.200 - .201 - LCL controllers (for testhead A, B)  
.202 - .203 - LCL controllers (for testhead C, D)

*NOTE: Existing devices are discovered during DHCP server startup to prevent IP address conflicts when assigning IPs to new devices.*

### MAC Addresses

Teradyne instruments and devices will provide their identity (type and ID/Slot numbers) through their dynamically generated MAC address MAC address in the form ’02-50-C2-18-Bx-xx’.

Specifically, the SMC System Node will use ‘B0-01’ for 24-slot “Legacy” systems, and ‘B2-00’ through ‘B2-03’ for the multi-head 6/12-slot “Gemini” systems as configured by the System Node’s ID cable. LCL boards will use ‘B0-02’ through ‘B0-05’ for testheads A-D, as configured by their jumper settings.

For purchased devices, the Organizationally Unique Identifier (OUI) of the MAC address (first three octets) may be used to identify at least the type of device. Specifically, the PSU and CDU devices used in the SMC system can be identified in this way to assign an IP address.

### Named Devices

An alternative method of identifying specific devices is to use the device host name (provided by DHCP option12). This allows the IP address to be assigned based upon the name (rather than the MAC address). For example, the PSUs will be assigned IP addresses based upon the host name template T5979\_vvvv\_xx, where xx is the PSU’s ID number (from the rocker switch setting).

*NOTE: A MAC match takes precedence over a name match when determining the device type to use when assigning IP addresses (although they should always indicate the same device type).*

# System Node Ethernet Operations

## IP Assignment

Each testhead is controlled/monitored by an associated SMC System Node (SN). Like all SMC devices, this controller requires an IP address for operation. It will generate a MAC address based upon the ID cable (for 6/12-slot “Gemini” systems) or the lack of a cable ID (for 24-slot “Legacy” systems) to identify itself in its DHCP request. Until it receives an IP address in response from the DHCP server running on the host PC of testhead A, it will continuously reset itself, preventing unexpected operation.

## Discovery

Once the SN has an IP address, it will attempt to “discover” the PSUs associated with its testhead and the shared CDU by creating a socket connection to the device’s expected IP address, according to the following table, and obtain status from the device:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **System Type** | **CDU** | **PSUs for Head A** | | **PSUs for Head B** | |
| **ID** | **IP** | **ID** | **IP** |
| **24-slot (Legacy)** | .10 | 0-5 | .100 - .105 | NA | NA |
| **6/12-slot (Gemini)** |  | 23-25 | .123 - .125 | 20-22 | .120 - .122 |

The SN also attempts to “discover” a PSU with a duplicate ID by creating a socket connection to the IP address of the “duplicate PSU” for the PSU group(s) associated with its testhead. (See the Dragon SMC System Node document in [References](#_References) for details of the discovery process.)

## Polling

Given the importance of safety, particularly in regard to the test system power, the Ethernet based PSU and CDU components include a shutdown response to a five second loss of communication with the System Node. Therefore, the System Node polls the PSUs and the CDU every second to maintain the communication link, send ON/OFF commands, and to obtain the current status of the devices.

# DHCP Server Operations

This section will describe the basic operation of the custom Teradyne DHCP server in relation to the SMC network including a description of the log file content.

## DHCP Installation / Startup

The DHCP server is installed and updated by the IG-XL Installer, which will stop and remove any existing copy of the server and install only a newer server that is included with the IG-XL release. It will be installed as an “automatic” service on the tester (host) PC, so that it will run upon power-up.

The DHCP server will also restart automatically whenever any change occurs in the SMC (or tester) network, such as plugging (or unplugging) the network cable to changing the static IP of the named NICs.

Upon startup (or restart), the DHCP server will obtain the desired SMC network IP subnet from static IP address of the host PC’s NIC named ‘Teradyne\_SMC’. It will also probe the network for any existing devices to allow the server to detect various error conditions, like duplicate PSU ID assignments or combination of “Legacy” and “Gemini” System Nodes.

## DHCP Server Log

The DHCP server log provides a great deal of information about the system operations, by recording all server (re)starts, IP assignments, and errors detected. The log file is stored on the host PC as C:\Temp\TerDhcpServer.log and is size limited to 1MB. When the file exceeds 1MB in size it is renamed to TerDhcpServer.bak and a new log is started. [This ensures that at least 1MB of logs will be present on a system for troubleshooting.]

This section will provide annotated examples of the DHCP Server logs produced by various conditions.

### Startup / Shutdown

Upon startup, the DHCP server build date is logged. Seeing a “Service Stopping” in the log indicates a proper shutdown.

*NOTE: A second “Log Started” message without a “Service Stopping” message in between indicates an improper PC* *shutdown (possibly due to an EMO event).*

Server Build Date

11/05/19 13:21:11 - Teradyne DHCP Server (Jun 28 2019 14:05:06) Log Started

…

11/05/19 13:27:41 - Service Stopping.

11/05/19 13:27:42 - Teradyne DHCP Server Log Stopped.

### Restart with No Network Connections

Without network cable connections, the DHCP server log will indicate the static IPs of the named NICs that were found, cable connection warnings (which may be due to the switch not being ready), and wait for a change in the connection state.

### 

Static IPs

Cable warnings

Host name

Teradyne DHCP Server Restarting.

11/18/19 13:29:10 - Winsock DLL initiated.

11/18/19 13:29:10 - TFTP path overidden by registry variable to: c:\Program Files (x86)\Teradyne\IG-XL\10.20.77\_uflx\Boards\Images\

11/18/19 13:29:10 - Parsing configuration file: C:\Program Files (x86)\Teradyne\IG-XL\Common\bin\TerDhcpServer.cfg

11/18/19 13:29:10 - Found Teradyne\_Private network adapter IP Address: 172.16.0.1

11/18/19 13:29:10 - WARNING: Network cable is not connected.

11/18/19 13:29:10 - Found Teradyne\_SMC network adapter IP Address: 10.0.0.1

11/18/19 13:29:10 - WARNING: Network cable is not connected.

11/18/19 13:29:10 - Local host name is:T3-UFLX2-Q0A

11/18/19 13:29:10 - No sockets to listen on...!

### Testhead A Initialization (Mains Power On)

The DHCP server initialization “pings” SMC devices to establish existing IP assignments. Following a Mains power on, all pings will fail since no devices will have IP addresses (yet).

Legacy PSUs

Gemini PSUs

CDU

LCLs

Legacy SN

Gemini SNs

All pings fail since devices have not yet received an IP address.

Teradyne DHCP Server Restarting.

11/18/19 13:35:16 - Winsock DLL initiated.

11/18/19 13:35:16 - TFTP path overidden by registry variable to: c:\Program Files (x86)\Teradyne\IG-XL\10.20.77\_uflx\Boards\Images\

11/18/19 13:35:16 - Parsing configuration file: C:\Program Files (x86)\Teradyne\IG-XL\Common\bin\TerDhcpServer.cfg

11/18/19 13:35:16 - Found Teradyne\_Private network adapter IP Address: 172.16.0.1

11/18/19 13:35:16 - WARNING: Network cable is not connected.

11/18/19 13:35:16 - Found Teradyne\_SMC network adapter IP Address: 10.0.0.1

11/18/19 13:35:16 - Local host name is:T3-UFLX2-Q0A

11/18/19 13:35:16 - Finding existing (0 based) device assignments...

11/18/19 13:35:17 - Checking 10.0.0.100 for PSU 0 - ping failed

11/18/19 13:35:17 - Checking 10.0.0.101 for PSU 1 - ping failed

11/18/19 13:35:18 - Checking 10.0.0.102 for PSU 2 - ping failed

11/18/19 13:35:18 - Checking 10.0.0.103 for PSU 3 - ping failed

11/18/19 13:35:19 - Checking 10.0.0.104 for PSU 4 - ping failed

11/18/19 13:35:19 - Checking 10.0.0.105 for PSU 5 - ping failed

11/18/19 13:35:20 - Checking 10.0.0.106 for PSU 6 - ping failed

11/18/19 13:35:20 - Checking 10.0.0.107 for PSU 7 - ping failed

11/18/19 13:35:21 - Checking 10.0.0.108 for PSU 8 - ping failed

11/18/19 13:35:21 - Checking 10.0.0.109 for PSU 9 - ping failed

11/18/19 13:35:22 - Checking 10.0.0.110 for PSU 10 - ping failed

11/18/19 13:35:22 - Checking 10.0.0.111 for PSU 11 - ping failed

11/18/19 13:35:23 - Checking 10.0.0.120 for GEMINI\_PSU 0 - ping failed

11/18/19 13:35:23 - Checking 10.0.0.121 for GEMINI\_PSU 1 - ping failed

11/18/19 13:35:24 - Checking 10.0.0.122 for GEMINI\_PSU 2 - ping failed

11/18/19 13:35:24 - Checking 10.0.0.123 for GEMINI\_PSU 3 - ping failed

11/18/19 13:35:25 - Checking 10.0.0.124 for GEMINI\_PSU 4 - ping failed

11/18/19 13:35:25 - Checking 10.0.0.125 for GEMINI\_PSU 5 - ping failed

11/18/19 13:35:26 - Checking 10.0.0.126 for GEMINI\_PSU 6 - ping failed

11/18/19 13:35:26 - Checking 10.0.0.127 for GEMINI\_PSU 7 - ping failed

11/18/19 13:35:27 - Checking 10.0.0.128 for GEMINI\_PSU 8 - ping failed

11/18/19 13:35:27 - Checking 10.0.0.129 for GEMINI\_PSU 9 - ping failed

11/18/19 13:35:28 - Checking 10.0.0.130 for GEMINI\_PSU 10 - ping failed

11/18/19 13:35:28 - Checking 10.0.0.131 for GEMINI\_PSU 11 - ping failed

11/18/19 13:35:29 - Checking 10.0.0.10 for CDU 0 - ping failed

11/18/19 13:35:29 - Checking 10.0.0.200 for LCL 0 - ping failed

11/18/19 13:35:30 - Checking 10.0.0.201 for LCL 1 - ping failed

11/18/19 13:35:30 - Checking 10.0.0.202 for LCL 2 - ping failed

11/18/19 13:35:31 - Checking 10.0.0.203 for LCL 3 - ping failed

11/18/19 13:35:31 - Checking 10.0.0.2 for SN 0 - ping failed

11/18/19 13:35:31 - Checking 10.0.0.2 for GEMINI\_SN 0 - ping failed

11/18/19 13:35:32 - Checking 10.0.0.4 for GEMINI\_SN 1 - ping failed

11/18/19 13:35:32 - Checking 10.0.0.6 for GEMINI\_SN 2 - ping failed

11/18/19 13:35:33 - Checking 10.0.0.8 for GEMINI\_SN 3 - ping failed

11/18/19 13:35:33 - Setting up Teradyne\_SMC network adapter...

11/18/19 13:35:33 - Socket created and bound to RDATE port (37).

11/18/19 13:35:33 - Socket created and bound to TFTP port (69).

11/18/19 13:35:33 - Socket created and bound to DHCP port (67).

### Testhead A Initialization (with devices)

When the DHCP server restarts after SMC devices have received their IP addresses, the initialization will find the existing devices and record their MAC and IP addresses to prevent potential conflicts when assigning new IP addresses.

Rather than duplicate the entire initialization log, the following are examples of existing SMC devices “found”.

### 

Check IP of PSU 20 Record MAC address

Check IP of SN 0   
Ascertain Gemini SN 0 by MAC address (b2:00)

Check CDU IP  
Record MAC address

11/15/19 09:33:32 - Checking 10.0.0.120 for GEMINI\_PSU 0 - ping succeeded

11/15/19 09:33:32 - GEMINI\_PSU 0 assigns 10.0.0.120 to 00:30:86:0a:06:ab

11/15/19 09:33:37 - Checking 10.0.0.10 for CDU 0 - ping succeeded

11/15/19 09:33:37 - CDU 0 assigns 10.0.0.10 to f4:54:33:ad:09:2a

11/15/19 09:33:39 - Checking 10.0.0.2 for SN 0 - ping succeeded

11/15/19 09:33:39 - Checking 10.0.0.2 for GEMINI\_SN 0 - ping succeeded

11/15/19 09:33:39 - GEMINI\_SN 0 assigns 10.0.0.2 to 02:50:c2:18:b2:00

### Testhead B Initialization (No DHCP Server)

All SMC IP addresses are served from the host PC associated with testhead A. However, the DHCP server on the PC for testhead B still runs to provide tester IP assignments on ‘Teradyne\_Private’.

### 

Static IPs

Testhead B at IP .3

Expected DHCP server warning

Teradyne DHCP Server Restarting.

12/12/19 10:16:12 - Winsock DLL initiated.

12/12/19 10:16:12 - TFTP path overidden by registry variable to: C:\Program Files (x86)\Teradyne\IG-XL\10.20.77\_uflx\Boards\Images\

12/12/19 10:16:12 - Parsing configuration file: C:\Program Files (x86)\Teradyne\IG-XL\Common\bin\TerDhcpServer.cfg

12/12/19 10:16:12 - Found Teradyne\_Private network adapter IP Address: 172.16.0.1

12/12/19 10:16:12 - Found Teradyne\_SMC network adapter IP Address: 10.0.0.3

12/12/19 10:16:12 - WARNING: Network adapter is not at expected address on subnet (.1)

12/12/19 10:16:12 - -- The DHCP server will not run on this NIC (only TFTP and RDATE).

12/12/19 10:16:12 - Local host name is:T3-UFLX2-Q0B

### IP Assignments for SMC Devices

All DHCP requests are logged with the MAC address and hostname (if provided). Any match to an SMC device type (by a recognized MAC OUI or hostname) is logged along with the IP assigned.

*Note: The PSU ID is included in the hostname and used in the IP assignment.*

Gemini SN 0 (A)

CDU Device

PSU Device – ID 23

11/15/19 09:02:53 - DHCP request received from 02:50:c2:18:b2:00

11/15/19 09:02:53 - Found MAC match for TER device.

11/15/19 09:02:53 - Client recognized and configured with IP address 10.0.0.2

11/15/19 09:03:01 - DHCP request received from f4:54:33:ad:09:2a

11/15/19 09:03:01 - Hostname provided in request: 2080LC50-f45433ad092a.

11/15/19 09:03:01 - Found MAC match for CDU device.

11/15/19 09:03:01 - Identified CDU device by hostname match.

11/15/19 09:03:01 - Client recognized and configured with IP address 10.0.0.10

11/15/19 09:03:47 - DHCP request received from 00:30:86:0a:01:de

11/15/19 09:03:47 - Hostname provided in request: T5979\_1.17\_23.

11/15/19 09:03:47 - Found MAC match for PSU device.

11/15/19 09:03:47 - Identified PSU device by hostname match.

11/15/19 09:03:47 - Client recognized and configured with IP address 10.0.0.123

### Duplicate PSU ID

If DHCP requests are made for a given PSU ID number from multiple devices (as determined by different MAC addresses), the DHCP server will log the error and assign a special IP address designated for PSU duplicates so that the error can be detected by the SN during its discovery process.

Duplicate PSU Error

Duplicate PSU IP

11/15/19 09:47:22 - DHCP request received from 00:30:86:0a:01:de

11/15/19 09:47:22 - Hostname provided in request: T5979\_1.17\_25.

11/15/19 09:47:22 - Found MAC match for PSU device.

11/15/19 09:47:22 - Identified PSU device by hostname match.

11/15/19 09:47:22 - Duplicate Device: T5979\_1.17\_25; GEMINI\_PSU 25 already assigned to 00:30:86:0a:06:ab

11/15/19 09:47:22 - Client recognized and configured with IP address 10.0.0.117

### PSU ID Out of Range

Not all 32 possible PSU IDs are supported by SMC. The DHCP server will recognize a request from a PSU with an unsupported ID number and log the error.

Invalid PSU ID

Invalid PSU ID Error

11/15/19 09:28:17 - DHCP request received from 00:30:86:0a:01:de

11/15/19 09:28:17 - Hostname provided in request: T5979\_1.17\_12.

11/15/19 09:28:17 - Found MAC match for PSU device.

11/15/19 09:28:17 - Identified PSU device by hostname match.

11/15/19 09:28:17 - Device number is not in supported range. Request ignored.

### 24-Slot and 6/12-Slot System Node Conflict

Only the 6/12-slot test systems are designed to share common resources. 24-Slot test system in combination with a 6/12-Slot test system is an unsupported configuration that is detected and logged by the DHCP server.

*Note: The second request to arrive is ignored, regardless of system types.*

Initial Gemini SN Request

Legacy SN Request

Conflict Error

11/15/19 09:02:53 - DHCP request received from 02:50:c2:18:b2:00

11/15/19 09:02:53 - Found MAC match for TER device.

11/15/19 09:02:53 - Client recognized and configured with IP address 10.0.0.2

…

11/15/19 09:32:46 - DHCP request received from 02:50:c2:18:b0:01

11/15/19 09:32:46 - Found MAC match for TER device.

11/15/19 09:32:46 - Conflict detected between Legacy and Gemini SN. Ignoring request.