

# **Güralp Discovery**

# Software Manual

Document Number: MAN-DIS-0001

Issue A,

*Designed and manufactured by* Güralp Systems Limited 3 Midas House, Calleva Park Aldermaston RG7 8EA England

# **Table of Contents**

1	Pre	liminary Notes	6
	1.1	Proprietary Notice	7
	1.2	Cautions and Notes	7
	1.3	Conventions	7

2	Sys	tem Overview	9
2	.1	Key features	9
2	.2	Typical applications	0

3	Networl	k Connectivity	11
	3.1 Ope	eration on a LAN	11
	3.1.1	To DHCP or not to DHCP	12
	3.1.2	Discovering Devices	12
	3.1.3	Changing IP addresses	12
	3.1.4	Manually Adding Devices	13
	3.2 Ope	eration over a WAN	13
	3.2.1	Registry Server	14
	3.2.1.1	Güralp Public Registry	14
	3.2.1.2	Setting Up Güralp Registry	15
	3.2.1.3	Setting Up Your Own Registry	16
	3.2.2	Interacting with WAN Instruments	17
	3.2.2.1	Port Forwarding	17
	3.2.2.2	Router/Gateway VPN	18
	3.2.2.3	Güralp Discovery Tunnel	18

4	Main D	evice List Window Overview	22
4	4.1 Ins	strument State of Health Information	22
	4.1.1	SOH on LAN	22
	4.1.2	SOH via registry on WAN	23

4	.1.3	Options for emailing SOH changes	. 23
4	.1.4	Options for SMS message updates	. 23
4	.1.5	Additional SOH direct from instruments	. 23
4.2	Cor	nectivity	. 23
4.3	Mai	in Window Applets	. 24
4	.3.1	Firmware Update	. 25
4	.3.2	Live View -GDI/GCF	. 26
4	.3.3	Web Page (System Browser)	. 28
4	.3.4	File Exchange	. 29
	4.3.4.1	. Minimus <sub>2</sub> , Minimus Lite and Artius Firmware Update	30
4	.3.5	System Configuration	. 30
4	.3.6	Running Scripts	. 32
4	.3.7	Calibration	. 33

5	Тоо	ls N	lenu	. 37
	5.1	mS	eed to Directory Structure	. 37
	5.2	CA	P Receiver	. 38
	5.2.	1	Network Settings	. 39
	5.2.	2	Map & Table View	. 40
	5.2.	3	Colour Categories – Site Fragility	. 41
	5.2.	4	Event Report & GeoJSON	. 42
	5.2.	5	Download Data	. 43
	5.2.	6	Triggers – Voting	. 44
	5.2.	7	Triggering Test Tool	. 46
	5.3	Min	iSEED Extractor	. 47
	5.4	Min	iSEED Gap Reporter	. 48
	5.5	Cor	nmand Scheduler	. 48

6 Data	Visualisation	
6.1 S	Streaming data into Discovery	
6.1.1	GDI protocol	
6.1.2	Metadata	
6.1.3	Waveform Viewer	

	6.1.3.1	Waveform Visibility	51
	6.1.3.2	Channel metadata	53
	6.1.3.3	Selection mechanism	54
	6.1.3.4	Saving Files	56
	6.1.3.5	Window Control Short-Cuts and controls	57
	6.1.3.6	Window Tools	59
6.2	Offlir	ne Data	. 61
6	.2.1	Jpload Metadata	. 61
6	.2.2	Directories and Filters	. 62

7	Data Ai	nalysis Tools	. 63
7	'.1 Plo	ts	. 64
	7.1.1	PSD	. 64
	7.1.2	Min PSD	. 65
	7.1.3	Self Noise	. 65
	7.1.4	Min Self Noise	. 66
	7.1.5	Spectrogram	. 66
	7.1.6	Transfer Function	. 67
	7.1.7	Channel coherence	. 68
	7.1.8	Channel correlation	. 68
	7.1.9	Alignment	. 69
7	.2 Set	up Calibration Emails	. 71
7	.3 Filt	ers	. 75
	7.3.1	Real-Time Filtering – Inbound Filters	. 76
	7.3.2	Non Real-Time Filtering – Filter+	. 78

8	Gür	alp Data Centre (GDC)	84
ł	8.1	Concept & Purpose	84
	8.2	Software Components	84
	8.3	Operating System Compatibility	84
ł	8.4	Open Ports	85
ł	8.5	GDC Configuration	85
	8.5.	1 IRIS ringserver	85

Ringserver miniSEED files storage location configuration	85
Ringserver miniSEED files storage auto-clean configuration	86
Slinktool	
Slink2dali	
C Discovery Interface	
Configuration - Adding a Station	
State of Health	
Advanced redundancy configuration	
GDC Restreaming	
Viewing Instrument/Digitiser WEB configuration via GDC	
	Ringserver miniSEED files storage location configuration Ringserver miniSEED files storage auto-clean configuration Slinktool Slink2dali C Discovery Interface Configuration - Adding a Station State of Health Advanced redundancy configuration GDC Restreaming Viewing Instrument/Digitiser WEB configuration via GDC

9	Disco	very Configuration	95
9.	1 Co	onfig file	95
9.	2 Da	ata locations	95

10 Ap	10 Appendix 1 - Güralp Discovery Installation						
10.1	Installation in Linux	96					
10.2	Installation in Windows	97					
10.3	Configuring Windows Firewall	100					
10.4	Update	104					
	•						

11	Арр	pendix 2 – I.P. Address Configuration on PC or Laptop	108
1	1.1	On Linux	108
1	1.2	On Windows	109

12	Appendix 3 - Operation with 3 <sup>rd</sup> Party Products	110
13	Revision History	112

# **Preliminary Notes**

### **1.1 Proprietary Notice**

The information in this document is proprietary to Güralp Systems Limited and may be copied or distributed for educational and academic purposes but may not be used commercially without permission.

Whilst every effort is made to ensure the accuracy, completeness and usefulness of the information in the document, neither Güralp Systems Limited nor any employee assumes responsibility or is liable for any incidental or consequential damages resulting from the use of this document.

### 1.2 Cautions and Notes

Cautions and notes are displayed and defined as follows:



**Caution:** A yellow triangle indicates a chance of damage to or failure of the equipment if the caution is not heeded.



Note: A blue circle indicates a procedural or advisory note.

### **1.3 Conventions**

Throughout this manual, examples are given of command-line interactions. In these examples, a fixed-width typeface will be used:

Example of the fixed-width typeface used.

Commands that you are required to type will be shown in bold:

Example of the fixed-width, bold typeface.

Where data that you type may vary depending on your individual configuration, such as parameters to commands, these data are additionally shown in italics:

Example of the fixed-width, bold, italic typeface.

Putting these together into a single example:

System prompt: user input with variable parameters

Specific references to menu buttons or selections are depicted:

Menu Button

# 2 System Overview

*Discovery* is a graphical application that offers a common interface to a number of tools that are relevant to three areas of Seismic instrumentation:

- 1. Instrument connectivity, Network Address Discovery and State of Health Display
- 2. QA of a seismic instrument through data analysis
- 3. Management of data storage and archiving The Güralp Data Centre (GDC)

Discovery is NOT an essential for managing Güralp Seismic instrumentation. However, it is designed with this in mind and offers a set of tools to make that process simple.

Much of the function of the application relates to Ethernet connectivity - either locally (LAN) or remotely via the internet (WAN). The system also supports the loading and analysis offline data files in the industry standard miniSEED format.

The applications name "Discovery" refers to its goal of 'discovering' an instruments IP address. This is done in a number of ways depending on the connectivity.

A wide range of 'applets' are built into the application to assist in verifying an instrument's performance as well as an installation's quality. This in turn offers the ability to diagnose potential problems.

The third area covered relates to recording and storing data from telemetered (Network connected) systems. This GDC function come with a set of tools to assist in the installation, managing and support of both small and large (100's of devices) networked arrays of sensors.

### 2.1 Key features

- IP Address discovery on LAN
- Interface to Güralp Cloud Registry for IP Address and SOH Discovery on WAN
- · Software update tools for Güralp sensors and Digitiser
- Analytic tools for sensor seismic data such as PSD, Coherence, Self-Noise, Correlation Functions, Filter tools
- MiniSEED Import
- Sensor Response plotting
- SOH display, email and text message on event and SOH transitions
- Graphical front end for GDC configuration and monitoring
- Sensor orientation and rotation calculation
- Sensor response and calibration verification

## 2.2 Typical applications

- Sensor performance verification
- Sensor/Digitiser management
- IP Address discovery
- GDC management
- Software update tools
- Digitiser System configuration

# **3 Network Connectivity**

### 3.1 Operation on a LAN

In Scan Locally mode, Discovery will automatically find and list Güralp devices connected via the local network(s). Discovered devices are displayed in the Discovery Main Window, serving as the entry point for the majority of the functionality provided by Discovery. Below is an example of Discovery finding devices on the local ethernet and WiFi, including a statically set device outside the appropriate netmasks.

ile	Edit Tools Wi	ndow Help N	Anuals Vie	w Discovery Manual	london			Clear Sear	
*	Status	Label	System	Name	Firmware Ver	LAN Address	Uptime	Free storage	
	Active	Comet Platinum	Affinity	DAS-405555-london	1.0-15811	10.30.0.103	01:34:26		
		London	Artius	ART-000C	2.1-1714	55.89.144.233	01:00:18	87.65%	
		Comet London	Certimus	CERT-1460	2.1-28926	10.30.0.49	6days 0Hrs	75.83%	
	00	London	Fortimus	FMUS-2169	2.1-28926	192.168.254.105	07:17:50	68.59%	
	00	Comet London	Minimus	MIN-456C	2.1-28932	10.30.0.19	08:16:03	98.62%	
		Comet London	Minimus Lite	MINL-6411	2.1-19520	10.30.0.113	07:48:28	97.58%	
		Comet London	Minimus Plus	MINP-3B68	2.1-28926	10.30.0.4	6days OHrs	99.95%	
Scan Locally O Registry     Devices Visible: 28									
<u>Clo</u>	oud server configu	ration		Search Resu			rah		

Figure 1 Discovery's splash screen, showing various devices

In addition, basic state of health information is presented in this screen, giving a convenient overview of the health of entire seismic networks in a single window.

A list of network interfaces detected and used by Discovery is shown in the Settings page under Device Discovery's Local Network section:

Device discovery	
Registry	
Group identifier:	YourGroupID
Query interval:	30 seconds $\sim$
End point address:	52.34.40.123
Local network	
	Broadcast on 10.30.0.59
Discover method:	Broadcast on 192.168.254.144

Figure 2 Discover methods (broadcast or direct broadcast) listed for each interface

### 3.1.1 To DHCP or not to DHCP

Güralp digitisers default to using DHCP. When coupled with Discovery this works seamlessly in locating device IPs. This is more often than not the best solution.

Static IP addresses often have hidden side effects and require both the netmask and default gateway to be set correctly.

### 3.1.2 Discovering Devices

Discovery makes use of broadcast packets to give the best chance of making contact with as many instruments as possible. A broadcast UDP packet is sent roughly every 10 seconds addressed to port 11788. Any Güralp device that receives this packet will respond with a single packet. This response is a Unicast packet if the device sees the Discovery packet as emanating from the same subnet. If the device sees the Discovery packet comes from another subnet, the response will be a broadcast.

This minimises the amount of local broadcast activity but still allows instruments to be "discovered" even if their IP address is on a different subnet. This would be the case if an instruments address was simply set wrongly on that connection.

This ability allows an instrument to be "discovered" and then configured even if its address is set arbitrarily.

From when Discovery is put into Scan Locally mode, regular attempts are made to probe the local network. This is both to find new devices and to refresh data for known devices with the latest state of health information.

In addition, Güralp devices will emit unsolicited network probes to promote detection with instances of Discovery running on their local network as quickly as possible. This typically occurs when a system starts up.

Not seeing an instrument respond when plugged directly into the LAN of a laptop can only be caused by firewall rules in the PC.

### 3.1.3 Changing IP addresses

Right-clicking the listed device and selecting **Edit Network Address** offers the option to set the IP Address. This is possible provided the system is on the same physical subnet as the computer running Discovery. A broadcast is used to send the new address so this will function even if the current address does not the computer's subnet.

#### Network Connectivity

#### Güralp Discovery - Software Manual

		0.0.0.0	101201210					
5C	(MIN-685C)	0.0.0.0	10.20.0.77	255.2				
58	Edit Network Address — Discovery ×							
57	Device Serial #: 679	99	1	255.2				
57	Update IP configuration:							
05	Network Address:	12 .1 .2 .	34	255.2				
99	Netmask: 255.255.0 .0							
65	Gateway:	<pre><keep existi<="" pre=""></keep></pre>	ng>	255.2				
EE		1		255.2				
0A	Obtain IP address	s automatically (D	нср)	255.2				
08	Local : 10.30.255.197							
65	(MINL-6765)	0.0.0.0	10.30.0.2/	255.2				
FD	(MINL-65FD)	0.0.0.0	10.30.0.41	255.2				

Figure 3 Change Network Address applet

### 3.1.4 Manually Adding Devices

In most cases it is *not* necessary to have prior knowledge of the network address of a device. However, different operating systems, subnet configurations, network topologies and networking hardware can affect the discovery of devices; in some cases not every device can be automatically found. In these situations it is possible to manually add a known device IP address to populate an entry in the Discovery main window.

Select the Edit menu option, followed by Add Device.

Manually adding a device's IP address can also be useful where direct communication is possible but outside of the local network, beyond the reach of broadcast packets; for example where a VPN has been used to connect to a remote device.

This is not a common use case.

### 3.2 Operation over a WAN

Where instruments are not located on the same local network as the instance of Discovery, the same automatic device detection as outlined for local devices is not possible. Moreover, network features such as firewalls and Network Address Translation often prevents direct communication between remotely located Güralp devices and Discovery instances completely, even if the device's IP address is already known.

### 3.2.1 Registry Server

Even in situations where direct network connectivity between Discovery and Güralp instruments is not feasible, device discovery and live instrument state of health updates are still possible. As long as both the Discovery instance and Güralp device are able to make outgoing connections to the same WAN (for example, the internet), a Güralp Registry Server may be used to facilitate communication between them.

A *Registry Server* is a publicly accessible server located on the WAN which is running Güralp's Responder software as a service.

A single outbound UDP packet is sent from the digitiser to the Registry Server every 10 seconds by default. The destination port number is 11788.

At deployment, instruments can be configured to make themselves known to one or more Registry Servers. In this fashion, a constantly updated list of instruments, with their state of health information, is maintained for a distributed network of seismic stations and devices.

Choosing **Registry** mode in the Discovery main window causes Discovery to poll the configured Registry Servers for their listed devices. The Main Window will be populated with these devices, displaying their identifying information, network addresses and state of health as if they had been discovered locally.

It comprises a simple binary that runs headless on a computer. A single UDP port 11788 must be open.

WAN Address reflects packet return address in packets received by registry from devices.

LAN Address reflects the instruments address on its ethernet interface.

### 3.2.1.1 Güralp Public Registry

To allow users to try this functionality before setting up their own Registry Server, Güralp hosts public Registry Servers for customer use. Only systems that have a matching "Group ID" are visible to a particular user. This service offers a simple way to discover the IP address of a system and to see the basic State of Health parameters of the system.

The default registry address shown below is programmed into all Güralp digitisers systems as a default.

*52.34.40.123 IP address of Güralp's Default Public Registry* 

To set up your own Registry Server, contact Güralp Systems for further information.

MAN-DIS-0001

### 3.2.1.2 Setting Up Güralp Registry

As mentioned previously, registered devices must be assigned to groups, each of which has a "Group Identifier". Instances of Discovery must also be configured with a Group ID and can only display registered devices from the matching group. This allows partitioning of large networks into smaller administrative domains. It also makes the simultaneous use of the Güralp shared Registry Server by multiple organisations possible.

Therefore, to use the Registry, you need to configure both the device and Discovery. Please follow these steps to set up your Registry.

- First, the address of the Registry Server and the chosen Group ID must be set individually for each participating device. To do this, first connect the device to the same network as a PC running Discovery. Then open the webpage and set Group ID and Registry address from the Network tab. To use the Güralp shared cloud server, enter 52.34.40.123.
- Once you have set these values, the device must be rebooted before the changes will take effect.
- Last, open Discovery and click on Cloud server configuration at the bottom left of the main window. Enter the Group ID and server IP address in the relevant fields ("Group identifier" and "End point address", respectively). Click on Apply.

From Discovery's main window, click the **Registry** button and all devices configured with the same Registry server and Group ID will now appear in the main list.

Discov	very			×						
Basic	Advanced									
Gener	General General Show unknown type system in application main device list Use slow draw mode for Data Viewer (for low end computers)									
Devic	Device discovery									
Group	u <u>v</u> o identifier:		YourGroupID							
Query	interval:		30 seconds $\sim$							
End p	oint address:		52.34.40.123							
Local	network									
Disco	ver method:		Broadcast on 10.30.0.59 Broadcast on 192.168.254.144							
Eartho	quake early wa	rning								
🗆 Hi	Highlight triggering station									
🗆 Au	Automatically clear the trigger on station information update									
Use sound notifications										
Restore d	lefaults		OK Cance	I						

Figure 4 Cloud Server Configuration window

### 3.2.1.3 Setting Up Your Own Registry

Administrators can create their own registry servers by installing a simple program on a server. The server itself must have a static IP address and be accessible to all connected devices, as well as the PCs running Discovery.

In order to create your own registry, Please follow these steps to set up your Registry.

- Contact Güralp technical support (<u>support@guralp.com</u>) to receive a copy of the program;
- Download the file attached to your email;
- Run the binary guralp\_responder on a Linux machine with a -d switch using the command:

./guralp\_responder -d

- Open the instrument's webpage and change the Registry IP address on the Network tab to be the one of the PC where the responder is running. Set a Group ID using the key you prefer. Repeat for all the instruments you want to add to the Registry;
- Open Discovery and change the IP address from Cloud Server Configuration on bottom-left of the window with the one of the PC running the responder;
- From the same window, set the same Group ID you used in the instrument's webpage;
- Click on **Registry** button in Discovery.

You should now see the configured devices appearing in Discovery main window when you click on Registry button.

In order to make it work, the following network ports need to be open:

UDP 11788 UDP 11789 TCP 11789



**Note:** The PC with the responder and the PC with Discovery cannot be the same machine because the same port 11788 cannot be used for different purposes.

If the instruments and the machine running the responder are in different networks you have to make sure that the ports in Table 1 below are also open/forwarded.

### **3.2.2 Interacting with WAN Instruments**

Beyond the information transmitted via Registry Servers, as outlined above, the functionality available for each instrument in Discovery depends upon network connectivity between the Discovery instance and the device.

In terms of configuring firewalls, the product manual provided for each Güralp device will outline the required open network ports for given functionality.

The most common are:

Port	Layer 4 Protocol	Description
80	TCP	HTTP server
1565	TCP	GDI transmission protocol
1567	TCP/UDP	GCF transmission protocol
4242	TCP	File exchange protocol
4244	TCP	Remote console
11788	UDP	Remote procedure calls
18000	TCP	SEEDlink transmission protocol

*Table 1 List of the main required open network ports* 

The most common and significant hurdle to communicating with remote devices is Network Address Translation. A number of solutions are here presented.

Right-clicking on the instrument row (on any column BUT the LAN address one) offers various functions that will all use the WAN address to communicate with the instrument. So all will function as expected as long as ports are open.

Right-clicking on the LAN address column forces the use of the LAN IP address to communicate with the device instead.

#### 3.2.2.1 Port Forwarding

In some cases, depending on networking equipment and topology, it may be possible to arrange the relevant device network ports to be forwarded by the WAN router. This allows direct connections to the remote device.

If a device is made available via port forwarding, users should initiate Discovery functionalities using the WAN address of the instrument. Where multiple network addresses are available for an instrument, it is possible to force Discovery to use the WAN address by selecting the WAN Address column of the device entry. Subsequent invocations either via the Edit menu or the right-click context menu will then utilise the WAN address. The WAN address is used by default when in Registry Mode

It is common when port forwarding to remap port numbers away from the default internal device ports when presented to the WAN. Discovery allows for this by MAN-DIS-0001 17

allowing for per device custom port numbers. Right-clicking on the instrument and selecting **Device Port Configuration** opens a window to change forwarding ports for an individual instrument.

3 MINL-66F9 port configuration - Discovery $ \Box$ $\times$								
HTTP server	80							
GDI transmission protocol	1565							
GCF transmission protocol	1567							
File exchange protocol	4242							
Remote console	4244							
Remote procedure calls	11788							
SEEDlink transmission protocol	18000							
Restore defaults		Clos	se	Apply	,			

Figure 5 Port configuration window for an individual device

### 3.2.2.2 Router/Gateway VPN

Some WAN routers include a VPN client feature which may allow remotely located instruments to appear as if they are on the same local network as the Discovery instance. Setting up a VPN is beyond the scope of this manual.

In some cases it is necessary to manually add devices which are accessible via a VPN, by selecting Edit  $\rightarrow$  Add Device.

### 3.2.2.3 Güralp Discovery Tunnel

The easiest way to overcome firewall and NAT networking challenges with remote instruments is to use the Güralp Discovery Tunnel. By combining a Güralp device running Dig firmware with a Registry Server and Discovery, it is possible to maintain full connectivity with remote WAN connected instruments without any extra network configuration (beyond connecting the instrument to the WAN).

This feature allows all network traffic between a Discovery instance and instrument to be routed via a Registry Server, using only outgoing TCP connections from each end point (device and Discovery instance). In this way, full communication is possible through firewalls and NAT routers without special configurations or degrading network security.



Figure 6 Discovery Tunnel

To enable this feature, relevant Güralp devices should be assigned to a Registry server and the **Tunnel Auto Connect** setting should be enabled. Where multiple Registry servers can be configured, the first Registry server slot should contain the tunnel enabled Registry server. For more details refer to the device manual.

To allow connectivity via a Registry server, the tunnel option must also be enabled when starting the Responder service. For more details refer to the help information for Responder. Port 8190 TCP is used to make the connection to the remote registry server from the digitiser – so this outbound port must be permitted in any firewall rules.

Generally, all that is required is the enable of the tunnel connection within the instrument by ticking the **Tunnel Auto Connect** box from the webpage, under the **Network** tab.



Figure 7 Discovery tunnel option available from the Network tab of the instrument webpage

In **Registry** mode, the Discovery Main Window will display the tunnel availability of listed devices. If this column is not displayed, it can be enabled by selecting **Window** → **Show** → **Tunnel Available**. Devices connected to a tunnel enabled Registry server

(and with tunnel connection enabled) will be indicated with "Available" in the Tunnel Available column.

Uptime	Last Contact	Latitude	Longitude	Tunnel Available	^
15days 14Hrs	Just Now	41.2938	-82.1524	Not Available	
247days 3Hrs	Just Now	-30.8091	22.1089	Not Available	
10days 15Hrs	Just Now	28.9985	-13.7498	Not Available	
8days 21Hrs	Just Now	18.9832	-99.2380	Not Available	
9days 4Hrs	Just Now	3.5349	-76.8709	Available	
3days 7Hrs	Just Now	3.5357	-76.8695	Available	
9days 4Hrs	Just Now	3.5354	-76.8689	Available	
14days 0Hrs	Just Now	51.3609	-1.1632	Not Available	
00:07:35	Just Now	51.3608	-1.1633	Not Available	
191days 18Hrs	2024-04-30T21:30:50	41.5156	118.8553	Not Available	
68days 16Hrs	Just Now	9.7799	-83.8415	Not Available	
5days 13Hrs	Just Now	1.2078	-77.3588	Not Available	
453days 23Hrs	Just Now	45.7559	5.4760	Not Available	
15days 4Hrs	Just Now	10.2807	-84.9628	Not Available	
11days 17Hrs	Just Now	0.0000	0.0000	Not Available	
				~	

-

Figure 8 Tunnel status shown in main device list

To utilise the tunnel connection, simply invoke a Discovery applet with the chosen device selected in Registry mode. Discovery will automatically default to using the tunnel network address for all communications with the instrument (unless the user specifically selects the WAN or LAN fields).

güral

More information regarding the tunnel's operation is shown in the Tunnel Status applet available by right-clicking on the entry of a device whose tunnel is enabled. This provides detailed status and connection information for each tunnel connected device.

### Network Connectivity

 $\times$ 

3 (CERT-2B69) Tunnel - Discovery

Registry Address	52.34.40.123	HTTP Web	127.10.43.105:22080				
Tunnel Relay	Connected	GDI	127.10.43.105:1565				
Device Connected		GCF	127.10.43.105:1567				
		File Exchange	127.10.43.105:4242				
		Remote Console	127.10.43.105:4244				
		RPC	127.10.43.105:11788				
		SeedLink	127.10.43.105:18000				
01/05/24 10:00:38 2131372905 ] 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38 01/05/24 10:00:38	01/05/24 10:00:38: Tunnel for device serial #: 11113 New Request. Suggested bind address: QHostAddress("127.10.43.105") [ 2131372905 ] 01/05/24 10:00:38: Attempting to bind sockets to QHostAddress("127.10.43.105")   Attempts left: 10 01/05/24 10:00:38: GDI socket Listening 01/05/24 10:00:38: GCF TCP socket listening 01/05/24 10:00:38: GCF TCP socket listening 01/05/24 10:00:38: GCF UDP Socket listening 01/05/24 10:00:38: RPC socket listening 01/05/24 10:00:38: RPC socket listening 01/05/24 10:00:38: Rept socket listening 01/05/24 10:00:38: Remote Console socket listening 01/05/24 10:00:38: Created: Istening 01/05/24 10:00:38: Created: QHostAddress("127.10.43.105") QAbstractSocket::ConnectedState						
			×				

Figure 9 Tunnel status applet

# 4 Main Device List Window Overview

### 4.1 Instrument State of Health Information

### 4.1.1 SOH on LAN

The instruments response to the Broadcast discovery packet on the LAN contains a range of state of health (SOH) information. The instrument's serial number, software version, supply voltage, temperature, event trigger status are all included.

To choose which parameters to display on the main window, click on Window  $\rightarrow$  Show and tick the boxes of the desired parameter.

The displayed values are typically shown with a latency of about 10 seconds. The time of last contact is remembered so an instrument that stops working or becomes disconnected from the network will be shown with its last (old) contact time.

Manually clicking the Scan Locally button, or the shortcut key F5, will clear the display of old instruments, losing the knowledge of the last contact times.

G	üralp Sy	/stems - [	Discovery												
File	Edit	Tools	Window Help												
*		Status	Scan Locally C	Ctrl+L		Serial #	Firmware Ver	Last Contact	Latitude	Longitude	Timing quality	Voltage	Humidity	Temperature	Free storage
		(()	Registry C	.tri+κ		E857	2 1-25520	Just Now	51.3612	-1.1640	100	12.70V	22%	34.90°C	97.34%
			Show	•	× 3	at the second se		Just Now	-59.9000	85.1029	0	1.00V	25%	32.30°C	90.56%
		$\overline{\mathbb{O}}$	Yen Testing		- 3 - L	abel		Just Now	51.3612	-1.1640	100	12.20V	28%	29.60°C	87.57%
			Ian's Minimus2		s	ystem		Just Now	0.0000	0.0000	0	12.60V	29%	32.40°C	98.70%
			FXM		Ν	lame		Just Now	-59.9000	91.6010	0	12.40V	20%	34.80°C	73.29%
		O	Ian's Minimus		v s	EED Name ierial #		Just Now	51.3614	-1.1642	0	12.50V	20%	33.30°C	99.99%
		O	NO LABEL		✓ F	irmware Ver		Just Now	-59.9000	99.1990	0	24.20V	21%	40.70°C	74.60%
		O	MARIS		(	Identifier)		Just Now	-59.9000	105.7960	0	33.10V	34%	35.10°C	99.99%
		Q	CERTIS_TEST04		V	VAN Address		Just Now	51.3608	-1.1634	0	23.00V	17%	36.00°C	70.29%
		Q	TestRoom1_CertisT	Fest#03	N	vetmask		Just Now	51.3604	-1.1640	0	15.60V	12%	40.10°C	93.72%
			Yen Testing		L	Jptime		Just Now	51.3611	-1.1641	100	13.10V	22%	34.10°C	94.80%
		Ö	NO LABEL		× L	ast Contact		Just Now	51.3612	-1.1640	100	9.20V	33%	26.90°C	
		Õ	Test Rack 3		✓ L ✓ I	atitude ongitude		Just Now	51.3612	-1.1641	100	24.30V	23%	32.60°C	97.37%
		Õ	3T reference COME	ET5	A	ltitude		Just Now	51.3612	-1.1641	100	16.30V	18%	33.30°C	83.95%
		Q			~ т	iming quality		Just Now	51.3606	-1.1635	0	24.00V	15%	31.90°C	99.87%
		Ö	2024 Freeze Off So	3		/oltage Jumidity		Just Now	51.3601	-1.1641	0	16.10V	19%	34.30°C	71.64%
	Ö	Ö	FXM		~ г ~ т	emperature		Just Now	-59,9000	104.4570	0	PoE	25%	33.30°C	99.39%
	Ö	Ö	SUPRT-EMUS		✓ F	ree storage		Just Now	51,3606	-1.1633	0	14.00V	24%	31.00°C	98.26%
		Ø	ENGTEST#02	_	L	ast EEW Time	stamp	Just Now	51,3612	-1.1640	100	15.70V	18%	34.30°C	99.84%
					✓ L ✓ т	ast EEW PGA I Junnel Availabi	le	Just Now	51 3611	-1 1641	100	24 30V	20%	34.60%	79.05%
					N	Network latence	y	Just Now	51 3611	-1 1642	100	24 20V	25%	36.40%	99.50%
			TostRoom1 CortisT	Foct#01	0	Data latency		Just Now	-50 0000	97 9090	0	12 201	2370	22.60%C	99.3070
H			CAP Testing 2	01	C	Cal Date		Just New	51 2606	-1 1625	0	24 701/	2270	22.00 C	00.44%
H			CAP Testing 3		B	attery Charge lattery Lifetime	e	Just New	51.3000	1 1627	0	24.700	2370	32.20-0	96.499/
H			CAP Testing 2		В	lattery Charge	Power	JUST NOW	51.3008	-1.103/	0	24.00V	28%	31./0~C	80.48%
			NO LABEL		В	attery Temper	rature	JUSE NOW	51.3010	-1.1640	0	11.00V	23%	34.30°C	98.09%

Figure 10 Example of some of the available parameters showing instrument's state of health

MAN-DIS-0001

### 4.1.2 SOH via registry on WAN

Operationally, the available SOH parameters for devices on a WAN are much the same as above. The information latency is between 10-20 seconds as the data must be fetched from the Registry server rather than directly from the device. The information remains on the Registry server for 24 hours (configurable). Restarting the local Discovery or pressing the **Registry** button simple re-fetches this SOH information.

The registry server can be configured to send emails or text messages when some changes happen in the systems in the Registry, such as:

- a system (which was not in the network) appears into the network
- a system disappears from the network (lost contact for more than 2 minutes)
- a system re-appears into the network
- the Status of a system changes
- an event is detected.

This functionality makes the monitoring of medium-large network easy and efficient.

### 4.1.3 Options for emailing SOH changes

HOW TO CONFIGURE FOR EMAILS - Work in progress....

### 4.1.4 Options for SMS message updates

HOW TO CONFIG FOR TEXT - Work in progress....

### 4.1.5 Additional SOH direct from instruments

Work in progress....

### 4.2 Connectivity

The IP addresses listed can be used to make connection with the digitiser devices.

slinktool -S DG\_05656 -v -p min-5656

slinkttool -Q 192.168.1.2

telnet 10.20.1.2 -P 11789

Ping 10.20.1.1

Example of connection to a seedlink server:

telnet min-5656 18000

MAN-DIS-0001

Trying 10.30.0.7...

Connected to min-5656.

Escape character is '^]'.

HELLO

SeedLink v3.0 (MIN-5656 CAP Testing 3) :: SLPROTO:3.0

DG.05656

Güralp Systems - Discovery

### 4.3 Main Window Applets

Right-clicking on a system offers a number of operations that depend on the recognised instrument type and potentially software version. Some of the available applets are introduced in the following Sections.

File Edit Tools Window Help Status Label Serial # Firmware Ver Last Contact Latitude Longitude NO LABEL 0155 2.1-21248 Just Now -59.9000 85.1029 🗆 🕥 🕓 🏻 Yen Testing 115D 2.1-21247 Just Now 51.3612 -1.1640 Ian's Minimus2 6805 2.1-13962 Just Now 0.0000 0.0000 FXM A75B 2.1-25440 Just Now -59.9000 91.6010  $\bigcirc$  $\bigcirc$ Ian's Minimus 9261 2.1-24257 Just Now 51.3614 -1.1642 NO LABEL 2 1-23401 Just Now -59.9000 99.1990 MINP-2163 10.30.0.106 MARIS -59.9000 105.7960 low Control Centre CERTIS\_TEST04 51.3608 -1.1634 low Live View ٠ TestRoom1\_CertisTest#0 -1.1640 51.3604 U low Firmware Update System Configuration Yen Testing 51.3612 -1.1641 1 low **Device Port Configuration** NO LABEL 51.3612 -1.1639 low Edit Network Address Test Rack 3 51.3612 -1.1641 1 low File Exchange **Tunnel Status** 3T reference COMET5 low 51.3612 -1.1641 Show On Map NO LABEL 51.3606 -1.1634 1 low View Web Page W 2024 Freeze Off SG 51.3601 -1.1641low View Web Page (in system browser) FXM -59.9000 104.4570 low Calibration SUPRT-FMUS 4D67 51.3606 -1.1633 2.1-21248 Just Now

Figure 11 Right-click menu

### 4.3.1 Firmware Update

**Caution:** Do **NOT** follow these instructions to update the firmware of Minimus<sub>2</sub>, Minimus Lite and Artius. To update the firmware of Minimus<sub>2</sub>, Minimus Lite and Artius units, follow the procedure in Section 4.3.4.1.

The **Firmware Update** applet offers automatic download of appropriate versions for Minimus, Minimus+, Fortimus and Certimus units. The software is then sent to the instrument where it is verified and stored before installation begins. Network problems during the upgrade process are therefore NOT an issue. The update is only performed at the instrument when all information is on the instrument. The update will continue even if the network disconnects at that point.

System updates do not affect the network settings such as IP address. Other parameters are typically reset to defaults when the new software starts up for the first time. Older system settings can be automatically re-applied after the update completes if the suitable options are ticked in the applet.

MINP-2163 - Firmware Update - Discovery			-		×
Host name: MINP-2163 IP address: 10.30.0.106 MAC address: 8C:59:3C:41:63:21					
Configuration					
Automatically download/upload configuration					
○ Reset configuration					
○ Apply configuration from file				Browse	
Firmware					
Current firmware date: 20-Feb-2024					
Current firmware version: 2.1-23491	_				_
Güralp server - stable (online version: 2.1-21248) Release r	notes	Get from serve	er and up	odate	
○ Güralp server - experimental (online version: 2.1-24522)		Get from serve	er and up	odate	
O Local file s/frestelli/Documents/Firmware/DIG	G_21243.gz	Browse	Up	pdate	
			[	Close	0% e

*Figure 12 Firmware Update applet for firmware update of Minimus, Minimus+, Fortimus and Certimus* 

Much of the applet is concerned with where the firmware file should be downloaded from. Typically, this will be from the Güralp webserver. There are always 2 versions available: the current qualified stable release and an experimental (Beta) build.

The experimental build is typically based on the last stable build but with additional bug fixes and features. It is generally not recommended to use the experimental version for active deployments unless directed by Güralp support.

Once an update has completed successfully from a local file path, it is then possible to perform multiple updates on other systems in one operation. Simply select a group of instruments in the devices list and right-click the **Firmware Update** option. This will launch multiple update applets that will run in parallel. Each will close as it completes.

### 4.3.2 Live View -GDI/GCF

The **Live View** applet launches the live seismic data viewer and a stream of data is initiated. The GCF protocol is offered for older systems. Newer systems all support the GDI protocol (and SeedLink). GDI (Güralp Data Interchange) runs over a TCP connection. It supports the concept of additional metadata on each stream as well as multiple streams on the same TCP connection at potentially differing sample rates. The protocol generally has a lower latency than GCF or SeedLink as samples are sent when ready rather than waiting for a full packet. When several channels are used (Z, N, E, Mass etc) this results in efficient packets being sent with a mix of the channels depending on sample rates. This differs to SeedLink where a packet contains only one channels data and must be filled with that channel alone before transmission.

The addition of metadata in the connection also ensures that instrument response and calibration parameters are inseparable from the seismic data. When a connection is made the calibration and response and SI Units etc all come automatically.



Figure 13 Waveform viewer main window

The left hand list of channels can be used to enable the display of the data in right hand viewer by using the tick boxes. Hovering over the name in the Channel List or the Channel name box in the viewer will display a hover help list of the channel's metadata as shown below:

ions 🗈 Güralp Systems — Disco	overv		MNF85C-1VELN2		24 Oct 12:46
		_	Name	Value	
			M-CAL	2.4400E-7	— Discovery
Add Device Load Search	Fit to v	iew Normali	M-CHAINNAME	S1SeisN	>> >>> Select range Go to 🕟 It. 🔯
Data		Scaling	M-COMPONENT	1	Timeline Tools
Channel List	Ξ×	MNF85	M-DAC	2.4400E-7	11:46:00 11:46:10
✓ ■ CERT-F85C		m.s <sup>-1</sup> Min = 1.0	M-DESCRIPTION	Main seismometer N chain	
✓ ■ Ainstrument		Max = -1.0	M-DISPCOLOUR	#FF0000	In the second
> Slint2		Avg = -1.0	M-DispNode	Ainstrument	
S1IntE		Scale = 66.	M-GAIN-0	2.4400E-7	A PERSON NUMBER OF A REAL PROPERTY OF A REA
Image: Size Size Size Size Size Size Size Size			M-GAIN-1	1.9396E+9	
✓ S1SeisE		MALEOF	M-GAIN-2	1	
S1RatioZ		m.s <sup>-1</sup>	M-GAIN-3	0	
► S1LTAZ		Min = -1.0	M-GAIN-4	-7.54E+16	
S1ClkDacFreqPull S1ClkDacFreqPull		Max = -1.0 Avg = -1.0	M-GAIN-5	-1.20E-24	
SIPLLOffset		Latency = 313	M-GAIN-6	-6.51E-32	
S1Pres		Scale = 100	M-GAIN-7	3.782E+20	
S1RotPitch S1RotRoll			M-GROUP	1	
IsiRotYaw		MNF850	M-MODIFIER	1	
S1TemprB     Timing		m.s" Min = 0.0	M-MODIFIERNAME		addina.
► MEMS		Max = 0.5	M-POLE-0	-63.7927 + i*-90.3864	
Power		Avg = 0.2 Latency = 269	M-POLE-1	-63.7927 + i*90.386398	
• Environment		Scale = 66.	M-POLE-10	-9.24E+37 + i*-1.46E+36	fflh.
			M-POLE-2	-755.898 + i*0	
		MNE85	M-POLE-3	-209.656 + i*0	
		m.s <sup>-1</sup>	M-SEEDNAME	DG.0F85C.1K.MHN	
		Min = 0.3 Max = 0.3	M-UNITNAME	Metres per Second	
		Avg = 0.3	M-WEBTXT	m.s <sup>-1</sup>	
		Latency = 313	M-ZERO-4	-9.50E+37 + i*3.358E-15	
		Scale = 225	M-ZERO-5	-4.52E+21+i*-2.45E+38	
			Transform	None	
		MNF850	adc-bitweight	2.4400E-7	
		Min = 0.0	adc-pga	1	111 TELEVISION CONTRACTOR CONTRACTOR CONTRACTOR AND A CONTRA
		Max = 0.0	component	N	
		Avg = 0.0 Latency = 268	data-class	primary	Will Mitch the state of the state
		Scale = 66.	dimension	velocity	ulle.
Select groups up to 1			gcf-channel-name	MNF85C-1VELN2	
	-	MNF85	instrument-id	CERT-F85C.S1Seis	
Select All Clear All		m.s <sup>-1</sup>	instrument-type	high-gain-seismometer	
Keep data in memory for		Min = 0.0 Max = 0.0	sensor-gain	1	
12 Hours	-	Avg = 0.0	sensor-is-differential	false	
Group viewer streams by		Latency = 313 Scale = 100	1%		
Device ID     O Stream type	e	100			
Reverse sort					
2.0.113005-beta		)	X 2024/1	0/24 11:45:43.038	

Figure 14 Channel associated metadata

### 4.3.3 Web Page (System Browser)



Guralp Systems Limited Midas House, Calleva Park, Aldermaston, Reading, RG7 8EA, UK Tel: +44 118 981 9056, Fax: +44 118 981 9943 E-Mait: <u>sales@guralp.com</u>, <u>support@guralp.com</u>

Figure 15 An instrument's WEB page

Most Güralp product's configuration can be viewed and modified via a Web page, which can be accessed by selecting the applet View Web Page. This is served by a HTTP Server within the instrument or Digitiser. This option launches a WEB viewer from within the Discovery software. This has limited functionality but is more than sufficient for most operations. The system browser can be launched if an alternative browser is required for say download management.

An instrument's webpage can also be accessed by typing the instrument's IP address in a web browser.

### 4.3.4 File Exchange

FMUS-CD5A - File Exchange — Discovery	×	
File download          Download file:       /ram/xtaltable.txt         Download as:	Browse	Receive a file from Instrument
Upload file:paczek/minimus2_project/Default/minimus2_project.bin	Browse	Send a file from PC to Instrument
Make web accessible	Upload	
	Ok	

#### Figure 16 File exchange window

File exchange enables files to be sent to a digitiser or received from a digitiser. This can be used for log files, station XML etc and software updates of certain systems and sub-systems.

When sending a file to a digitiser the 'Upload as' field specifies the name of the file as written in the digitiser. This is typically of importance as a number of specific filenames are known to the receiving systems and are used as the cue to decide what to do with the new file.

Some examples below:

'certis.bin' - software for the Certis instrument

'femtomus.bin' – software for Aquarius and Certimus ultralow power internal digitiser

battery\_project.bin - Power Pack Module firmware update

Once the filename paths are set up in the applet, multiple systems can be updated in one hit. Simply select a group of instruments in the device list and right-click the File Exchange selection. This will launch multiple applets that run in parallel. The popup will close automatically as it completes the transfer.



**Note:** This does not mean that an update is fully complete – only the file transfer. Watch the LEDs on the instrument or the device list to reflect the new version etc. *before* repowering anything.

The file exchange window can also be used to run a script file that contains a list of commands to be executed at specific dates and time. This can be used for operations such as scheduled instrument calibration. For more details, see Section.

### 4.3.4.1 Minimus<sub>2</sub>, Minimus Lite and Artius Firmware Update

File Exchange, specifically the bottom section called File Upload, is also used for updating the firmware of the Minimus<sub>2</sub> and Minimus Lite units. The Prepare Firmware Update option automatically downloads the most recent stable or experimental build from the web and fills in the columns above, ready for the upload.

Caution: When using the Stable and Experimental buttons next to Prepare
 Firmware Update for the update process, it is vital that the name next to
 "Upload as" remains unchanged. Any alterations will result in issues after uploading this new firmware.

, mile or of the exchange observery	-		×
File download			
Download file:			
Download as:	Browse		
		Downlo	ad
File upload Upload file: C:/Users/kkitka/AppData/Local/Temp/kkitka/firmware_update_files/minl_rele	ase.bin	Browse	
Upload as: /ram/minimus2_project.bin			
Make web accessible			
Upload as:     /ram/minimus2_project.bin       Make web accessible       Prepare Firmware Update:     Stable       Experimental		Uploa	d

### 4.3.5 System Configuration

A Configuration Import/Export tool can be access by selecting System Configuration. All Güralp digital sensors and digitisers have the idea of configuration files. These allow the entire system configuration to be copied from a system and reapplied to another system (or systems).

The config file is in text readable format. It comprises name/value pairs. The names are the same as they appear on the instrument's web page. Text values appear as they do on the web page. Pulldown menus appear as enumerations (index into the list).

The config files can be manually edited if desired. It is also possible to remove items from a config file. This has the effect of those parameters remaining unchanged when the settings are applied. This may be useful when a group of instruments with unique system and station names require all their channel sample rates changing without affecting other parameters such as the names, or you can make a file with

MAN-DIS-0001

perhaps just one parameter that can be sent to a group of systems to change just that singular setting.

System Configuration Import/Export Tool - Distance	covery	_		$\times$	
Configuration source					
$\textcircled{\ensuremath{}}$ Use configuration from one of the devices:	CERT-E667 (10.20.1.92)	M Download co	nfiguratio	on	
$\bigcirc$ Use configuration from file:	C:/Users/frestelli/Downloads	Brow	/se		
Devices Select devices for configuration upload		Check the s the "U	system Jpload	is tl coi	hat will receive the config file when nfiguration" button is pressed.
MINP-6158 (10.30.0.74)		Note: selec	ting a (	gro	up of systems from the systems list
MIN-4058 (10.20.0.146)		before righ	IT-CIICK	ing	the same effect
Select All	L				
Upload					
		Upload co	nfiguratio	on	
		Rebo	ot selecte	ed	
			OK		

#### Figure 17 System configuration window

To perform mass configuration, preselect a group of instrument in the Discovery device list, right-click and select System Configuration. The applet below appears with the instruments preselected (ticked). Further selection of additional instruments can be performed before uploading a chosen file to all the selected systems in parallel. Once the Upload is complete, the Reboot Selected button can be used to restart all the instruments in one button press.

Loading an old .config file onto a system with newer software is perfectly acceptable. Any new parameters added in the newer version will simply not be modified by the upload.

#### Main Device List Window Overview

								Gür	alp Systems — Dis	icovery							
<u>Fia</u>	pdit 1	ools Wi	qiet wohe											Search			Clear Searc
*		States	Label		System	Name	SEED Name	Serial #	Firmware Ver	(Identifier)	WAN Address	LAN Address	Netnask	uptime	Last Contact	Latitude	Longitu
		0	Midwa ND LADEL		Minimus	MIN-2058	06.02060	2050	2.1-21244	(MIN-2168)	0.0.0.0	10.20.0.72	255.255.0.0	00:50:01	2023-12-13710:26:43	51.3807	-1.1635
		0	Nidas ND LAREL		Mininus	MIN-3368	06.03368	2368	2.1-21244	(NDN-3268)	0.0.0.0	10.20.0.112	255.255.0.0	00:31:03	2023-12-13718:26:43	51.3667	-1.1634
		0	MLCas NO LABEL		Mininus	MIN-3568	06.03568	3568	2.1-21244	(MDN-3568)	0.0.0.0	10.20.0.78	255.255.0.0	00:18:22	2023-12-13T10:26:13	51.3667	-1.1634
		0	NLCas NO LABEL		Mininus	MIN-3068	56.83068	3068	2.1.21244	UNDN-3C683	0.0.0.0	10.20.0.5	255.255.0.0	05:57:39	2023-12-12714:57:21	51.3614	-1.1637
		0	MLdas 3T ref		Mininus	MIN 4858		4958	2.1.10	UMEN 48581	0.0.0.0	10.20.0.116	255.255.0.0	20days SHirs	2023 12 13712:23:23	51.3688	1.1631
		0	Midas NO LABEL		Mininus	MIN-4268	06.84268	4268	2.1-21244	(MEN-4268)	0.0.0.0	10.20.1.0	255.255.0.0	00:27:10	2023-12-13T10:26:43	51.3686	-1.1635
		0	Micas NO LABEL		Mininus	MIN-4768	26.84768	4768	2.1-21244	(MDN-4768)	0.0.0.0	10.20.0.254	255.255.0.0	00:37:50	2023-12-13T10:25:43	51.3687	-1.1635
	Ø	0	Midas Johns Box of			Systen	n Configuration	import/Expo	rt Tool — Discove	erv.		ж	255.255.0.0	23:00:57	2023-12-13T12:29:14	51.3610	-1.1635
	0	0	Carwel CENTIS TESTI										255.255.0.0	11days 20Hrs	2029-12-13T12:59:52	51.3811	-1.1842
	۲	0	Configura	dion source									255.255.0.0	11clays 20Hrs	2023-12-13T12:33:52	51.3511	-1.1640
	A	0	Carwt CERTIS_TESTI 🔍 Use	configuration from	m one of the de	vices: MIN-	9459 (10.20.0.)	193)			* Download	configuration	255.255.0.0	édays 21Hrs	2023-12-13T12:33:55	51.3611	-1.1640
		0	Conet CERTIS TEST OUSe	configuration from	m file:						Bro		255.255.0.0	1days 15Hrs	2023-12-13T11:04:05	51.3613	-1.1641
		0	Conet Rinimus 651 Devices										255.255.0.0	2days 1Hrs	Just How	51.3612	-1.1668
	0	0	MLCOS RADIAN TEST	index for config	in the second second												-1-1634
	0	0	MLCas RADIAN TEST	revices for coming	a actor aptorate												-1.1630
	0	0	MICas RADIAN TEST	4-4768 (10.20.0.2	254)								255.255.0.0	43days 19Hrs	2023-12-13T12:33:53	8.8888	8.0908
	0	0	MICAS RADIAN TEST	4-685C (10.20.0.)	77)								255.255.0.0	19days 22Hrs	2023-12-13110:30:13	51.3151	-1.2244
	0	0	Nicas RADIAN TEST	4-7957 (10.30.0.4	13)								255.255.0.0	43days 19lins	2023-12-13112:33:53	0.0000	0.0000
	0	0	Nicas RADIAN TEST	4-7D63 (10.30.0.)	80)								255.255.0.0	42days 23Hrs	2023-12-13T12:33:53	-59.9052	89.5495
	0	Õ	Nidas Radian/ Cert	4-7E63 (10.30.0.7	79)								255.255.0.0	53days 10Hrs	2023-12-13T12:25:23	51.3605	-1.1635
	0	õ	Nicas SUPRT-NEN	4-8358 (10.30.0.6	96)								255.255.0.0	Sdays Olirs	2023-12-13712:33:53	51.3665	-1.1634
	ē	õ	Conet 3T reterence	4-9261 (10.30.0.2	(0)								255.255.0.0	01:37:59	2023-12-13712:33:55	51.3613	-1.1641
	0	õ	Micas Balance Rig	4-9359 (10.20.0.2	(51)								255.255.0.0	113days Offers	2023-12-13712:33:53	51.3689	-1.1628
	0	0	MLras CERT/AQU Ter	4-9459 (10.20.0.1	193)								255.255.0.0	64days 1Hrs	2023-12-13712:33:53	51.3612	-1.1638
		0	Nidas Certinus Bat	4-9559 (10.20.0.1	98)								255,255.0.0	2daux SHre	2023.12.13712:25:23	51.3685	1.1637
		0	Nidas Badian Back	4-9659 (10.20.0.1	1945)								255 255 8 8	Barlays Mirs	list Big	51 3612	-1 1629
		0	Nidas Badian Back	4-9759 (10.20.0.1	59)								255 255 8 8	Striage Mire	2023.12.18112-89-59	51, 3510	1 1638
		0	Nicas Badian Back	tt All									255 255 0.0	18riaus 210rs	2023-12-13112-33-53	51 3611	-1 1541
		0	Mides Super Are T Upload										11.5	01-11-12	3833.13.13713.88.88		1.1414
	1	8	Count CEDITIC TEET										385.355.0.0	ddaus 211ics	Just New	51 3613	1 1645
		8	Caret CENTIS TEST								Uplead	onfiguration	355 355 0.0	days 210 s	Just How	51, 3612	-1.1641
	×		Conet Timis										385 355 6 6	00-04-02	3451 Hot	53, 3613	-1.1640
			Conec run s								Reb	oot selected	255.235.0.0	10.04.95	2423-12-12110-31-34	51.3011	-1.1049
			ALLIAS SUPATIALALI										255.235.0.0	18:46:51	2023-12-13111-10-13	51,3667	-1.1634
			Conet Mooin LP be										255.235.0.0	00:00:11	2023-12-13110.40:52	0.0000	8.0909
	2		Conet Australian_t										255.235.0.0	adays 22mrs	2023-12-13110:49:03	51.3005	-1.1033
			Conet Australian_1										255.255.0.0	3days 22Hrs	2023-12-13118:49:65	51.3607	-1.1636
		0	Micas SUPRT-MINL-1										255.255.0.0	18:28:55	2023-12-13110:49:43	51.3605	-1.1635
		0	Mican SUPRT-MIAL-1									OK	255.255.0.0	19:51:34	2023-12-13112:33:53	51.3597	-1.1635
		<b>O</b>	Carwt TIME TEST 3										255.255.0.0	21:12:23	2023-12-13712:25:03	51.3613	-1.1640
	0	0	Canet CS		Minimus Lite	MINL-6765	5G. 90999	6765	2.1-13991	(NDL-6765)	0.0.0.0	10.30.0.27	255.255.0.0	19days 22Hrs	Just New	51.3612	-1.1639
	0	0	Conet Australian_Certis_Hud	dle#86	Minimus Lite	MIN6799	06.86799	6799	2.1-13338	UNDAL -67993	0.0.0.0	10.30.0.67	255.255.0.0	01:42:04	Just Now	51.3611	-1.1641
	0	0	Conet Australian_Certis_Hud	dle#05	Minimus Lite	MINL-67F2	06.867F2	67F2	2.1.13265	UNDNL-67F2)	0.0.0.0	10.30.0.23	255.255.0.0	01:42:55	Just Now	51.3612	-1.1642
	0	O	Conet Australian_Certis_Hud	dlc#01	Minimus Lite	MINL-6885	06.86885	6885	2.1.13244	(MDNL-6805)	0.0.0.0	10.38.0.31	255.255.0.0	Adays dHrs	Just Now	8.8688	8.8959
	0	0	Conet Australian_Certis_Mud	dla#83	Minimus Lite	MINL-6888	26.86888	6358	2.1-13244	(MINL-6808)	0.0.0.0	28.38.8.54	255.255.0.0	Adays dHrs	Just Now	8.868	8.0909
	4	0	Micas NO LABEL		Minimus Lite	MINL-6889	06.86889	6389	2.1-12848	(MINL-6889)	0.0.0.0	18.28.8.145	255.255.0.0	23:12:31	2023-12-13711:47:14	51.3685	-1.1635
	4	0	Midas NO LABEL		Minimus Lite	MINL-688A	DG. 0058A	ABEA	2.1-12848	(MDNL-688A)	0.0.0.0	18,20.0.155	255.235.0.0	23:00:02	2023-12-13111:52:53	51.3567	-1.1637

*Figure 18 System configuration import/export tool* 

### 4.3.6 Running Scripts

A shell script can be run directly from Discovery. The script receives the instruments Hostname and IP Address as the first two parameters.

Both Linux and Windows builds of Discovery support this operation. With Windows it is necessary to install the Linux shell functions of Windows 11 onwards.

Bash or Python or any shell scripts can be run in this manner.

Group selection of multiple systems results in multiple shells being launched to run each script. An example of this would be to instigate a data download from the instrument's web server. These downloads will all operate in parallel for maximum speed. This is an effective way of offloading systems after a deployment.

In order to run scripts, first configure the folder that contains the script files by editing the config2.ini file (see Section 9.1 to find out the location of this file). Add the tag ScriptFilePath= to the folder that contains the script files. Files must be named "discovery\_xxxx" They will appear in the right-click context menu under Scripts:

#### Main Device List Window Overview

D5A	CD5A	(FMUS-CD5A)	0.0.0.0	10.20.1.26 255.255.0.0 2						
C57	1	MIN-7E63 10.30.0.79		10.30.0.44 255.255.0.0						
E63	Control	Centre	10 30 0 79 255 255 0 0							
205	Live Viev	v	•	10.50.0.79 255.255.0.00						
65B	Firmwar	e Update	U	10.30.0.36 255.255.0.0						
957	System (	Configuration		discovery_add_to_overnight						
	Device P	ort Configuration		discovery_annex5						
	GDI Con	figuration		discovery_beta_daily						
	Data cale	endar view		discovery_check_cron_list						
	Edit Net	work Address		discovery_daily_beta						
	File Exch	ange		discovery_deploy						
	Tunnel S	tatus		discovery_disable_cal						
	Show Or	п Мар		discovery_disable_cal_1Hr						
	View We	b Page	w	discovery_enable_cal						
	View We	b Page (in system bro	owser)	discovery_fullformat						
	Show G	OI Low Latency		discovery_get_response_files						
	Sensor t	est grid		discovery_get_time_offset						
	Scripts		•	discovery_gps_off						
	Calibrati	on	•	discovery_gps_on						

Figure 19 Script files are listed automatically

The example below fetches all the data files from the digitiser. This is using the HTTP (WEB Page) protocol to download all the files shown on the file list page of the instrument. Scripts are only supported on the Linux version of Discovery.

```
#!/bin/bash
set -x
foo=$(date +%Y-%m-%d)
mkdir $foo
cd $foo
mkdir $1
cd $1
wget -rnp http://$2/tab9.html
cd ..
```

### 4.3.7 Calibration

Calibration is a procedure used to verify or measure the frequency response and sensitivity of a sensor. It establishes the relationship between actual ground motion and the corresponding output voltage. Calibration values, or response parameters, are the results of such procedures.

Response parameters typically consist of a sensitivity or "gain", measured at some specified frequency, and a set of poles and zeros for the transfer function that expresses the frequency response of the sensor. A full discussion of poles and zeros is beyond the scope of this manual. The gain for a seismometer is traditionally expressed in Volts per

MAN-DIS-0001

ms<sup>-1</sup> and, for an accelerometer, in Volts per ms<sup>-2</sup>. Other instruments may use different units: an electronic thermometer might characterise its output in mV per °C.

A calibration procedure is also used to establish the relationship between the input voltage that a digitiser sees and the output, in counts, that it produces. The results are traditionally expressed in Volts per count. Güralp digitisers (Minimus, Minimus+, Minimus<sub>2</sub> and Minimus Lite) are programmed at the factory so that they know their own calibration values. However, when an analogue sensor (*e.g.* Güralp Fortis, 3T, etc.) is connected to a digitiser of the Minimus family you are required to manually input the sensor's calibration values.

To enter the calibration values for your analogue instruments, right-click the digitiser's entry in Discovery's main window and select Calibration  $\rightarrow$  Edit Poles & Zeros. This actions opens the Calibration Editor window.

This form has one tab for each seismic component, mass position and a calibration channel. The instrument's response values should be entered in here. These are:

- The **Digitiser Volts per Count (VPC)** the ratio between the input voltage and the digitised output value ("counts"). This field will be populated automatically with the correct value for this input channel of the Minimus.
- Analogue Instrument Gain this specifies the output voltage of the analogue seismometer per unit of ground motion, as measured at 1 Hertz. This information is normally provided on the calibration document that is shipped with the instrument. In the calibration document, this parameter is often referred to as "Velocity Output V/m/s" or "Acceleration Response V/m/s<sup>2</sup>" depending on the analogue instrument. This value can vary slightly across the three components.
- The **ADC offset** is the quiescent output seen when digitiser input is zero. This field will be populated automatically with the correct value for this input channel of the Minimus.
- The **Coil constant** is the coil constant for the component being calibrated, in A/ms<sup>-2</sup>, as given on the analogue sensor calibration sheet. This value is the same across all three components. This value is not relevant when Minimus is used with a Güralp Fortis accelerometer or Güralp Certis broad-band seismometer.
- The Calibration resistor is the value of the calibration resistor, in Ω, as given on the sensor calibration sheet. This value is the same across all three components. This value is not relevant when Minimus is used with a Güralp Fortis accelerometer or Güralp Certis broad-band seismometer.
- The **Normalising factor** specifies the value that the transfer function (as specified by the poles and zeros) must be multiplied by in order to provide unity gain at 1 Hz. This value is the same across all three components.
- The **Poles** and **Zeros** describe the frequency and phase response of the component. *They must be specified in Hertz.* This information is normally provided on a calibration document that is shipped with the instrument. If poles and zeros are not included in your calibration document, nominal values can be found here:

MAN-DIS-0001

<u>https://www.guralp.com/apps/paz/</u>. This value is the same across all three components.



ettings						
ettings instrument serial num	ıber:		[	TE0164		
iser annene sen af fiun			l	110104		
					{instrun	nent type
Component Z	Component N	Component E	Con	nponent X	Mass Z	Ma ◀
Units						· · · · · ·
Customize cor	nponent input u	nit				
Physical unit: M	etres per Second	Squared [m/s <sup>2</sup>	]∨ Un	it modifier: no	ne :	~
Parameters						
Digitizer Volts p	er count 2.4399	999e-06	V per	count		
🗹 Analogue Instru	ment 4.0479999	V per p	icocour	nt (reciprocal	0.2470	36)
ADC Offset	-1000		counts			
Coil constant	nan		A/m/s²			
Calibration resis	tor nan		Ω			
Response						
Response						
Normalizing fac	tor 1.9396e+09					
Poles (Hz)	tor 1.9396e+09					
Normalizing fac Poles (Hz) Pole 0	tor 1.9396e+09	+ i*	-90.3899	999	Hz	
<ul> <li>Normalizing fac</li> <li>Poles (Hz)</li> <li>Pole 0</li> <li>Pole 1</li> </ul>	tor 1.9396e+09 -63 -63	+ i*	-90.3899	999	Hz Hz	
Normalizing fact Poles (Hz) Pole 0 Pole 1 Pole 2	-63 -63 -755.90002	+ i* + i* + i*	-90.3899 90.38999 nan	99	Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> </ul>	-63 -63 -755.90002 -209.7	+ i* + i* + i* + i*	-90.3899 90.38999 nan nan	99	Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>❑ Pole 4</li> </ul>	-63 -63 -755.90002 -209.7 nan	+ i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan	99	Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> </ul>	-63 -63 -755.90002 -209.7 nan nan	+ i* + i* + i* + i* + i* + i*	-90.38999 90.38999 nan nan nan	99	Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> </ul>	1.9396e+09           -63           -63           -755.90002           -209.7           nan           nan           nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan	99	Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> <li>○ Pole 7</li> </ul>	1.9396e+09           -63           -63           -755.90002           -209.7           nan           nan           nan           nan           nan           nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan	999	Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> <li>○ Pole 7</li> <li>○ Pole 8</li> </ul>	1.9396e+09           -63           -63           -755.90002           -209.7           nan           nan           nan           nan           nan           nan           nan           nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan	999	Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> <li>○ Pole 7</li> <li>○ Pole 8</li> <li>○ Pole 9</li> </ul>	1.9396e+09           -63           -63           -755.90002           -209.7           nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan nan nan	999	Hz Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fact</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>Pole 4</li> <li>Pole 5</li> <li>Pole 6</li> <li>Pole 7</li> <li>Pole 8</li> <li>Pole 9</li> <li>Pole 10</li> </ul>	tor 1.9396e+09 -63 -63 -63 -755.90002 -209.7 nan nan nan nan nan nan nan nan nan na	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.38999 90.389999 nan nan nan nan nan nan nan nan	99	Hz Hz Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fact</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>Pole 4</li> <li>Pole 5</li> <li>Pole 6</li> <li>Pole 7</li> <li>Pole 8</li> <li>Pole 9</li> <li>Pole 10</li> </ul>	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan nan nan nan nan nan nan nan nan na	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.38999 90.38999 nan nan nan nan nan nan nan nan	99	Hz Hz Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fact</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>Pole 4</li> <li>Pole 5</li> <li>Pole 6</li> <li>Pole 7</li> <li>Pole 8</li> <li>Pole 9</li> <li>Pole 10</li> <li>Zeros (Hz)</li> </ul>	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan nan nan nan nan nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan nan nan		Hz Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fact</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> <li>○ Pole 7</li> <li>○ Pole 8</li> <li>○ Pole 9</li> <li>○ Pole 10</li> <li>Zeros (Hz)</li> <li>Zero 0</li> <li>Zero 4</li> </ul>	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan nan nan nan nan nan nan nan	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan nan nan nan		Hz Hz Hz Hz Hz Hz Hz Hz	
<ul> <li>✓ Normalizing fac</li> <li>Poles (Hz)</li> <li>✓ Pole 0</li> <li>✓ Pole 1</li> <li>✓ Pole 2</li> <li>✓ Pole 3</li> <li>○ Pole 4</li> <li>○ Pole 5</li> <li>○ Pole 6</li> <li>○ Pole 7</li> <li>○ Pole 8</li> <li>○ Pole 9</li> <li>○ Pole 10</li> <li>Zeros (Hz)</li> <li>✓ Zero 0</li> <li>○ Zero 1</li> </ul>	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan n	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan nan nan nan		Hz Hz Hz Hz Hz Hz Hz Hz Hz	
Normalizing fac Poles (Hz) Pole 0 Pole 1 Pole 2 Pole 2 Pole 3 Pole 4 Pole 5 Pole 6 Pole 7 Pole 8 Pole 9 Pole 10 Zeros (Hz) Zero 0 Zero 1 ystem calibration val Pole 10 Pole 1	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan n	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.3899 90.38999 nan nan nan nan nan nan nan nan nan		Hz Hz Hz Hz Hz Hz Hz Hz Hz	
Normalizing fac Poles (Hz) Pole 0 Pole 1 Pole 2 Pole 2 Pole 3 Pole 4 Pole 5 Pole 6 Pole 7 Pole 8 Pole 9 Pole 10 Zeros (Hz) Zero 0 Zero 1	tor 1.9396e+09 -63 -63 -755.90002 -209.7 nan nan nan nan nan nan nan nan nan na	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.38999 90.38999 nan nan nan nan nan nan nan nan nan	P99	Hz Hz Hz Hz Hz Hz Hz Hz Hz	from file
Normalizing fac Poles (Hz) Pole 0 Pole 1 Pole 2 Pole 3 Pole 4 Pole 5 Pole 6 Pole 7 Pole 8 Pole 9 Pole 9 Pole 10 Zeros (Hz) Zero 1 ystem calibration values	tor 1.9396e+09  -63 -63 -755.90002 -209.7 nan nan nan nan nan nan nan nan nan na	+ i* + i* + i* + i* + i* + i* + i* + i*	-90.38999 90.389999 nan nan nan nan nan nan nan nan	P99	Hz Hz Hz Hz Hz Hz Hz Hz Hz	from file

Figure 20 Calibration Editor window

**Note:** If the calibration document is lost, please visit the website to learn how to request a copy (<u>https://www.guralp.com/customer-support</u>).

The calibration parameters for one component can be copied to any other component of the same instrument, or other instruments. This is especially useful for poles and zeros because they are typically identical for all three components of all instruments in a class.

Within the "Component configuration" section, the "Copy:" drop-down box allows the selection of what to copy: poles and zeros, parameters, or All(tab dependant). The destination sensor can be set in the "to sensor" box and takes the numeric identity of the sensor as detected by the Minimus. Finally the specific components can be selected in the "to component" drop-down box. Click on the Copy button to copy and paste the selected values. Finally click on Send axis Z button to send the calibration values to the digitiser and save them permanently. Repeat this last step for the other axis. Note that Send axis Z only sends the calibration of the selected axis.

Compo	onent configuration			
Сору:	All 🖂	to sensor 0 🖨 to component ZNE 🗸	Сору	
	All			
	Poles and Zeros		Send axis Z	
	Poles			~
-System c	Zeros			
System C	Parameters			

Figure 21 How to copy parameters to various components.

The overall system calibration parameters can be exported and saved in a file for future use by clicking on the **Export to file** button under "System calibration values".

System calibration values				
	Poles and Zeros	•	Export to file	Import from file
		_		
		Ser	nd instrument cali	bration to device

*Figure 22 How to apply instrument calibration values.* 

The resulting filename will have the extension ".conf". Values from an existing calibration file can be imported using the Import from file button. The associated dropdown menu allows specification of what to import: poles and zeros, gains, or everything. Click on Send sensor0 calibration to device to send the calibration values to the digitiser and save them permanently.



**Note:** When using Minimus+, this action will only send the calibration of the selected sensor. Click on the Send to device button to send the complete calibration to the digitiser.
# 5 Tools Menu

There are a number of tools and applets available which perform functions that are not specific to devices. These are available in the **Tools** menu

# 5.1 MiniSEED to Directory Structure

Güralp instruments record data in miniSEED format. These files can be offloaded from the SD cards. The directory structure on the SD cards is flat and comprises 128Mbyte files.

These file are pre-created and stretched to 128Mbytes. The key reason for this is to prevent the File Allocation Table (FAT) being constantly updated as the system records. In fact, a loss of power during the update of the FAT would result in a loss of most or all data on the card. The pre-stretched files are never extended during normal operation so a loss of power during a write would result in just one corrupt block in the middle of a miniSEED file, which is typically skipped over by any reader.

This tool allows you to chop a large miniSEED file in smaller miniSEED files with a fixed length of 1 hour. It will process the miniSEED files to create a folder structure of month/day/hour with the hour-long miniSEED files in each folder.

mSeed to Directory S	Structure — Discovery
Load file(s)	Load from directory
//nome/nizmetriz/Certimus_TEST_DATA/20         00EA61_S1TemprB       _00005_00010.it         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1ClkDacFreqPu_00005_00009.it         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1PLLOffset         _00005_00008.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1PLLOffset       _00005_00008.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1APG       _00005_00007.it         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1ExtPres       _00005_00006.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1Voltage       _00005_00004.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1SeisXA       _00100_0003.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1SeisNA       _00250_00002.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1SeisNA       _00250_0000.m         /home/hizmet12/Certimus_TEST_DATA/20         00EA61_S1SeisNA       _00250_0000.m         /home/hizmet12/Certimus_TEST_DATA/20       _00EA61_S1SeisEA         _00250_0000.m       _home/hizmet12/Certimus_TEST_DATA/200         _00EA61_S1SeisEA       _00250_0000.m         _home/hizmet12/Certimus_TEST_DATA/200 <td>24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed</td>	24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed 24-02-26/AQU-EA61/10.30.0.13/sd/ mseed
Output location: /home/hizmet12/Cer	timus_TEST_DATA/2024-02-26/AQU-EA61
	Select location
	Cancel Convert to directory
1/2	276
	Close

Figure 23 mSeed to Directory Structure window

EA61	
2023	
December	
- 24	
2300	
00EA61_S1SeisNB	00005_00232.mseed
- 25	
0000	
00EA61_S1SeisNB	00005_00232.mseed
0100	
00EA61_S1SeisNB	00005_00232.mseed
0200	
00EA61_S1SeisNB	00005_00232.mseed
0300	
00EA61_S1SeisNB	00005_00232.mseed
0400	
00EA61_S1SeisNB	00005_00232.mseed
00EAG1_S1SeisZA	00250_00233.mseed
0500	
00EAG1_S1SeisNB	00005_00232.mseed
00EAG1_S1SeisZA	00250_00233.mseed
0600	
00EAG1_S1SeisNB	00005_00232.mseed
00EAG1_S1SeisZA	00250_00233.mseed
0700	
00EAG1_S1SeisNB	00005_00232.mseed
00EAG1_S1SeisZA	00250_00233.mseed
0800	
00EAG1_S1SeisNB	00005_00232.mseed
00EA61_S1SeisZA	00250_00233.mseed
0900	

*Figure 24 Resulting file hierarchy* 

# 5.2 CAP Receiver

Instruments can detect local events using a number of algorithms. Typically, an STA/LTA trigger is used. This is relatively immune to slow changes in background noise such as day to night.

A trigger can be configured to send a message (CAP – Common Alert Protocol). Güralp Discovery includes a CAP receiver. It listens on a specified UDP port for incoming CAP messages. When one arrives, it can be displayed on a map alongside a table of information. Furthermore, there is a user defined *event window* where Discovery's CAP receiver will receive multiple event messages and evaluate them producing:

- An event log containing all the raw CAP messages received during the event
- An Event Report PDF listing crucial details from the event messages
- An epicentre based on trigger times of the event messages
- A GeoJSON file for importing the results to third-parties

On generating the above the CAP Receiver will stop listening for CAP messages and open a new instance that will continue listening for new events. This allows the user to review the data inside the CAP Receiver if needed whilst still actively listening.

Note: In order to receive CAP messages, please make sure that the CAP receiver has been started by clicking on the Start button. If you see instead a Stop button, it means that the CAP receiver is already listening.

Locate

PGA

Clear events

PGV PGD Latitud

5.2.1 Netw	ork S	Settir	ngs
------------	-------	--------	-----

2 CAP Receive	er Setting:	s - Discovery			×
General	Events	Network	Categories		
← CAP Receiv Port ← ☑ Forwarc	ing serve	9r		11789	
Forwarding Download	request r	ange (secs)			
Offset befo Offset after	ore event: r event:				2s 🜩 18s 🜩
				OK	Cancel

Export JSON

Timestamp

Start

Sender

Figure 25 CAP receiver network settings

The CAP receiver window allows specification of the listening port. This is available by clicking on Settings and then on the Network tab. Each device from which messages should be received must have this value specified as the "CAP Port" in its triggering settings (from the Trigger tab of the webpage). The value should be between 1025 and 65535. You should avoid numbers in the list at https://en.wikipedia.org/wiki/List\_of\_TCP\_and\_UDP\_port\_numbers.



**Note**: For full instructions about how to configure triggers using instruments that run the DIG firmware (i.e. Minimus, Minimus+, Fortimus and Certimus) see DIG firmware's manual (**MAN-DIG-0001**).

If you wish to forward the CAP messages to a server, type its I.P. address into the field and tick the check-box named "Forwarding server". An error message is displayed if the entered I.P. address is not valid.

## 5.2.2 Map & Table View

CAP Receiver — Discovery					×
CoenStreetMap Edit * History Export More * Log In Sign Up	Load logf	ile Gene	erate PDF	Download data	Settings
Sevenage Sevenage	Start	Expo	ort JSON	Locate	Clear events
Search Where is this? GO	Sender	PGA	Network	Timestamp	
Burford Aylesbury Trong Welwyn Garden Ware Sawbridgerouth	MIN-1000	4	DG	2024-04-16T1	5:54:07.753
Oxford Thame Wendover Berkhamsted St Albans Hoddesdon	MIN-1007	4.32809	DG	2024-04-16T1	5:54:08.906
Fairford Princes Rsborougn Kings Langley Potters Bar, Chipping Or National Amersham	MIN-1004	2.25342	DG	2024-04-16T	15:54:10.160
ade. Faringdon Watlington Landscape Watford Chipping Barnet Loughton	MIN-1013	2.9618	DG	2024-04-16T1	5:54:10.993
Wantage Wallingford Gerrards.Cross Harrow East Finchley Roman	MIN-1005	2.33658	DG	2024-04-16T	15:54:11.316
Swindon Uxbridge Weinbley Heington East Ham	MIN-1009	2.8991	DG	2024-04-16T	15:54:11.332
Sough Lanning London Shard	MIN-1006	2.35855	DG	2024-04-16T	15:54:11.785
Harlborough Human Ashford Wimbledon	MIN-1001	2.36353	DG	2024-04-16T	15:54:11.813
Hungerood Newbury ++ Walton-on- Thames Ersyston	MIN-1014	2.54021	DG	2024-04-16T1	15:54:12.848
Tadiey Sandhurst Woking Cobham Epson Couldson Biggin Hill Ro	MIN-1008	1.63576	DG	2024-04-16T1	5:54:12.940
Bachosola	MIN-1003	1.61458	DG	2024-04-16T	15:54:13.250
Ludgershall + + Aldershot Guildford Dorking Reigate	MIN-1002	1.72024	DG	2024-04-16T1	5:54:13.968
Amesbury Hortey Edenbridge	MIN-1012	1.74012	DG	2024-04-16T	15:54:14.162
Stockbridge Bordon Crawley Crawley	MIN-1011	2.70673	DG	2024-04-16T	15:54:14.311
New Alresford Hastemere Horsham Crowborough Har	MIN-1010	1.45424	DG	2024-04-16T1	5:54:14.330
10 mi OpenStreetMap contributors • Make a Donation. Website and API terms					
15 Event Messages					Close

#### Figure 26 Discovery's shake map

Each row of the table contains information from a CAP message, such if you have three devices trigger you will see three rows in the table. If the device is setup to send Peak Ground data or remote triggers, these will merge with the initial trigger they relate to. This means after the initial trigger is received the PGA column may be empty but it will populate when the Peak Ground data comes through later on.



**Note**: PGA, PGV and PGD are available only for instruments running the DIG firmware (Minimus, Minimus+, Fortimus and Certimus. **NOT** Minimus2/Minimus Lite). To receive PGA, PGV and PGD information, the EEW parameters have to be enabled. See DIG firmware's manual (**MAN-DIG-0001**) for more details.

The column headers in the table are configurable in Settings, giving a range of useful information from the CAP messages. Colour coding schemes are used for the PGA column and optionally for the Sender column if Site Fragility is enabled. is used to show individual station's PGA values in the list. The list can be sorted by clicking on the column header.

Clicking on entries in the list will highlight the location on the map – and vice versa.

Each device that has triggered is displayed on the map as a black cross. Red crosses on the map reflect sensors that have some form of compromised performance – possible timing inaccuracies or poor connectivity

# 5.2.3 Colour Categories – Site Fragility

There is a default colour category for PGA values which will colour the PGA column of the CAP message table in either green, yellow, orange, or red (for most severe).

An advanced colouring option called Site Fragility can be used to colour the Sender Name column and optionally be used to colour the PGA column as well.



Figure 27 – An example of Site Fragility categories overriding PGA categories

In the above example the event table has been ordered by PGA and we can see the colouring is no longer dependant entirely on PGA but is different per site. Each site has PGA limits set for it. This can be found in Settings on the Categories tab:

<ul> <li>✓ Site fragility</li> <li>/home/example/fragility.csv</li> <li>✓</li> <li>Override standard PGA colourings:</li> <li>✓</li> <li>MIN-1000, 8, 6, 4</li> <li>MIN-1001, 3.5, 1.2, 0</li> <li>MIN-1002, 20, 12, 8.6</li> <li>MIN-1003, 6, 5, 4</li> <li>MIN-1004, 9.1, 7.2, 4</li> </ul>	herat Events	Network	Categories	
/home/example/fragility.csv Loa Override standard PGA colourings: ✓ MIN-1000, 8, 6, 4 MIN-1001, 3.5, 1.2, 0 MIN-1002, 20, 12, 8.6 MIN-1003, 6, 5, 4 MIN-1004, 9.1, 7.2, 4	Site fragility			
Override standard PGA colourings: ✓ MIN-1000, 8, 6, 4 MIN-1001, 3.5, 1.2, 0 MIN-1002, 20, 12, 8.6 MIN-1003, 6, 5, 4 MIN-1004, 9.1, 7.2, 4	home/example/fr	agility.csv		Load
MIN-1000,8,6,4 MIN-1001,3.5,1.2,0 MIN-1002,20,12,8.6 MIN-1003,6,5,4 MIN-1004,9.1,7.2,4	verride standard	PGA colourii	ngs:	V
MIN-1005,8.1,7.2,4 MIN-1006,4.4,100,100 MIN-1007,8,7,5.5 MIN-1008,9,7,4.8	4IN-1004,9.1, 4IN-1005,8.1, 4IN-1006,4.4, 4IN-1007,8,7, 4IN-1008,9,7,	7.2,4 7.2,4 100,100 5.5 4.8		

Figure 28 – Settings, Categories tab

The format of the CSV file is <sender-name>, <red>, <orange>, <yellow>, <green>. Where the colours relate to a PGA value (it turns red after the PGA reaches <red>).

# 5.2.4 Event Report & GeoJSON

When an event window closes, or when the user presses Generate PDF, a PDF is built from the information in the current event's CAP messages. This displays the sender information, timestamps, Peak Ground data, and latitude/longitude. The example below uses faked data which is why there are no PGV or PGD values.

		1000	re			
	E a utila av cal ca	<b></b>		<b>N</b> -+	-:!-	
	Eartnquake	e Eve	nt L	Jet	aits	
	First Trians and Chatian		100			
	First Triggered Station	- N	11N-100	00		
	Trigered Date & Time	- 1	074-04	-16T15	·54·07 753	7
Canadam	<b>T</b> ime at a mark	DCA	DCV	DCD		
Sender	Timestamp	PGA	PGV	PGD	Latitude	Longitud
MIN-1000	2024-04-16115:54:07.7532	4	0	0	51.3976	-1.0/5/5
MIN-1001	2024-04-16115:54:11.8132	2.36353	0	0	51.51/3	-0.988528
MIN-1002	2024-04-16115:54:13.9682	1.72024	0	0	51.1989	-1.12658
MIN-1003	2024-04-16115:54:13.2502	1.61458	0	0	51.2366	-1.1973
	2024-04-16115:54:10.1602	2.25342	0	0	51.3814	-0.953563
	2024-04-16115:54:11.3162	2.33058	0	0	51.4481	-1.24205
MIN-1000	2024-04-10115:54:11.7852	4 22800	0	0	51.2704	1 12/52
MIN-1007	2024-04-10115:54:08.9062	4.52609	0	0	51.4047	1.04000
MIN-1008	2024-04-10115:54:12:9402	2 8001	0	0	51.2511	1 16429
	2024-04-10115.54.11.5522	1 45424	0	0	51.2550	1 169 45
MINI 1010	2024-04-16115:54:14.3302	2 70673	0	0	51.1920	-1.10945
MIN-1010		2.70075	0	0	51.1959	1 05280
MIN-1010 MIN-1011	2024-04-16715:54:14:5112	1 74012			51.1905	-1.05565
MIN-1010 MIN-1011 MIN-1012	2024-04-16T15:54:14:3172 2024-04-16T15:54:14.162Z	1.74012	0	0	51 3702	-0.913457
MIN-1010 MIN-1011 MIN-1012 MIN-1013	2024-04-16115:54:14.162Z 2024-04-16115:54:14.162Z 2024-04-16115:54:10.993Z	1.74012 2.9618	0	0	51.3702	-0.913457

Figure 29 - Example of an Event Report PDF

When an event window closes, or when the user presses **Export JSON**, a JSON file is built from the sender name, PGA, and latitude/longitude for all current CAP messages.

# 5.2.5 Download Data

Stream data can be download from the selected instruments by selecting them either in the table or on the map view and pressing the **Download data** button.

The time range to download is configurable in Settings allowing a range before the event and a range after.

General	Events	Network	Categories		
CAP Rec	eiver			11789	
Forwardi	arding serve	Pr			
– Downloa Offset be Offset af	nd request r efore event: ter event:	ange (secs) —			2s 🔹
				ОК	Cancel

**Note**: Immediately after an event occurs the device will not have copied the data across so requesting data with Download data will not be successful until some time afterwards.

# 5.2.6 Triggers – Voting

When multiple instruments are deployed within a network, a voting scheme is typically used to reduce false triggers. Local voting among sensors helps filter out spurious events, as simultaneous triggers from widely spaced sensors are highly improbable in the absence of a genuine seismic event.

The voting scheme in Discovery's CAP receiver is characterised by two parameters: the voting threshold and the event window. These two parameter can be set from the Events tab of the CAP receiver Settings.

#### **Tools Menu**

3 CAP Receiver Settings - Discovery					
General	Events				
Configura	tion				
Enable sha	ake map:	$\checkmark$			
Ignore event window:					
Spawn new receiver:				$\checkmark$	
Event window:			7000 ms 🖨		
Voting thr	eshold:	5			

The voting threshold defines the minimum number of CAP messages that must be received within a specified time frame (event window) to confirm an actual event. When a new CAP message is received, the event window is initiated. If another CAP message arrives within the event window, the timer resets, and the full duration of the window begins again from that point. If the threshold is not met before the event window expires (i.e., no new messages extend it further), Discovery's CAP receiver terminates the instance, discards all collected messages and takes no further action.



The total number of CAP messages sent by an individual instrument varies depending on its settings.

When a trigger is configured on individual channels, a CAP message is immediately issued upon trigger activation. If the EEW (Earthquake Early Warning) transform is applied to that channel, a second CAP message is sent a few seconds later containing the calculated PGA (Peak Ground Acceleration), PGV (Peak Ground Velocity) and PGD (Peak Ground Displacement) values.

Triggers can also be configured on seismic triplets. In this case, triggering can be based on the 3D resultant of the Z, N and E components together, or the Z component and the 2D resultant of the N and E components separately. In this case, a CAP message is issued upon trigger activation, and additional CAP messages are sent if the EEW transform is enabled.

The table below provides some examples of trigger configurations and the corresponding number of CAP messages generated.

Source	EEW transform	Triplet options	Triggered channels	N° CAP messages
Single tap	Disabled			1
Single tap	Enabled			2
3 × Single tap	Disabled			3
3 × Single tap	Enabled			6
Triplet	Disabled	3D		1
Triplet	Enabled	3D		2
Triplet	Disabled	Z & NE	Z or NE	1
Triplet	Disabled	Z & NE	Z <i>and</i> NE	2
Triplet	Enabled	Z & NE	Z or NE	4
Triplet	Enabled	Z & NE	Z <i>and</i> NE	5

**Note:** EEW transform is only available for Minimus, Minimus Plus, Certimus and Fortimus, **NOT** for Minimus2 and Minimus Lite. Therefore, for Minimus2 and Minimus Lite only the rows with EEW transform disabled are relevant.

# 5.2.7 Triggering Test Tool

In order to see the event locator and logging operate without the need for a real event, Güralp has written a test tool that generates fake trigger events and sends CAP messages. with an 'epicentre' within the geographic region specified.

The test tool is installed in the Program Files folder under Guralp Systems / Discovery2. Simply double click 'thing.exe'

L	> This PC > Local Disk (C:) > Program Files	s > Guralp Systems > Discovery2
^		Date modified
	thing.exe	16/04/2024 12:57
	unins000.dat	16/04/2024 13:36
~	unins000.exe	16/04/2024 13:36

Figure 30 Discovery's test tool

First, enter the IP address of the CAP receiver (the computer running Discovery), in the Destination IP field. To find out the IP address of a Windows computer, key **Windows** + **R** to open the "Run" dialogue, enter cmd and press the Enter key. Type ipconfig in the terminal. Look for the right network adapter (e.g. Wi-Fi or Ethernet). The IP address will show next to the IPv4 Address entry.

				Testing	Utility Tool			-	o x
Faux Data	Data Requests	Hashing Monitori	ng						
Connect									
	Registry	Hostname		Groupid	Label	Station	Network	IP Address	
Add	18.168.216.36	TEST-1234		mine	My system	01234	00	10.88.1.2	
Delete									
		Num Sensors	Region Lat/Lon			Destination IP	Port	Max PGA	
Send CAP		5	51.3611	-1.1	22000		11789	10	

#### Figure 31 CAP sender Test Tool

The number of instruments can be specified under Num Sensor, such that triggers are randomly generated from these instruments and create arrival times consistent with a simulated 'epicentre' within the geographic region specified. The maximum PGA can also be specified.

# 5.3 MiniSEED Extractor

The miniSEED extractor serves two purposes:

- When an SD card is quick-formatted, each file is marked as unused but previously recorded data can still remain in them. Subsequent recordings overwrite these files from the beginning but, if the previous recording had a longer duration, old data will remain in the files. When the files are copied from the SD card to a PC, these older data can cause problems.
- The format used on the SD cards consists of fixed-length, 128 MiB files. Some recordings might not use all of this space. When the files are copied from the SD card to a PC, this can cause wasted disk space.

The miniSEED extractor reads miniSEED files on the PC and copies them to a selected Destination folder, keeping track of the latest block time-stamp as it goes. If it encounters either an unused block or a time-stamp which is earlier than the previous one, it stops copying, truncating the output file at that point. This guarantees that each output file contains only blocks in time order and contains no wasted space.

To use the tool, select "miniSEED Extractor" from the **Edit** menu. Click the first **Browse** button to select which files you wish to process and then the second **Browse** button to select the folder into which you wish the output files to be written.

Finally, click the **Trim Files** button to extract the valid data from the selected files into new files in the selected destination folder. When the process reaches 100% the win-dow can be closed and the trimmed miniSEED files can be found in the chosen folder.

# 5.4 MiniSEED Gap Reporter

This tool can generate a report of any gaps in the data from the input files. To use, upload the desired input and then click Gap Report to view the report of all files or just selected files.

# 5.5 Command Scheduler

# 6 Data Visualisation

# 6.1 Streaming data into Discovery

### 6.1.1 Streaming protocols

Discovery offers a versatile live waveform/data viewer. To open the Waveform Viewer, in Discovery's main window, select an instrument, right-click on it and select Live View. The menu will then present options for data streaming, either GDI or Seedlink.

Ø	0	Radian Rack 4A/4B		Minimus	E256	2.1-225	76	(MIN-E256)	0.0.0.0	10.20.0.50	255.255.0.0	21days 4Hrs
Ø	0	Radian Rack 3A/3B		Minimus	C757	2.1-225	76	(MIN-C757)	0.0.0.0	10.20.0.70	255.255.0.0	27days 20Hrs
Ø	0	Radian Rack 2A/2B		Minimus	2856	2.1-225	76	(MIN-2856)	0.0.0.0	10.20.0.86	255.255.0.0	27days 20Hrs
Ø	0	Radian Rack 1A/1B		Minimus	2456	2.1-225	76	(MIN-2456)	0.0.0.0	10.20.0.93	255.255.0.0	16days 21Hrs
Ø	0	REF-Final Test		Fortimus	CD5A	2.1-212	48	(FMUS-CD5A)	0.0.0.0	10.20.1.26	255.255.0.0	14days 0Hrs
Ø	0	RADIAN TEST 6		MIN-9859 10	.20.0.249		17	(MIN-9859)	0.0.0.0	10.20.0.249	255.255.0.0	1days 2Hrs
	0	RADIAN TEST 5	Contr	ol Centre			17	(MIN-9659)	0.0.0.0	10.20.0.196	255.255.0.0	29days 21Hrs
	0	RADIAN TEST 4	Live V	liew		•	GD		0.0.0.0	10.20.0.251	255.255.0.0	30days 2Hrs
Ø	0	RADIAN TEST 3	Firmw	Firmware Update U System Configuration Device Port Configuration			GDI and GCF		0.0.0.0	10.20.0.198	255.255.0.0	30days 2Hrs
	0	RADIAN TEST 2	Devic				MSeed	eed	0.0.0.0	10.20.0.159	255.255.0.0	30days 2Hrs
Ø	0	RADIAN TEST 1	Edit N	letwork Addres	5		30	(MIN-9459)	0.0.0.0	10.20.0.193	255.255.0.0	30days 1Hrs
Active		Platinum	File E	xchange al Status			11	(SUPRT_NAM2)	0.0.0.0	10.20.1.80	255.255.0.0	82days 22Hrs
Active		Platinum	Show	On Man			)9	(sapphire)	0.0.0.0	10.30.0.121	255.255.0.0	203days 20Hrs
Active		Platinum	View	Snow On Map View Web Page W		11	(DAS-40554F)	0.0.0.0	10.20.1.81	255.255.0.0	35days 22Hrs	
Active		Platinum	View	Web Page (in sy	stem brows	ser)	11	(GBB-EAMU6792)	0.0.0.0	10.20.0.53	255.255.0.0	8days 3Hrs
Active		Platinum	Calibr	ration		•	11	(EAM4435)	0.0.0.0	10.20.0.145	255.255.0.0	5days 23Hrs
Active		Platinum		EAM	6607	1.0-157	59	(eam6607)	0.0.0.0	10.20.0.19	255.255.0.0	217days 22Hrs

Figure 32 Discovery main window and Live View options

The Seedlink option utilises the industry standard SEED protocol, allowing the user to stream data from a single instrument or an instance of the Güralp Data Centre (GDC). For more information on GDC and Seedlink archive, see Section 8.6.4.

All newer systems support the GDI protocol. The GDI protocol streams data sampleby-sample and provides a low-latency data link for seismic data, both time-series (sample) and state-of-health information. These much smaller packets of samples allowing for a faster time-to-receive and a smoother feeling live stream.

The GDI protocol also allows the sending of each instrument's calibration parameters so that data can be expressed in terms of physical units rather than digitiser counts. This is discussed in more details in Section 6.1.2.

The main features and controls of the Live View window are introduced in Section 6.1.3.

## 6.1.2 Metadata

Name	Value
	4.056E-10
	Keterence
M-DAC	2.4400E-6
M-DESCRIPTION	Main seismometer N chain
M-DISPCOLOUR	#FF0000
M-DispNode	Ainstrument
M-GAIN-0	2.4400E-6
M-GAIN-1	2304000
M-GAIN-2	1.6795E-4
M-GAIN-3	0
M-GROUP	1
M-INPUTGAIN	1
M-MODIFIER	1
M-MODIFIERNAME	
M-POLE-0	-0.00589 + i*-0.00589
M-POLE-1	-0.00589 + i*0.0058900
M-POLE-2	-180 + i*0
M-POLE-3	-160 + i*0
M-POLE-4	-80 + i*0
M-SEEDNAME	DG.0456C.0J.HHN
M-UNITNAME	Metres per Second
M-WEBTXT	m.s <sup>-1</sup>
M-ZERO-0	0 + i*0.
M-ZERO-1	0 + i*0.
Transform	None
adc-bitweight	2.4400E-6
adc-pga	1
component	Ν
data-class	primary
dimension	velocity
gcf-channel-name	MN456C-VELN0
instrument-id	MIN-456C.S0Seis
instrument-type	high-gain-seismometer
sensor-gain	1.6795E-4
sensor-is-differential	false

Figure 33 Example of metadata available by hovering over GDI channel

GDI metadata consists of name/value pairs of text. The above list shows a typical set of metadata from a digitiser seismic channel, which appears when hovering on the GDI channel. Most of the metadata is sent only once on the connection of the channel.

Metadata can be edited using the View/Edit Metadata function, accessible by rightclicking on the waveforms. Gain and response parameters can be manually overwritten, but this is lost when a new connection is made. This can be used as a quick diagnostic tool. The metadata can be modified in a permanent way through the Calibration Editor.

M-CAL represents the scaling factor used for the conversion from digital counts to physical units. M-CAL is the product between M-GAIN0 (the digitiser's sensitivity expressed in V/counts) and M-GAIN2 (the sensor's sensitivity expressed in m/s/V for a velocity instrument and m/s<sup>2</sup>/V for an acceleration sensor).

Changing the value of M-DISPCOLOUR will result in the stream being drawn with a different colour.

A Seedlink stream to a Guralp device will automatically request the dataless file. This file is the SEED protocol for metadata. On receiving the dataless file the stream will populate the metadata with units, gains, poles, zeros, etc.

### 6.1.3 Waveform Viewer

To open the waveform viewer, right-click on an instrument in Discovery's main window and select Live View.

More than one instruments can be selected by clicking on their entries while holding down the Shift key (to select a range of instruments) or the Ctrl key (to select each instrument individually).

## 6.1.3.1 Waveform Visibility

The left tree display (Channel List) allows individual streams of data to be made visible or hidden from view. The Clear All and Select All buttons remove everything from view and display all the streams, respectively.

Channel List	8 ×
✓ ■ MIN-456C	
✓ ■ Ainstrument	
> S0IntZ	
> S0IntN	
> SOIntE	
SOSeisZ	
✓ ■ S0SeisN	
MN456C-0VELN0	
MN456C-0VELN2	
SOSeisE	
> SORotPitch	
> SORotRoll	
> SORotYaw	
✓ 🗹 S0SeisX	
MN456C-0AUXX0	
> Power	
> Timing	
> Environment	

Figure 34 Channel List check boxes control waveform visibility

Right-clicking on one of the channels offers access to filters to apply visibility over all available channels (also across different instruments). There are three different filter options presented:

#### Data Visualisation

▼ ■ MIN-456C         ▼ ■ Ainstrument         > S0IntZ         > S0IntZ         > S0IntE         > S0SeisZ         ▼ ■ SOSeisN         ✓ MMA         Toggle seismic         MMM         S0RotP         S0RotP         S0RotP         S0RotP         S0RotP         S0RotP         S0RotP         S0Seisi         Edit customname         S0SeisN*         Solsconnect MIN-456C         Delete MIN-456C	Channel List		ē ×
	<ul> <li>MIN-456C</li> <li>Ainstrument</li> <li>SOIntZ</li> <li>SOIntR</li> <li>SOSeisZ</li> <li>SOSeisS</li> <li>SOSeisS</li> <li>SORotP</li> <li>SORotP</li> <li>SORotP</li> <li>SORotV</li> <li>SOSeis3</li> <li>Power</li> <li>Timing</li> <li>Environm</li> </ul>	Toggle seismic         Toggle preset       >         Toggle custom       >         View/edit metadata       >         Edit customname       >         Set as reference       >         Disconnect MIN-456C       >         Delete MIN-456C       >	*OVELN0 *N0 *MN456C-0VELN0* *S0SeisN* *Ainstrument*

*Figure 35 Context menu offers filters* 

• **Toggle Seismic** – A quick and simple way to toggle on or off all the seismic channels (ending Z/N/E). The selection choice is set in a config option 'SeismicToggleBands' which can be set in the advanced settings. It is a list of the acceptable seedname values for the first character in the channel code:

Basic Advanced			
Show empty entries		band	
Seismic Toggle Bands	CFH		

*Figure 36 Searching the advanced settings for 'band' to edit 'SeismicToggleBands'* 

- **Toggle Preset** Automatically generated possible searches based on the hierarchy of the Channel List
- **Toggle Custom** A simplified expression search filter where "\*" is used as wildcard and "," is used to add more filters.

Some filter examples:

- $*Z \rightarrow$  select all channels with names ending in 'Z'
- \*ACCN2, \*ACCE2 → select all acceleration channels (tap 2) for horizontal components
- \*Timing\*  $\rightarrow$  select all channels with timing information

# 6.1.3.2 Channel metadata

As mentioned previously, GDI channels and Seedlink with dataless carry metadata in addition to the sample stream. This can be displayed by right-clicking on a channel and select View/Edit.

For GDI, the values can be modified such that other applets use the new values. The modifications remain until restarting the application.

Draw Scale	100.00	
M-CAL	4.098E-10	Edit
M-CHAINNAME	S0SeisN	Edit
M-COMPONENT	1	Edit
M-CUSTOMNAME	Reference	Edit
M-DAC	2.4400E-6	Edit
M-DESCRIPTION	Main seismometer N chain	Edit
M-DISPCOLOUR	#FF0000	Edit
M-DispNode	Ainstrument	Edit
M-GAIN-0	2.4400E-6	Edit
M-GAIN-1	2304000	Edit
M-GAIN-2	1.6795E-4	Edit
M-GAIN-3	0	Edit
M-GROUP	1	Edit
M-INPUTGAIN	1	Edit
M-MODIFIER	1	Edit
M-POLE-0	-0.00589 + i*-0.00589	Edit
M-POLE-1	-0.00589 + i*0.0058900	Edit
M-POLE-2	-180 + i*0	Edit
M-POLE-3	-160 + i*0	Edit
M-POLE-4	-80 + i*0	Edit
M-SEEDNAME	DG.0456C.0J.HHN	Edit
M-UNITNAME	Metres per Second	Edit
M-WEBTXT	m.s <sup>-1</sup>	Edit
M-ZERO-0	0 + i*0.	Edit
M-ZERO-1	0 + i*0.	Edit
Transform	None	Edit
adc-bitweight	2.4400E-6	Edit
adc-pga	1	Edit
component	N	Edit
data-class	primary	Edit
dimension	velocity	Edit
gcf-channel-name	MN456C-VELN0	Edit
instrument-id	MIN-456C.S0Seis	Edit
instrument-type	high-gain-seismometer	Edit
sensor-gain	1.6795E-4	Edit
sensor-is-differential	false	Edit

Figure 37 Metadata access from Channel List context menu

### 6.1.3.3 Selection mechanism

Dragging the mouse with left-click extends the selection. Once a temporal selection has been made, the channel makeup of the selection can be altered.

Use Ctrl + left-click on other individual channels within the selected region to toggle their inclusion.

Use Shift + left-click to extend the selection across multiple channels.

When no key modifier is used, dragging the mouse with left-click over a waveform shows the maximum, minimum and average (in terms of mean and RMS) values for the selection. These values are typically expressed in physical units, with the counts shown in brackets.



Figure 38 Left-click and drag selection of waveform

#### Data Visualisation

		Gura	aip viewer — Discovery		^
Add Device Load Search Data	Fit to view Normalise O Live	Manual All Recent     Centring	<<>> >> Select range Timeline	Go to Dit. Dit.	2024/10/24 12:05:39.840
Channel List	<ul> <li>MNF85C-1VELE0         <ul> <li>m.s<sup>-1</sup></li> <li>250sps</li> <li>Min = -1.04949</li> <li>Max = -1.04614</li> <li>Avg = -1.04605</li> <li>Latency = 264000ns</li> <li>Scale = 29.6296%</li> </ul> </li> </ul>	12:02:10	12:02:20	12:02:30 04879m.s-1max (-4.29832e+0 n = 1min (-4.3012e+06)	12:02:40 5)
	Main seismometer E chain		<ul> <li>-1.04909m.s-1mean (-4.2995</li> <li>2024/10/24 12.02.15</li> <li>→ 10.5037Secs (2625Samples)</li> </ul>	i5e+06)1.04909m.s-1rms (4.	29955e+06)
	Min = -0.594867 Min = -0.594867 Max = -0.147781 Avg = -0.11822 Latency = 264000ns Scale = 29.6296% Main seismometer N chain	hannen an hannen an hannen	Antone and the second secon	Min both water	
Select groups up to 1 Select All Clear All Keep data in memory for 12 Hours Group viewer streams by Device ID Stream type Reverse sort	MNF85C-1VELZ0 m.s <sup>-1</sup> 2505ps Min = 0.0704145 Max = 0.0706035 Avg = 0.0706033 Latency = 264000ns Scale = 29.6296% Main seismometer Z chain		Q	85m.s-1max (4.34244e+06) 1e+06) (0.070612m.s-1ms (4 0705915m.s-1min (4.33955e+	.34081e+06), 11/14 (19) Dēji (10) (10) (10) (10) (10) (10) (10) (10)
2.0.113006-beta	х	2024/10/24 12:02:07.476			2024/10/24 12:02:47.913

Figure 39 Use Ctrl + left-click to select two channels not close to each other

Key modifiers (*Shift, Alt*) changes the annotated text to depict different signal statistics.

- Shift → The mean of the selected waveform if subtracted from the min and max. The range (difference between min and max) is also shown.
- Alt → The integral (area between signal and mean), the time in seconds between min and max and the ratio of min/max are displayed.

Using the Alt key changes the numerical annotation of the selected waveform as shown below. Using this feature to analyse a seismic instrument's step response will display damping factor and estimated long period corner in seconds.

**Note:** This approach to instrument verification is relatively quick to achieve an estimate of the instruments frequency response but it is highly broadband noise calibration is performed for a better, more accurate measurement.



Figure 40 Step response analysis with Alt Key

# 6.1.3.4 Saving Files

Portions of waveforms displayed in the Live View window can be saved to your PC in miniSEED format. In order to do this, highlight the section of waveform you want to save, right-click on it, and select Save as mseed. Multiple waveforms can also be selected as described in Section 6.1.3.3.

Various files are saved in the chosen directory, specifically:

- One file in miniSEED format for each channel selected, named after the channel name, which contains the highlighted portion of waveform
- One dataless file
- One file called all.mseed in miniSEED format, which contains multiple traces from all the channels selected.

If channels from more than one instruments are selected, the files from the different instruments are saved in folders named after the serial number of the devices. Each folder contains the same files as specified above.

# 6.1.3.5 Window Control Short-Cuts and controls

You can change the display of the waveforms with based on a combination of keystrokes and mouse wheel and menu buttons. These commands are shown in the tables below:

Command	Window control
<<>>	Extend view over all available data
>>	Show most recent minute or so of data
>>>	Show most recent few seconds of data
Ctrl + mouse wheel	Pan time-scale right/left
Shift + mouse wheel	Zoom time-scale in/out
Mouse wheel	Scale amplitude of all traces
Mouse wheel – over trace label	Scale amplitude of that individual trace
Right Click Context menu – Zoom in	Re-zoom whole display to show the selected region only
Right Click Context menu – ReZero	Remove mean from the selected portion of the waveform
Double left-click over Channel Stats	Magnify that channel
R Key When in Waveform Context	Re-scale and re-zero channels individually to be visible
+ Key When in Waveform Context	Change offset to bring last 10% into view
Mouse Wheel Over Channel Info Text	Zoom that one stream independently
Mouse Wheel Over Channel Info Text +Shift	Move that one stream's offset
Mouse Wheel Over Channel Info Text +Control	Fine move that one stream's offset

*Table 2 List of commands to change waveform display* 

The overall waveform window scaling and offset of channels is controlled by the buttons above the waveforms. These change all the channel's zoom and offset values in one 'hit'.

#### Data Visualisation

### Güralp Discovery - Software Manual



Figure 41 Scale, Offset and Zoom controls in Live View window

Button	Scale	Offset	Comments
Fit to view (formally Reset)	Each channel scaled to fit	Set to the channel's mean	A quick way to guarantee actually seeing something irrespective of any channel offset or signal size
Normalise	Reset Zoom to fit the biggest waveform. Other channels given the same zoom	Set to the channel's mean	Useful to compare relative size of multiple instrument's response to an event.
Live	No Effect	Dynamically set to the mean of the channel's recent data.	Toggles Live mode.
Manual (formally Centre Streams)	No Effect	Call <mark>All</mark> once.	Toggles Manual mode.

### Data Visualisation

All	No Effect	Set to Channel's Mean	Manual mode only.
Recent	No Effect	Set to the mean of the channel's recent data.	Manual mode only.

# 6.1.3.6 Window Tools

There are 3 tools available within the waveform window to assist in analysing the trace data.

Viewer — Discovery		
<<>> >> >> Select range Go t Timeline	o 🔝 it. 🖾   Tools	2024/10/2
er andere sen til på lævnik filmstef folg beter en der på på skriftet for det att sævni Oster på er på lævnik sen stør er konstanter på skriftet for som forste som	n male, kink on de prove dat jinne av gy og til fordansk in Anne produkt i blende sjonder politiker fordaler og en fordijinger	n en sin e benef wij en die en bestikten en beken en beseit het en werden. Hin het en en eine sin werden en be en de sig en je son werden eine gewenne werden sin de sig kan met en de je de en werde de sig en fan de stere werde benef werden eine beken. Het werde en en werde werde en werde de stere en de stere en de stere en stere e
T.	Souro 12 Monorious	Toolo

Figure 42 Waveview Tools

From left to right these tools do the following:

1 – Stream Marker Labels - Used to highlight any gaps or overlaps.



*Figure 43 Stream Marker Labels showing gap in data* 



2 – Vertical Time Bar – Allows user to pinpoint the time of a specific event in the stream data.

Figure 44 Vertical time bar being used to analyse a specific seismic event

3 – Connection Events –A live list of connection events. Useful for gaining understand of what is happening in terms of device connection, disconnection and re-connection.

Connection Events — Discovery	×
MIN-725C	
	1
2024:10:24-11:54:43 Subscribing to channel RA0000-81MPB0	<u> </u>
2024:10:24-11:54:43 Subscribing to channel RA0000-8VOL10	
2024:10:24-11:54:43 Subscribing to channel RA0000-8R01Y0	
2024:10:24-11:54:43 Subscribing to channel RA0000-8R01P0	
2024:10:24-11:54:43 Subscribing to channel RA0000-8ROTR0	
2024:10:24-11:54:43 Subscribing to channel MN725C-0VINP0	
2024:10:24-11:54:43 Subscribing to channel MN725C-0HUMA0	
2024:10:24-11:54:43 Subscribing to channel MN725C-0TMPA0	
2024:10:24-11:54:43 Subscribing to channel MN725C-0CVDAC	
2024:10:24-12:08:31 Disconnecting from MIN-725C	
2024:10:24-12:08:40 Lost GDI Connection, attempting to reconnect	
2024:10:24-12:08:40 Establishing GDI connection for	
2024:10:24-12:08:41 Connection successful	
2024:10:24-12:08:41 Establishing GDI connection to 10.30.0.18	
2024:10:24-12:08:46 Subscribing to channel MN725C-0AUXX0	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCZ0	
2024:10:24-12:08:46 Subscribing to channel MN/25C-0ACCZ2	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCN0	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCN2	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCE0	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCE2	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCM8	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCM9	
2024:10:24-12:08:46 Subscribing to channel MN725C-0ACCMA	-1
2024:10:24-12:08:46 Subscribing to channel MN725C-0ROTY0	<u> </u>

Figure 45 Connection Events Widget

All tools can be enabled/disabled easily via the Wave View page.

# 6.2 Offline Data

MiniSEED data can be loaded directly into the viewer from files. Open the data viewer from the **Tools** menu. Clicking on the **Load data** option from the top of the viewer screen opens the file dialog for this purpose.

MiniSEED data can either be loaded from file(s) or from directory. This second option will be explored in Section 6.2.2. MiniSEED files can also be loaded by dragging them into the Viewer.

A miniSEED file stores time series data with very limited metadata (time series identification and simple SOH flags). Therefore, when a miniSEED file is uploaded alone, the time series is displayed in counts.

The metadata, including the instrument response, is contained in the dataless SEED volume. To visualise the time series in physical units the dataless SEED volume is needed.



Figure 46 Load data option from the Live View window

### 6.2.1 Upload Metadata

Metadata (calibration, gains etc) is loaded from a .dataless file. Choose a file of this extension and any matching seed channels will display gains, units etc in their respective metadata from then onwards.

First, drag into the Data Viewer or upload the dataless file. Then, drag or upload the correspondent miniSEED file(s). Alternatively, load miniSEED and dataless file together. Now your waveforms will be displayed in physical units.

The dataless file can be offloaded from any Güralp digitisers from the Storage tab of the webpage.



Figure 47 Upload the dataless SEED file together with the miniSEED file to display the waveforms in physical units

### **6.2.2 Directories and Filters**

As mentioned previously, there is an option for loading files from a directory (folder). If this option is chosen, a later dialog will ask if you want to filter the loaded files depending on the filenames by using the wildcard \*.

Some examples:

\*  $\rightarrow$  load all the files in the directory

\*SeisZ\*  $\rightarrow$  load all the Z channel data

EVENT\*  $\rightarrow$  load all the files generated as a result of triggers

\*Rot\*  $\rightarrow$  load all the files with rotation information (yaw, pitch and roll)

 $DG^* \rightarrow$  load all the files with network code DG (including dataless file if available)

This feature is based on the matching of the filenames, so the expressions may vary depending on the instrument.

# 7 Data Analysis Tools

Data analysis tools are available for both real-time data (Live Viewer) and offline data (Data Viewer).

**Note:** When offline miniSEED files are uploaded to the Data Viewer tool, remember to upload also the dataless file before performing data analysis (see Section 6.2.1).

Once the waveform viewer is opened and the desired streams are displayed, selecting a portion of waveform and right-clicking on it gives the user access to various processing applets. These generally accept a block of samples from the selected region and perform a function that may then lead to a graph or dialog. Most of the applets either accept multiple channels and would overlay results or launch one instance of the applet per stream, as applicable.



The following sections describe the main applets available.

Figure 48 Right-click context menus

# 7.1 Plots

# 7.1.1 PSD



Figure 49 Example of PSD of 3 components of an instrument

Clicking on Plot  $\rightarrow$  PSD allows you to plot of the Power Spectral Density (PSD) of selected data. More than one streams can be selected simultaneously to overlay the results. The PSDs of your data will overlay the new high- and low-noise models (NHNM and NLNM, respectively).

This operation deconvolves the instruments response with the poles, zeros and gain extracted from the channels metadata. The PSD is calculated from the signal in various, overlapping, finite-length windows within the data selection. The window function, overlap and step can be set by right-clicking on the selection of data, and selecting **Windows**.

The plot can be zoomed in/out by using the mouse and modifier keys as follows:

Mouse Wheel – Change overall zoom Shift + Mouse Wheel – Horizontal zoom only Ctrl + Mouse Wheel – Vertical zoom only.

Clicking on the entry of a specific channel in the legend box will remove that line from the graph. Click on it again to re-add the line.

PSDs can be saved in different formats, including PDF, JSON and JPG. JSON files can be loaded into your graph to create overlay.

#### 7.1.2 Min PSD

In order to show the instrument's best performance over a period of time, the user should compute the Min PSD, which can be done by clicking on Plot  $\rightarrow$  Min PDS.

For the calculation of the Min PSD, the PSD is computed multiple times at increasing time offsets. The power measured in each frequency bin is then minimised across all the PSDs that have been calculated, so that the effect of local impulse noise is removed. This presumes that a large amount of source data is selected, typically 12 or 24 hours. This is an intensive operation that takes advantage of multi core hardware.

The statistical spread of the instruments output is represented as is the mode.



Figure 50 Example of Min PSD

# 7.1.3 Self Noise

The measurement of an instrument's self-noise requires a second instrument which is used as a reference. The reference instrument must be precisely aligned with the **MAN-DIS-0001** 

65

instrument under test. During the computation of the self-noise, the common signal between the two instruments is eliminated, leaving only the non-coherent signal. The residual noise is plotted as indication of an instrument's performance.

To generate a self-noise plot, at least two streams must be selected. The first stream serves as a reference and corresponds to data from the reference instrument. Subsequent streams represent the instruments for which the self-noise is being calculated. Once the data is selected, right-click on the selection and choose Plot  $\rightarrow$  Self Noise.

# 7.1.4 Min Self Noise

## 7.1.5 Spectrogram

A spectrogram is a visual representation of how the frequency content of a seismic signal changes over time. The Spectrogram function thus generates a spectral plot over time. It is designed to spot typically anthropomorphic noise picked up by a sensor such as vibration from motors, engines, vehicles etc.

The horizontal axis represents the time duration of the selected seismic recording. The vertical axis shows the frequency content of the signal in Hz. This axis of the spectrogram is linear, with the maximum corresponding to the Nyquist frequency. The colouring represents the energy at each frequency over time, and it follows a logarithmic scale.

The plot can be zoomed in/out and modified by using the mouse and modifier keys as follows:

Mouse Wheel – Change overall zoom Shift + Mouse Wheel – Horizontal zoom only Ctrl + Mouse Wheel – Change colour palette Left Mouse drag – Move X,Y

#### Data Analysis Tools



Figure 51 Example of a spectrogram for a 250sps channel



# 7.1.6 Transfer Function

Figure 52 Plot of the transfer function based on metadata poles/zeros

The poles and zeros from the selected channel are plotted as a Bode plot giving phase and magnitude response of the instrument. Note that this applet does not compute the poles and zeros, but only plots the transfer function based on the poles and zeros already supplied.

## 7.1.7 Channel coherence

This tool measures the similarity between seismic signals recorded at two different stations or channels as a function of frequency. Amongst various uses, coherence results can help to identify common signals (high coherence means that signals are part of the same seismic event), to assess stations performance (low coherence may indicate sensor issues or poor site conditions), to assess site amplification effects (coherence between vertical and horizontal components).



Figure 53 Example of coherence plots between the East channels of two co-located seismometers

### 7.1.8 Channel correlation

This tool performs a time domain correlation between selected channels. To plot the correlation between two desired channel, select a portion of data from one stream (which will be deemed the reference) and then Ctrl + Click on the second stream. Right-click and select Plot  $\rightarrow$  Channel correlation.

The data is windowed (using the Hanning function) before the correlation is computed. For the computation of the correlation one signal is shifted continuously towards the reference, and for each time-shift the value of the correlation is calculated. A peak at the mid-point (marked zero on the output) shows how similar (correlated) the channels are.

This tool can be used to calculate the time offset between channels even if the data is not identical. For example, it can be useful in order to measure the time delay between two seismometer channels. The numerical time offset is displayed in the text region below the graph.

Performing this on a single channel plots the autocorrelation function of the data.

The left hand graph shows the same data as the right hand but at an oversampled (x100) rate. This allows a more accurate, sub-sample time period to be measured.

The graphs can be panned and zoomed with the mouse wheel and control and shift keys as follows:

Mouse Wheel – Change overall zoom Shift + Mouse Wheel – Horizontal zoom only Ctrl + Mouse Wheel – Vertical zoom only Left Mouse drag – Move X,Y

This applet can be also used to correlate a calibration signal (for example, a sine wave) and the instrument's output. The values reported in the text box below the graphs can be used for gain calculation and phase analysis. For more information, the reader is referred to Section 7.2.



Figure 47 Correlation between calibration signal and instrument output

### 7.1.9 Alignment

This function attempts to align a subject sensor to a reference by rotating the subject data through a series of angles and comparing it to the reference via their coherence,

over the specified frequency range. The angle between the sensors is determined by finding the highest coherence, the mean squared error is used to check for a 180° offset (coherence is a function of power and therefore will give the same result whether or not the subject is inverted).

The alignment plot is used primarily to find the yaw (clockwise rotation around the vertical axis) of the subject. In its most basic form one horizontal channel is needed as a reference, while all subjects will need both their N/S and E/W channels. With channels selected in this manner the reference drop down in the dialog will contain only one possible option and the "Subject Starting Orientation" controls are disabled.

If the both the horizontal channels are selected for the reference the subject will be evaluated against each in turn, with the final result being the sum of the N/S and E/W coherences. If all three channels are provided for the subject, you can specify starting roll and pitch angles (can be taken from the sensors MEMS accelerometer channels if it has them).



Figure 54 Alignment Dialog

Finally if all three axes for both the reference and subjects are selected, the option to apply a "3D small angle correction" will appear. This searches for the best total coherence while rotating the subject around all three axes (roll, pitch and yaw) over a ±4° range.

The reference and subject steams need to have the same sample rates and should have the same response (poles and zeros) although this is not essential if they have a good match over the specified frequency range. Comparing sensors with different unit types (e.g. acceleration against velocity) is not advised as it can give odd results.

Once Discovery finishes processing you will get an alignment plot for each subject. This shows the coherence and mean squared error versus yaw angle and replots the selected reference timeseries data against the newly rotated subject.

#### Data Analysis Tools



Figure 55 Alignment plot

The notes section will give you the angle with best coherence found and provide a quaternion equivalent to this rotation which can be applied directly to the subject sensor via the transforms tab of its digitizer webpage.

# 7.2 Setup Calibration Emails

This function can be performed as a superset of the Correlation function above (Section 7.1.8).

An instrument can be 'excited' with a test signal – typically a sine wave.



Figure 56 Typical output during calibration with a Sine Wave

The output of the instrument can be correlated with the excitation signal and then the results tested between limits to decide whether the instrument is working as expected.

These limits can be set through Discovery, according to the frequency and type of excitation.

Two measurements are made on the correlation. The first is the time offset between the excitation signal and the instrument output. This measures the phase response of the instrument. The second is the relative amplitude of the instrument's output as compared to the excitation amplitude. This relates to the instrument's gain.

Numerical values of the phase and magnitude are calculated and saved to a log file.

This function is enabled in the digitiser by performing a Sine Wave Calibration. The action of turning off the calibration triggers the analysis automatically.



Note: the Calibration channel needs to be enabled on the digitiser.

Emails can be configured to be set out when the sine wave calibration signal is sent. To do this, right-click on the Wave Viewer and select <mark>Setup Calibration Emails</mark>.

Setup Calibration Email - Discovery —								$\times$	
							Help		
Signal		Delay threshold (ms)		+/-	Gain thres	hold	+/-		
Sine Wave 1 Hz		53812		124	0.248123		0.2		
Clear table	Add new ro	Add new row Save			Load new calibration details				
Log file location C:/Users/frestelli/Calibration.log									
					Chan	ge Lo	g Loca	tion	
smtp Server	smtp://smtp.exan	nple.com					:		
Username	username@example.com								
Password	password								
Sender Email	sender@mail.com								
Recipients	user@recipient.list, anotherUser@mail.com								
Auth Required	d								
						Send	Test Er	mail	
Close					Disable		Enable	е	

Figure 57 Setup calibration email window

This window will assist with setting up emails to notify the success or failure of correlating calibration data of ZNE streams, based on the thresholds indicated in the table.
The required threshold can be inserted into the table either manually or by loading a \*.csv file with 5 columns. These columns will contain:

- The type and frequency of the excitation as it appears on the instrument's webpage ("Signal")
- The threshold for the time offset between the excitation signal and the instrument output in ms ("Delay threshold")
- The tolerance of the time offset ("+/-")
- The threshold for the relative amplitude of the instrument's output as compared to the excitation amplitude ("Gain threshold")
- The tolerance of the relative amplitude ("+/-")

Note: the type and frequency of the excitation in the "Signal" column has to be written exactly as it appears in the label of the calibration channel in Discovery's Live View (i.e. "Sine Wave 1 Hz"). If you do not see any labels, click on the icon with the symbol in the figure below (under the Tools section). If you do not see the label at the beginning of the calibration signal, you may need to upgrade the instrument's firmware.

<<>> >> Select Timeline	t range	
s s s s s s s s s s s s s s s s s s s	14:52:20	14:52:30
	fechanical	

The 2 lines below represent an example of valid entries for the csv file:

Sine Wave 2 s	64522	845	0.248123	0.03
Sine Wave 1 Hz	53812	124	0.248123	0.02

Any lines in the csv file that do not contain 5 items will be discarded. Blank data is accepted. However, these rows will not be read when reading calibration data.

If your smtp server requires authentication, tick the "Auth required" box and fill in the "Username" and "Password" fields. If authentication is not required, do not leave the box un-ticked and the "Username" and "Password" fields empty.

When adding emails to the recipients list, separate them with a comma (','):

someone@example.com, someoneelse@example.com

Once the email settings have been filled in, send a test email by clicking on Send Test Email. If the test email was successful, click Enable to complete the setup. Your password will not be stored, so this feature will need to be reenabled if Discovery is restarted.



The action of turning on and off the calibration signal basically triggers the Channel Correlation applet, which performs the correlation between the excitation and each one of the three seismic channels. The results of the three correlations will appear on the same plot as in the figure below.

#### Data Analysis Tools



The success/fail email will be sent once a calibration signal that matches a row in the table is started *and then switched off*.

If there are fewer than 10,000 samples the email will not be sent as the data set will be insufficient.

Below is an example of the curl script used to send the email:

```
curl --url 'smtp://mymailhost.com:25' --mail-from
me@mymailhost.com' --mail-rcpt 'whoever@mymailhost.com' -vv --
upload-file
```

Note: To send emails, curl must be installed on your system

Success and failures will also be logged to the location specified in this window to a fie called "Calibration.log". The location of the log file can be changed using the button Change Log Location.

# 7.3 Filters

Filters are an essential tool in seismic data processing. The main types of filters are:

- Low-pass filters: they allow lower frequencies to pass through while attenuating higher frequencies

- High-pass filters: they allow higher frequencies to pass through while attenuating lower frequencies
- Band-pass filters: they allow only a specific range of frequencies to pass through while filtering out the others. A combination of low-pass and high-pass filter can be used to create a band-pass filter.

Filters are typically used for the following purposes:

- Remove unwanted noise from various sources, such as ocean waves or human activity
- Enhance signals of interest or different seismic phases
- Spectral analysis to study earthquake source properties and site effects
- Instrument response removal, along with deconvolution techniques.

Discovery offers both real-time filters and non-real-time filters, as detailed below.

### 7.3.1 Real-Time Filtering – Inbound Filters

Filter can be applied in real-time to data coming into Discovery (inbound). Either a low-pass, high-pass, or combination of both can be used. Since these filters are performed in real time, they are *causal* in nature. In short, causal filters are filter where the output at any given time depends only on the past and present inputs, and not future inputs. This makes them suitable for real-rime processing applications. All inbound filters will be remembered and applied the next time a stream is opened.

To add a filter to data streamed to the Discovery Live Viewer, right-click on the channel summary and select Inbound Filters.



Figure 58 Right-click to apply real-time filters

This action opens the "Inbound Filters" widget.

#### Data Analysis Tools

#### Güralp Discovery - Software Manual

Inbound Filters - Discovery	- 0	×
Channels		
✓ ■ MIN-A65B		
MNA65B-0VELZ0		
MNA65B-0VELNO	)	
MNA65B-0VELE0		
Select All	Clear All	
Select All Composition	Clear All	
Select All Composition Highpass	Clear All	
Select All Composition Highpass 0.00000  Hz	Clear All Clear All Clear All Hz	
Select All Composition Highpass O.00000  Hz Ist order	Clear All Lowpass 1.00000 Hz Ist order	
Select All Composition Highpass 0.00000 + Hz 1st order	Clear All Clear All Clear All Clowpass Lowpass Lowpass Lowpass Lowpass Lowpass Lowpass Clear All	20)(
Select All Composition Highpass 0.00000 + Hz 1st order Vote: Inbound filters are applied to or nalysis done on a filtered channel w	Clear All Clear All Clear All Clowpass Lowpass Lowpass Hz Ist order data coming <i>in</i> to Discovery, meaning ill be done on filtered data.	any

#### Figure 59 Inbound filters widget

All channels visible in the Data Viewer will be listed and the one used to open the widget will be automatically selected and checked. Multiple channels can be selected by ticking the relative boxes. The Composition section of the widget allows the user to choose which type and order of filters to apply to the selected channels. A combination of high-pass and low-pass filters can be used to achieve a band-pass filter. When Apply or OK are pressed, the current composition will be applied to all channels in the list that are checked. After setting a filter on a channel it will show up on the channel summary:



Figure 60 Channel with filter applied

**Note:** Inbound filters are applied to data coming *into* Discovery. This means that any analysis done on a filtered channel will be done on filtered data.

### 7.3.2 Non Real-Time Filtering – Filter+

The Filter+ applet allows you to apply filters to non-real-time data. These data can be either miniSEED files loaded into the Discovery's Data Viewer (together with the relative dataless file – see Section **Error! Reference source not found**.), or a selection of data streamed to the Live Viewer.

To select a section of time-domain signals on one channel, right-click on the waveform and drag to make a selection. To then select multiple channels, click on them while holding the Ctrl or Shift key. Once the desired data have been selected, right-click and choose Filter+. This action opens the "Filter+" widget. The Replot button is used to re-plot the data after any filter or other options have been selected. Click on the Replot button also to visualise the data upon opening the Filter+ widget (otherwise, no data is displayed).



#### Figure 61 Filter+ widget

Tick the Use Cal box to visualise the data in physical units rather than digital counts. When this box is ticked, the data is scaled using the scaling factor represented by M-CAL (see Section 6.1.2). Tick the Auto Scale box to automatically optimise the view. Tick the Remove DC box if you want to plot the data centred around zero. If multiple streams have been selected they may overlap, making it difficult to distinguish the features of each waveform. Tick the Spread box to centre the data from each channel around different values, ensuring all waveforms are visible simultaneously. Note that when this box is ticked the vertical label loses its meaning.

#### Data Analysis Tools



*Figure 62 Ticking the Spread box allows you to visualise multiple waveforms simultaneously without overlaps* 

At the top-left of the Filter+ window, low-pass and high-pass filter options (hence band-pass filters) are implemented. The order of the filter can also be set. The Linear Phase check boxes are used to perform symmetrical (forwards and backwards, or acausal) filtering, which ensures that the timing of edges for picking remain the same.

Both the original input and filtered output can be displayed as shown below. Individual traces can be hidden or revealed by clicking the names in the legend on the top-right.



Figure 63 Filter+ Applet displaying original and filtered traces

The **Deconvolve** check box performs a deconvolution of the time-domain data using the instrument's response (poles and zeros). Typically, for a seismometer this is a bandpass response. This results in a boost for the low and high frequencies as the plot below demonstrates.

#### Data Analysis Tools



Figure 64 Low-pass filter and Deconvolution with cursors

Waveform statistics can be displayed by ticking the **Stats** box. To view true peak ground motion, use the **Cal** option and the **Deconvolve** option. Typically, also the **Remove DC** option is used to eliminate instrument drift when looking at the PGA of an event.



See below for an example.

Figure 65 Stats display to the right of the waveforms

A PDF report can be generated for Filters+ with the **pdf** button. This will catalogue the filter options used, including: timestamps, deconvolution, and any pass filters applied. It also displays the plot of waveforms followed by a table for each waveform detailing the min/avg/max and, if they are from seismic channels, the PGA/PGV/PGD. An example output follows.



*Figure 66: PDF report for applying M-CAL, DC removal, deconvolution, and a first order high pass filter to a selection of two streams.* 

Filter+ also allows you to select a time window within the Filter+ widget and automatically highlight the corresponding data segment in the Data Viewer. To do this:

- Hold down the Ctrl key and left-click at the desired start time. A red line will mark the selection start.
- While still holding the Ctrl key, right-click at the desired end time. A yellow line will mark the selection end.
- The same time window will automatically be highlighted in the Data Viewer as shown in the image below.

#### Data Analysis Tools



Figure 67 Time selection of data in the Filter+ widget and corresponding data in the Data Viewer

A possible application of this feature is related to the computation of an instrument's PSD (see Section 7.1.1) for performance assessment. For an optimal performance evaluation of the instrument, data should be selected from quiet periods. Usually, nighttime data are used, when human activity is at its minimum. Applying filters before computing a PSD can help in selecting the best data. In fact, filtering the data

can emphasise transient events (e.g. spikes and glitches) that would otherwise not be visible.

The figure below shows an example of how filtered data (green) can reveal spikes that are not visible in the original waveform (grey).



Figure 68 Example of filtered data revealing spikes not visible in the original waveform

For the computation of a PSD for performance analysis, a time window which excludes the spikes should be selected. This can be done in the Filter+ widget as explained above. This action will highlight the corresponding time selection in the Data Viewer, which can then be used to compute the PSD.

# 8 Güralp Data Centre (GDC)

# 8.1 Concept & Purpose

Güralp Systems Data Centre software package (acquisition software package) consists of several applications with the primary purpose of acquiring, saving and redistribute miniSEED data. It also provides system state of health monitoring and distribution, with remote configuration capabilities.

## 8.2 Software Components

- IRIS ringserver
- slinktool
- slink2dali
- Güralp Data Centre controller service
- Güralp Data Centre monitor service
- Güralp responder service
- Güralp Discovery application (NOT Deployed on GDC server)

Optional components:

- Earthworm client
- SeiscomP3 client

# 8.3 **Operating System Compatibility**

Güralp Systems Data Centre software package has been tested on the following x86\_64 platforms:

- Red Hat Enterprise Linux 8 (or equivalent, e.g. Rocky Linux 8 or AlmaLinux 8)
- Amazon Linux 2

# 8.4 Open Ports

The GDC requires access to the network to operate correctly. Please make sure that the system security settings allow the network traffic to and from the machine on ports specified in the table below. It also might be needed to configure SELinux features in relation to the mentioned requirements.

Port	Protocol	Description
11788	UDP	Used for sending and requesting state of health information by system components and Discovery desktop application.
11788	TCP	Configuration exchange protocol used by Discovery desktop application to configure data streaming connections.
16000	TCP	DataLink data transmission protocol connection to IRIS ringserver.
18000	TCP	SeedLink data transmission protocol connection to IRIS ringserver for both incoming and outgoing data streams.

*Table 4 Ports that have to be open for GDC* 

# 8.5 GDC Configuration

#### 8.5.1 IRIS ringserver

IRIS ringserver does not require any specific configuration unless change in either default storage location (/var/cache/guralp/miniseed/) or time for which the data is kept on the hard drive is required. Application runs as an operating system service and listens for SeedLink connections on TCP port 18000. If required listening port is different to 18000 please contact <a href="mailto:support@guralp.com">support@guralp.com</a> for instructions.

### 8.5.2 Ringserver miniSEED files storage location configuration

IRIS ringserver storage location is configured by the home directory of ringserver user and if required can be changed by system administrator by editing the user properties. This can be done via SSH into data centre. Newly selected directory should have sufficient permission and ownership. The steps below show how to modify the home directory of the ringserver user in Red Hat Linux environment (please note that commands may require elevated permissions).

a. Copy tmpfiles.d guralp-miniseed.conf file to /etc system location

cp /usr/lib/tmpfiles.d/guralp-miniseed.conf/etc/tmpfiles.d/guralp-miniseed.conf

b. Edit the copied configuration file and append a new line specifying the new storage location:

d	/run/guralp/etc	0755	root	root	
F	/run/guralp/etc/iris-ringserver.conf	0640	root	ringserver -	
MSee	edWrite %%n_%%s_%%l_%%c_%%Y_%%j.mseed				
d	/var/cache/guralp/miniseed	0775	root	ringserver	3d
d	/mnt/new/storage/directory	0775	root	ringserver	3d

- c. Save the changes made to the file
- d. Modify the ringserver user home directory

usermod -d /mnt/new/storage/directory ringserver

e. Reboot the system to apply the changes. Please note that only the following top directories can be used: /home /media /mnt /opt /srv /var

### 8.5.3 Ringserver miniSEED files storage auto-clean configuration

IRIS ringserver storage is controlled by system tmpfiles clean timer and can be configured by editing guralp-miniseed.conf file. To change the configuration of time that historical data is kept in the system please follow the steps below.

a. Copy tmpfiles.d guralp-miniseed.conf file to /etc system location

cp /usr/lib/tmpfiles.d/guralp-miniseed.conf/etc/tmpfiles.d/guralp-miniseed.conf

b. Edit the copied configuration file and change the age of storage location to the required value.

```
d/run/guralp/etc0755 rootrootF/run/guralp/etc/iris-ringserver.conf0640 rootringserver-MSeedWrite %%n_%%s_%%l_%%c_%%Y_%%j.mseed0775 rootringserver3d
```

where 3d is the age of temporary files (read more: https://www.freedesktop.org/software/systemd/man/tmpfiles.d.html).

c. Save and reboot the system.

### 8.5.4 Slinktool

Slinktool process runs as a service with parameters provided through the service name in a form of a '@' separated list of values. Under normal operation there is no requirement to manually configure (enable/disable or start/stop) the service, this task is performed by the Data Centre controller on remote request from the Discovery desktop application.

Manual service configuration can be performed but it is not recommended. To do that, please log in to the Data Centre computer and use systemctl command to enable/disable and/or start/stop the Slinktool service. Slinktool service is run with a set of parameters:

slinktool@NN@ST@LLCHA@CONNECTION@PORT.service

where:

- NN is the SEED network code.
- ST is the SEED station code.
- LLCHA, is SEED location and channel codes.
- CONNECTION, is the connection IP address or hostname, for latency monitoring in the Data Centre this is set to 127.0.0.1 (localhost)
- PORT is the connection port of the Seedlink data.

Wildcard character for SEED location and channel name can be used and is represented by '\_' character. Also, a list of location and channel names can be provided to a given service and should be separated with '-'character.

Example:

<u>slinktool@DG@0585A@\_\_\_\_@127.0.0.1@18000.service</u>, will connect to station 0585A of DG network, subscribing to any channel (wildcard selector of 5x '\_' character).

<u>slinktool@DG@0585A@0NHHZ-0NHHN-0NHHE@127.0.0.1@18000.service</u>, will connect to station 0585A of DG network, subscribing to 0N.HHZ, 0N.HHN and 0N.HHE channels.

### 8.5.5 Slink2dali

Slink2dali process runs as a service with parameters provided through the service name in a form of a '@' separated list of values. Under normal operation there is no requirement to manually configure (enable/disable or start/stop) the service, this task is performed by the Data Centre controller on remote request from the Discovery desktop application.

To configure the required connection (slink2dali and Slinktool services) use the Discovery desktop application described below.

# 8.6 GDC Discovery Interface

After primary installation and configuration, the GDC is intended to run as a headless server. Further configuration, maintenance and SOH monitoring can be accomplished though Discovery. The purpose of GDC is to record data streams from multiple

sensors. This archive of miniSEED files is then available to applications on the Linux environment.

The system also runs a SeedLink server that is capable of re-streaming any of the streams that are being recorded. Any SeedLink client can connect to this server to retrieve data.

Discovery can be used as a SeedLink client also. In this mode, data can be viewed live without the need to pull a second stream directly from the device.

### 8.6.1 Configuration - Adding a Station

- Open Discovery desktop application and change the view to "Registry" mode.
- Right-click on the Data Centre instance.
- Select Configuration option.
- In the configuration widget, if not preloaded with configuration, click on "Restore" button to retrieve the Data Centre configuration.

	lon	don - Data Centre Configuration — Disco	very			×
General settings						
Registry group identifier:						
Monitoring period for latency cha	nnels:	30				
Monitoring period for active chan	nels:	60				
Monitoring period for active devi	ces:	120				
Filter for active channels monitor	ing:	71.77777.77				
Filter for channels latency monito	oring:	??.????.0N.???				
Registry servers						
127.0.0.1						Remove
52.34.40.123						Remove
52.66.185.185						Remove
						Add server
Station subscription list						
DG.0725C (127.10.114.92:11785)	<i>?</i> ?.???		Remo	ve	Use tun	nel connection
DG.0F85C (127.10.248.92:11785)	77.777		Remo	ve	Use tun	nel connection
		Add station	from disc	overed	Add st	ation manually
Restore					Canc	el Apply

Figure 69 Data Centre Configuration Controller

• From here Devices on the same registry server can be added from 'Add station from discovered.

• To apply configuration changes to device, choose 'Apply'. Ensure that when adding devices that 'Use tunnel connection' is selected.

### 8.6.2 State of Health

The Data Centre state of health can be monitored in the real time either in the Discovery desktop application main window by checking the status indication icons, and/or by accessing the dedicated Data Centre state of health widget.

Comet	t FEM_TEST_JIG t Test Rack	Aquarius	AQU-145A	5210											
Comet	t Test Rack			3210	2.1-10023	10.30.0.18	10.30.0.18	255.255.0.0	00:00:24	0.0000	0.0000	-12.34		n/a	n/a
Comet		Fortimus	FMUS-585A	22618	2.1-11215	10.30.0.68	10.30.0.68	255.255.0.0	26 days 22 Hrs	51.3612	-1.1643	125.00	70.99%	n/a	n/a
	t R&D	Fortimus	FMUS-9059	36953	2.1-11311	10.30.0.20	10.30.0.20	255.255.0.0	4 days 0 Hrs	51.3614	-1.1639	-12.34	98.68%	n/a	n/a
Comet	t Five-character serial number	Minimus	MIN-12345	74565	2.1-11547	10.30.0.11	10.30.0.11	255.255.0.0	6 days 23 Hrs	51.3612	-1.1640	114.20	97.73%	3.90s	4.53s
🕓 🔳 Comet	t NO LABEL	Minimus	MIN-7957	31063	2.1-11312	10.30.0.49	10.30.0.49	255.255.0.0	00:36:21	51.3615	-1.1640	-12.34	99.85%	n/a	n/a
🔇 🔳 Comet	t NO LABEL	Minimus	MIN-9355	37717	2.0-8282	10.30.0.90	10.30.0.90	255.255.0.0	10 days 23 Hrs	-59.9000	85.5410	-12.34	4.87%	n/a	n/a
🕓 🖀 Comet	t Orac	Minimus	MIN-CC57	52311	2.1-1679	10.30.0.38	10.30.0.38	255.255.0.0	00:00:46	51.3612	-1.1640	-12.34	99.23%	n/a	n/a
🔇 🔳 Comet	t deck@aqu-deck-dev.guralp.local	Discovery	aqu-deck-dev	4C5262264CEC	1.1-263	10.30.0.108	10.30.0.108	255.255.0.0	6 days 0 Hrs	51.3611	-1.1639	0.00	97.94%	n/a	n/a
Comet	t DATC@guralp.guralp	Data Centre alp 10.30.0.37	ouralo	D850E6BE7E96	0.3-1	10.30.0.37	10.30.0.37	255.255.0.0	02:51:00	0.0000	0.0000	0.00	67.46%	3.90s	4.47s
	State of Configu	f health dashb ration	oard												

*Figure 70 Access to GDC state of health from Discovery's window* 

The state of health dashboard widget is divided into 4 main parts as shown and described in the following Figures.

🗣 genes - Data Conte Faulti Darlimani - Disconte	- О. н
Litera	No ong
44	Terral Terral State Stat
+	
10	
-	1
	340
10	2.00
18-	
Antonio approve approve approve approve approve approve approve the second transmission to a second transmission approximate the second tr	10000 00100 00000 00000 00000 00000 00000 00000 0000
MARK	4049.98
gende underlande anvelas is interes gende organisede anvelas is interes gende of gende gende anvelas is interes enter anvelas interes anvelas is interes enter anvelas interes anvelas is interes enter anvelas interes anvelas interes interes quenter enter anvelas interes interes quentes interes anvelas interes interes quentes interes interes quentes interes anvelas interes anvelas interes interes quentes anvelas interes anvelas interes interes quentes anvelas interes anvelas interes interes anvelas interes anvelas interes interes anvelas interes anvelas interes anvelas in	Sten det 6 (100104 (2011) Service): 5. Nure Adv. aristopy 6. Nure Adv. Service (1000000000000000000000000000000000000
ing fac	
The still by the Differentiation of the	
Constant of the same of the last of the second seco	

*Figure 71 Top-left widget is a latency graph displaying the highest historical latency value for up to last 30 minutes.* 

#### Güralp Data Centre (GDC)



*Figure 72 Top-right widget is a disk usage graph displaying the disk free space in MB (blue graph, left y axis) and disk used space percentage (red graph, right y axis)* 



*Figure 73 Bottom-left widget displays the state of services running on the Data Centre and allows to configure the logfile and output data file for activity log and latency/disk usage data respectively.* 



*Figure 74 Bottom-right widget displays the activity log based on state of health information packets received.* 

#### Log line contains the following information:

- Timestamp
- Latency value
- Sample latency value
- Number of active channels
- Number of active devices
- Latest sample timestamp
- Available disk space in KB
- Disk used space in KB
- Percentage value of free disk space

#### And is logged as single line in the following format:

{[Timestamp]} Latency: {Latency value}s; Sample latency: {Sample latency value}s; Active channels: {Number of active channels}; Active devices: {Number of active devices}; Latest sample timestamp: {Latest sample timestamp}; Disk available: {Available disk space in KB}; Disk used: {Disk used space in KB}; Disk free: {Percentage value of free disk space}%;

#### Example:

[Fri Jul 9 13:50:34 2021] Latency: 1.50s; Sample latency: 1.81s; Active channels: 26; Active devices: 2; Latest sample timestamp: Fri Jul 9 13:49:43 2021; Disk available: 73364480; Disk used: 54698232; Disk free: 25.44%

### 8.6.3 Advanced redundancy configuration

It is possible to have two data centre servers running concurrently. For advice on this more advanced configuration please contact Güralp at <a href="mailto:support@guralp.com">support@guralp.com</a>

### 8.6.4 GDC Restreaming

Discovery can fetch live data directly from the GDC ring buffers.

×	s	tatus	Label	System	System Name *		Firmware Ver	(Identifier)	WAN
		0	Comet DALHOUSIE_47	Aquarius	AQU-EA61	EA61	2.1-17870	(AQU-EA61)	89.21
		0	Comet NO LABEL	Certimus	CERT-115D	115D	2.1-23391	(CERT-115D)	89.213
		0	Comet Test Rack 4	Fortimus	FMUS-1F5A	1F5A	2.1-22576	(FMUS-1F5A)	89.21
		$\bigcirc$	Midas SUPRT-FMUS	Fortimus	FMUS - 4D67	4D67	2.1-21246	(FMUS-4D67)	89.213
		0	ESSJ	Fortimus	FMUS - DA5B	DA5B	2.1-11027	(FMUS-DA5B)	181.17
		0	TunnelTest	Minimus	MIN-6855	6B55	2.1-22166	(MIN-6B55)	81.149
		0	NO LABEL	Minimus	MIN-8E5A	8E5A	1.2-8713	(MIN-8E5A)	37.76.
		$\odot$	Midas Radian/ Certimus 3T Reference	Minimus	MIN-9C57	9C57	2.1-11027	(MIN-9C57)	89.213
		$\bigcirc$	Comet NO LABEL	Minimus	MIN-9C66	9C66	2.1-23391	(MIN-9C66)	89.213
		0	Comet 3T reference COMET5	Minimus	MIN-A65B	A65B	2.1-21242	(MIN-A65B)	89.213
	Ø	0	DATC@london.eu-west-2.compute.internal	Data Cent	london '	18.168.216.36	-1	(DATC-0AFBD04EF29E)	18.168
		0	DATC@oregon.us-west-2.compute.internal	Data Cent	State of he	ealth dashboar	d - 1	(DATC-0A8F06D0EF79)	52.34.
					Configura	tion			
					MSeed				

Figure 75 Context menu when selecting a GDC server

Selecting the <mark>Mseed</mark> option will connect to the SeedLink server at the GDC instance and start live streaming of data into the Discovery Viewer.

Dataless files for instruments re-streamed from the GDC can be placed in a folder:

Linux:

```
~config/Guralp Systems/Discovery/dataless/
Windows:
```

C:\Users\<username>\AppData\Local\Guralp Systems\Discovery\dataless

These files are read when a stream is first created.

Alternatively, manually loading a dataless file using the Load Data button in the viewer has the same effect. The units and calibration should then appear in the viewer. Hover over the stream status to view the metadata associated with that channel.

Add Device	Search For Stream	Rese	t Scale	Normali	se Scale Centr	e Streams Live Centre	₩ <b>t.</b> <>>	>> >>> Load data, Select Time Ra
Channel List			V Min Max Avg Scale	DG.1F5A.0 = -5.110 = -5.110 = -5.110 = -5.110 = 6.8	U.HCA 200sps 25e+06 23e+06 24e+06		unditer viet And Report	
			m.s <sup>-2</sup> Min Max Avg Scale m.s <sup>-2</sup> Min	Ho	VER HER		hadenlingenderstendigen	annan an a
			Max	= -4314	Name	Value		
			Avg Scale	= -4385	M-CAL	2.33276e-06		
					M-CHAINNAME	0J.HN	بالزارية يعتقنها	والمتعادية ومتلقاتها والتركية القرورية والمتاركة
				DG.1F5A.0	M-COMPONEN			altered in the data field of the second states of the
			m.s <sup>-2</sup> Min	- 12100	M-DISPCOLOUR	#FF0000		
			Max	= 12100	M-DISPNODE	DG.1F5A		
			Avg	= 121152	M-GAIN-0	5.78165e-07		
			Scale	= 0.43	M-GAIN-1	2.97489e+07		
				DG 1654 9	M-GAIN-2	4.03476	http://www.alsan	فاللناء يرجعه والمراجع فراقته الطنا المتعمية والمتعادية
			%	00.11 JA.3	M-POLE-0	-154.371064 + i*294.94	7532	and the second of the difference of the second s
			min=		M-POLE-1	-154.371064 + i*-294.94	47532	
			avg=		M-POLE-2	-267.404178 + i*0.0000	000	
			scale=		M-UNITNAME	Metres per Second Squa	ared	
					M-WEBTXT	m.s <sup>-2</sup>	I.	1. 1
Select grou	ps up to 1	•	Min Max Avg Latend	IS.KUKS.: = -1063 = -141 = -601.8 :y = 192100	BHE 50sps 18 Dons	N WWW	WANN	MMMM MANNA MANA
Keen data in m	emony for		Scale	= 0.19				
Unlimited	ieniory for	•		IS.KUKS	BHN 50sps			البر ميرام الم

Figure 76 Channel metadata originating from dataless file

### 8.6.5 Viewing Instrument/Digitiser WEB configuration via GDC

Typically, digitisers are connected to the GDC via a tunnel. This circumvents NATs and makes the connection more secure. Güralp digitisers have an inbuilt tunnel that can be enabled in the Network tab of the instrument.

When such tunnels are implemented, the GDC retrieves Seed data using the SeedLink protocol. This travels via the tunnel.

Access to the instrument's web config page and other services can also be made via the same tunnel connection.

When running Discovery as a local client, the tunnel is not terminated locally. Accesses to the WEB pages need to be forwarded through the GDC server. This is handled automatically. Right-clicking on the Tunnel column forces the local Discovery to access the instrument via the GDC. This avoids to need for separate port forwarding or additional

### Güralp Data Centre (GDC)

	Search			C	lear Search		
	Temperature	Free storage	Tunne	l Available	Batte		
	32.40°C	71.32%	Availa	ble	0%		
	27.70°C	97.18%	Availa	ble	0%		
Pight-click in t	his column	22%	Avoila	ble EMUS	0%	× 216.36	
to force tunnel		5	Not A	Control Cer	ntre	0.210.50	
the GDC		B6%	Not A	Live View		*	
		B%	Not A	Firmware U	Jodate	U	
	30.20°C	2.79%	Not A	System Cor	figuration		
	32.50°C	95.11%	Avail	Device Port	Configurati	ion	
	30.90°C	98.55%	Avail	Data calend	dar view		
	30.60°C	99.58%	Avail	Edit Netwo	rk Address		
	0.00°C	92.48%	Not A	Tunnel Stat	us		
	0.00°C	72.42%	Not A	Show On M	lap		
				View Web I	Page	W	
				View Web I	<sup>p</sup> age (in syst	em browser)	
				Show GDI L	ow Latency		
				Sensor test	grid		
				Scripts		•	
			L	Calibration		•	
					LINDEDETA	Contours	dit Nano set for
				gü	OPTIMISE PROTECT	Summary Health Sensors Eve	Tase Maintenance M
		Status	Login Help		Fort	limus	Solution         Time DK         Archive cost         20%           OVEG summing         32         30.0 Efficient of 19.3 GB
	System type: Fortimus   Host lab	el: Test Rack 4   Host name: FMUS-1/5A	(10.30.0.28)   Seria stem Status	number: 01F5A		_	Active lar active Zmmy Usernamy E2 as Locap Zmm Territoria
	Host name FMUS-1FS	A Host label Test Rack	4 System type	Fortimus Pro	duct type Fortimus		Sarran System
	Digitiser temperature 31.400 °C	Firmware version 2.1-22576 Digitiser humidity 27.17%	IPv4 addres	(DHCP) etal 24.400 V Poo	Ion (no site) arr over Ethernet 24.202 V		and an
	System time 9:37:34 AM Fei 1-Mar-2	024 Uptime 9d 18h 8m	30s ETH status	sckr. 16/60 data: 1/6			Configuration datas
	GRESS connection status Last lock time Mean	ted Last timestamp 0000-00-00 00:00:00		X Y	12 H		Verse produce () and the second NA
	Latitude 51.361538	Longitude -1.164219 Horizontal dilution of Undefined		Anne Part	5258	15 KUNS 3HC @ 52 Hz	
	GNISS PPS status Not Truster No Pulse	d GNSS NMEA stream Bad input	R	Tot	THA		Mentel Menunga Milleheidan Milleheida, Milleheida an Milleheida
	DNSS Lock state No lock	Number of satellites Used: 0 In view: 0	PTP Status	Report a pro	biem   € OpenStreet/Ap contri	Bullors A TATINA TATINA	a substantia da la constanta d
	PTP state Phase Loci Master IPe4 address 10.30.255.5	ked Last PTP timestamp 2024-03-0 09:37:332 4 Master clock class PRI REF	Last PTP los PTP Master clock	k time 2024-02-26 pTp 11:35:35Z pTp accuracy <1.0us (0x23) Mas	tar time source GPS	15 KURS, BHV & 50 Hz	at the second
	Network path delay 34.1 us	Network jitter estimate 2 425 ns Date microSD total 60030076	Network out a Record Status KB microSD us	d 17912960 Kill	roSD free	n Maryak	We have been and the state of the
	Number of sensors 1	5	ensors Status				a data canadala tallati dalla da data a
	Sensorð	Serial number (0) Seismometer Z (0) 120233	Firmware ve Seismomete	r (0) 0.2-0 r H (0) -4768 Seit	enometer E (0) 20279	LI, LL	ورتيط تعلمون البلاء ففاطهم وعمرائه اللها فالمرابع الطعارين
		Gum Mittes Vesure, Califord Pa Ter +44.118 Mi 5. Mair samatha	in Traderio Landad A. Aldermontov, Bandon 1955, Faix - etd 118.98 and Line Science/Disc	PGT HA, UK 9943 9.409		<b>White William</b>	Waadad Mahaa waada amada amada aha Kana aha

*Figure 77 Instrument Access* 

# 9 Discovery Configuration

# 9.1 Config file

Discovery reads a config file on startup. There are a number of options and parameters that can be changed in this file. The file is written when parameters change or when Discovery is closed. For this reason, editing of this file should be done *after* Discovery is closed.

Linux:

~/.config/Guralp Systems/Discovery/config2.ini

Note: The space in "Guralp Systems" may need to be escaped with a backslash when using some shell command lines:

~/.config/Guralp\ Systems/Discovery/config2.ini

#### Windows:

C:\Users\<username>\AppData\Local\Guralp Systems\Discovery\config2.ini

# 9.2 Data locations

# 10 Appendix 1 - Güralp Discovery Installation

Güralp Discovery is a software package for Microsoft Windows, MAC and Linux, which facilitates the identification, configuration and management of Güralp digitisers and instruments.

Güralp Discovery has a conventional .msi -based installer. Once installed, the software can check whether it is the current version and can update itself using a button on the Help→About menu.

### **10.1** Installation in Linux

The Linux version of Discovery 64-bit is delivered in a self-contained package.

To install Güralp Discovery:

- 1. Open the terminal
- 2. Visit www.guralp.com/sw/download-discovery.shtml to download the appropriate installation script or use the command

wget http://www.guralp.com/download/discovery/Discovery.run

3. Make the downloaded file executable using the command

chmod +x Discovery.run

4. Run the script with the -h option to see the installer's help message:

```
./Discovery.run -h
Online installer for Guralp Systems Discovery application
Usage: ./Discovery.run [parameters]
Parameters:
-h : this message
-i : perform installation
-o <directory> : output directory (default
/opt/guralp/discovery)
```

5. Execute the script, either accepting the default installation directory

./Discovery.run -i

or providing your own, alternative location

./Discovery.run -i -o /usr/lib/discovery

The script proceeds through the following installation stages:

1. A confirmation prompt:

Guralp Discovery will be installed in: /opt/guralp/discovery. [C]ontinue/[A]bort

Type  $\Box$  to continue installation in listed directory, or A to abort and change directory using the  $-\circ$  execution parameter

2. Downloading. The following message is printed:

```
Downloading Discovery from Guralp Systems server [Downloading]
```

This step downloads the discovery package from the Güralp server. It is around 50 MiB in size so downloading may take a long time if you have a slow Internet connection.

3. Next, the following message is printed:

Creating installation directory: /opt/guralp/discovery [OK]

This step creates the installation directory. If an error occurs at this stage, please make sure that the user running the installation script has permission to create the specified directory.

4. The downloaded archive is now unpacked into the specified installation directory. The following message is printed:

Unpacking Discovery to /opt/guralp/discovery [OK]

5. The next step removes the downloaded file from the disk.

Removing downloaded Discovery archive [OK]

6. A this point, the installation is complete. The message

Discovery is now installed in: /opt/guralp/discovery/discovery

is displayed and the application is available in the specified directory.

# **10.2 Installation in Windows**

To install Güralp Discovery on a Windows machine:

1. Download the appropriate installer – 32-bit or 64-bit – from

https://www.guralp.com/sw/download-discovery/

Double-click the downloaded file. You may be asked whether you wish to continue: answer yes.

3. The following screen asks where, in the Start Menu, you would like to place the Discovery short-cut. The default location is normally satisfactory but you can change it from here if you wish.

Setup - Discover		_		×
Select Start Menu Folder Where should Setup place the program's sh	ortcuts?		<u>67</u>	B
Setup will create the program's sho	prtcuts in the followin	g Start Menu	ı folder.	
I o continue, click Next. If you would like to	select a different fol	der, click Bro	wse.	
	< <u>B</u> ack	<u>N</u> ext >	Cancel	
Click Next > , key	or key	Alt +	N to	o continue.

4. The next screen asks whether you would like to place an icon for Discovery on the desktop:

Setup - Discover		- [	×
Select Additional Tasks Which additional tasks should be performed?			
Select the additional tasks you would like Setup then click Next.	p to perform while insta	alling Discove	er,
Additional icons:			
Create a desktop icon			
	< <u>B</u> ack <u>N</u> ext	:>	Cancel
Tick the check-box if yo	ou wish and	then o	lick

5. The installer then offers a last chance to change any of your decisions:

### Appendix 1 - Güralp Discovery Installation

Setup - Discover —	
Ready to Install Setup is now ready to begin installing Discover on your computer.	
Click Install to continue with the installation, or click Back if you want to review change any settings.	or
Destination location: C:\Program Files (x86)\Guralp Systems\Discover	^
Start Menu folder: Guralp Systems\Discover	~
<     < <tr>         &lt; Back</tr>	Cancel
Click Install, key or key Alt+	I if you are happy with your
choices or click < Back (or key Alt	+B) if you wish to revisit any of
them.	
5. Once you have clicked Install, the ir	nstallation begins and a progress
screen is displayed:	
Setup - Discover —	
Installing Please wait while Setup installs Discover on your computer.	
Extracting files C:\Program Files (x86)\Guralp Systems\Discover\Qt5Webkit.dll	
1	Cancel
Pressing <b>Cancel</b> or keying Esc now	will remove all of the installed files

(except the installer itself) and reverse any changes made so far.

7. Once installation is complete, the following screen is displayed:

#### Appendix 1 - Güralp Discovery Installation



# **10.3 Configuring Windows Firewall**

Windows Firewall can interfere with Discovery's ability to send information to instruments and/or receive information from instruments over the network. If you use Windows Firewall, you should make special provision for allowing Discovery to communicate, as described in this section.

1. Click in the "Ask me anything" search box at the bottom left of your Windows screen:



2. Type "allow an app"



- 3. Select "Allow an app through Windows Firewall" from the search results.
- 4. Windows will display the "Windows Firewall Allowed Applications" screen.

This displays a list of applications in alphabetical order. Each application is provided with three check-boxes which indicate whether the application can communicate with networked devices in the "Domain" profile, the "Private" profile or the "Public" profile. (Profiles are also known as "network locations".)

llow apps to compunicate through Wind	owe Firewall			
o add, change or remove allowed apps and ports, click	Change settings.			
/hat are the risks of allowing an app to communicate?	, ,	Ch	ange sett	ing
Allowed apps and features:				
Name	Domain	Private	Public	^
Core Networking		Image: A start of the start	Image: A start of the start	
✓ Cortana	$\checkmark$	$\checkmark$	<b>~</b>	
Delivery Optimization	$\checkmark$	$\checkmark$	<b>~</b>	
✓ DiagTrack	$\checkmark$	<b>~</b>	$\checkmark$	
✓ DIAL protocol server	V	$\checkmark$		
✓ discovery		<b>~</b>		>
Distributed transaction Co-ordinator				
✓ Dropbox	$\checkmark$	$\checkmark$	$\checkmark$	
Email and accounts	$\checkmark$	$\checkmark$	$\checkmark$	
Feedback Hub	$\checkmark$	$\checkmark$	$\checkmark$	
File and Printer Sharing	$\checkmark$			
✓ Films & TV	$\checkmark$	✓	✓	¥
	Det	ails	Remov	e

The "Domain" profile applies to networks where the host system can authenticate to a domain controller. The "Private" profile is a user-assigned profile and is used to designate private or home networks. The default profile is the "Public" profile, which is used to designate public networks such as Wi-Fi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see http://www.tenforums.com/tutorials/6815-network-location-set-privatepublic-windows-10-a.html or your Windows documentation.

5. First click the **Change settings** buttons to activate the interface.

6. Highlight the "discovery" line and then click the Details... button. The "Edit an app" window is shown:

Edit an app ×					
You can allow communication with this app from any computer, including those on the Internet or just from computers on your network.					
Name:	D discovery				
<u>P</u> ath:	C:\program files\guralp systems\discovery\discovery.exe				
What are the risks of unblocking an app?					
You can choose which network types to add this app to.					
<u>N</u> etwork t	Network types OK Cancel				

 Click the <u>Network types...</u> shown:

button. The "Choose network types" window is

Allowed and Backing	
Mar Allowed applications	×
$\leftarrow$ $\rightarrow$ $\checkmark$ $\bigstar$ Windows Firewall $\Rightarrow$ Allowed applications $\checkmark$ 👌	Search Control Panel 🔎
<ul> <li>Allow apps to communicate through Windows Firewall To add, change or remove allowed apps and ports, click Change settings.</li> <li>What are the risks of allowing an app to communicate?</li> <li>Allowed apps and feast</li> <li>Allowed apps and feast</li> <li>Choose Network Types</li> <li>Allow this app or port to communicate through Windows Firewall for the selected network type:</li> <li>Core Network</li> <li>Cortana</li> <li>Delivery Optin</li> <li>DiagTrack</li> <li>DiagTrack</li> <li>Distributed Tr</li> <li>You</li> <li>Private: Networks in public places such as airports or cafés</li> <li>Pille and Printer Sha</li> <li>Files at Private Sha</li> </ul>	Search Control Panel
	Allow anothe <u>r</u> app
	OK Cancel

8. After making appropriate changes, click OK first in the "Choose network types" window, then in the "Edit an app" window, then in the "Windows

Firewall Allowed Applications". This closes the Windows Firewall "Allowed Applications" tool and saves the changes that you have made.

# 10.4 Update

If a PC running Güralp Discovery has an Internet connection, Discovery can check whether an update is available. To initiate this, click About from the Help menu or

t	+l	Η	followed by	A

0 0	D Güralp Systems - Discovery							
File	Edit	View	Help	<b>)</b>				
		Status	D	About	System	Name	Firmware Ver	WAN Address
1		0	?	Help	Minimus	MIN-B056	1.0-1271	95.6.57.152
2	Ø	0		SalesDEMO	Minimus	MIN-8256	1.1-1022	89.213.16.117
3	Active	e		fishyNAM	NAM2	SUPRT-NAM2	1.0-15757	89.213.16.113
4		0		Murray	Minimus Plus	MINP-6158	1.2-8599	89.213.16.113
5		0		NO LABEL	Minimus Plus	MINP-E658	1.2-8563	89.213.16.113
6		0		NO LABEL	Minimus Plus	MINP-DD58	1.2-8555	89.213.16.113
7		0		NO LABEL	Minimus Plus	MINP-E558	1.2-8563	89.213.16.113
8	Ø	0		NO LABEL	Minimus Plus	MINP-E058	1.2-8555	89.213.16.113
9		0		NO LABEL	Minimus Plus	MINP-6458	1.2-8563	89.213.16.113
10		0		NO LABEL	Minimus Plus	MINP-E958	1.2-8563	89.213.16.113

A screen like the following is displayed:



The currently installed version is shown. If this is the most recent version

available, the screen will say Up to date and the <u>Update</u> button will be disabled, as shown above. If a newer version is available, the screen will look like this:

Discovery About - Guralp Disco	very	_		×
	Discovery application is provided by Guralp Systems Limited.			
güralp	Head office: Guralp Systems Limited, Midas House, Calleva Park, Aldermaston, Reading. RG7 8EA, United Kingdom Tel: +44 118 981 9056 E-Mail: sales@guralp.com			
	Update to version 0.1.669 is available online. Please use "Update" button	to downl	oad the in	staller.
			Upda	ate
	Ok			

If you wish to proceed with downloading the newer version, click the <u>Update</u> button. This does not commit to an immediate upgrade: it just downloads the

installer. If you do not wish to download the installer, click \_\_\_\_\_Ok \_\_\_\_ to close the "Discovery About" dialogue.

If you clicked \_\_\_\_\_\_, you may see the following warning if the previous installer is still in your download folder:

s Part Loca	Guralp Systems Limited, Midas House, Calleva Park, Aldermaston, Reading.		_	
All> D File download - Guralp Discove	ery	- 0	×	
D Fil	e already exists Guralp Discovery	×	taller.	
	C:/Users/fish.GURALP/AppData/Local/Temp/I	DiscoveryInstall.exe	s N	<b>Vetm</b> ask
	Yes	No	25	55.255.0.
Close this window automatically w	hen finished.		25	5 <b>5.2</b> 55.0.
	Cancel Ok		25	55.255.0.
			25	<b>55.25</b> 5.0.
aüra			25	<b>55.25</b> 5.0.
gaic			25	55.255.0.
Simply click Yes	or key to continu	ıe: the download will	l start	

While the download is in progress, the following indicator will be displayed:

File download - Guralp Discovery		-	×
	Downloading discovery installer.		
	Completed in 41%		
	(12335614B of 29530541B)		
$\hfill \Box$ Close this window automatically when finished.	Cancel Ok		

When the download is complete, the following screen is displayed:



If you wish to complete the installation immediately, click <u>Yes</u>. If you would rather defer the installation, click <u>No</u> and run the installer at a more convenient time.

Once the upgrade is complete, start Discovery in the usual way. Windows, recognising that the program has changed, may ask you to specify how you wish Discovery to interact with the Windows Firewall. Because Discovery requires network communication in order to function, it is important that you understand the options available. The following screen is displayed:

🔐 Windows Secu	P Windows Security Alert					
💮 Windo	ws Firewa	l has blocked some features of this app				
Windows Firewall h networks.	as blocked som	e features of discovery on all public, private and domain				
	Name:	discovery				
	Publisher:	Unknown				
	Path:	C:\program files (x86)\guralp systems\discovery \discovery.exe				
Allow discovery to	communicate or	n these networks:				
🗹 Domain netw	☑ Domain networks, such as a workplace network					
🖌 Private netw	✓ Private networks, such as my home or work network					
Public networks, such as those in airports and cafés (not recommended because these networks often have little or no security)						
What are the risks of allowing an app through a firewall?						
		Cance	I			

The screen provides three check-boxes which indicate whether Discovery can communicate with networked devices in the "Domain" profile, the "Private" profile or the "Public" profile. (Profiles are also known as "network locations".)

The "Domain" profile applies to networks where the host system can authenticate to a domain controller. The "Private" profile is a user-assigned profile and is used to designate private or home networks. The default profile is the "Public" profile, which is used to designate public networks such as Wi-Fi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see www.tenforums.com/tutorials/6815-network-location-set-private-publicwindows-10-a.html or your Windows documentation.

# 11 Appendix 2 – I.P. Address Configuration on PC or Laptop

With APIPA (Automatic Private I.P. Addressing), a laptop or PC can automatically configure itself with an I.P. address in the range 169.254.0.1 to 169.254.255.254. The default subnet mask is 255.255.0.0.

Connect you Güralp device to the laptop or PC using the blue Ethernet cable and power it up.

# 11.1 On Linux

On your Linux computer, open the terminal and type the command

#### sudo bash

Key 🔲 and provide the appropriate password. Then, enter the command

#### ifconfig

to identify the Ethernet network interface to which your device is connected. Once you have identified the correct interface, connect the device, power it up and enter the commands

ifconfig wlp2s0 down

ifconfig wlp2s0 up

replacing w1p2s0 with the name of the appropriate interface on your PC.

Enter the command **ifconfig** again to verify that the IPv4 address of the Ethernet adapter is now included in the network 169.254.0.0/16 - *i.e.* the address begins 169.154....



In the example above, the interface has been allocated address 169.254.139.29, which is in the correct network.
## 11.2 On Windows

On a Windows computer, key  $+ \mathbb{R}$  to open the "Run" dialogue, enter ncpa.cpl and key -

Right-click on the network adapter which is connected to the device and select "Disable" from the context menu. Right-click on the same adapter again and select "Enable". Close the network settings window.

Key **H** and type cmd., then **L**. This opens a command window. Type the command **ipconfig** and verify that the IPv4 address of the Ethernet adapter is included in network 169.254.\*.\*.



In the example above, the interface has been allocated address 169.254.139.29, which is in the correct network.

## 12 Appendix 3 - Operation with 3<sup>rd</sup> Party Products

Discovery and GDC supports systems that source data using SeedLink protocol. This is a well-defined 'Industry Standard' protocol that is supported by many manufacturers.

The streaming protocols are standard yet typically the mechanism of discovering and finding the IP address of a device is manufacturer specific.

In order to allow Discovery and GDC to access data from 3rd party devices, Güralp has added a mechanism to add an entry for that device in the Devices list in Discovery.

Once we have made the Discovery aware of the existence of the device, we can perform a number of operations on the device – such as viewing the WEB page or streaming data.

There are two mechanisms of adding a 'fixed' device to the device list:

1. For Local devices (ordinarily found by Scan Local) we can Edit/Add Device.

This should largely be used to test a connection. Using this to add a Güralp product is NOT recommended as the normal automated discovery mechanism should work. If not, other problems will likely follow!

These manually 'added' devices are not saved as their use is only transitory.

2. For Remote devices an entry can be added to the Cloud registry. This is a permanent addition as the details are saved on the registry server. They can also be individually deleted.

This operation is performed from the Güralp "Test Facility" application. This is available from the Start menu/Guralp Systems on Windows systems. On Linux the executable 'Thing' should be run.

					Testing	Utility Tool			_ = = =
Faux Data	Data Requests	Hashing M	Ionitoring						
Connect									
	Registry	Registry Hostname			Groupid	Label	Station	Network	IP Address
Add	18.168.216.36	TEST-1234			mine	My system	01234	00	10.88.1.2
Delete									
		Num Senso	ors	Region Lat/Lon			Destination IP	Port	Max PGA
Send CAP		5		51.3611	-1.1	22000		11789	10
Send CAP		5		51.3611	][-1.1	22000		11789	10

Figure 78 Test Utility

Use the Add button to send a packet to the Registry (IP Address specified) thus registering the present of such an instrument.

MAN-DIS-0001

Assuming that the device is a SeedLink server, specifying Station and Network code and the devices IP Address, will give Discovery sufficient information for it to request SeedLink data or instruct a GDC to request SeedLink data.

Leaving the <mark>Station</mark> and Network blank will cause Discovery to probe the system for a list of Stations when a GDC connection is requested.



A 2022-03-11 Initial release