



# HighFinesse

The Standard of Accuracy

User Guide

## HighFinesse NetAccess, Network Solution (beta)



HighFinesse  
Wavelength Meter (WS-Series)



HighFinesse  
Laser Spectrum Analyzer (LSA)

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## Scope of document

**HighFinesse\_NetAccess\_YYYYMMDD.zip contains following beta software components:**

- wlmDataServer.exe versions:  $\geq 7.32/64.263.4$
- wlmData.dll version: wlmData.dll version:  $\geq 7.263.4$
- wlmData-M.m.b-ARCH.deb, .rpm, .sh and .tar.gz packages version:  $\geq 7.263.4$
- wlmData-M.m.b-ARCH.pkg macOS installer package  $\geq 7.263.4$

# 1. Introduction

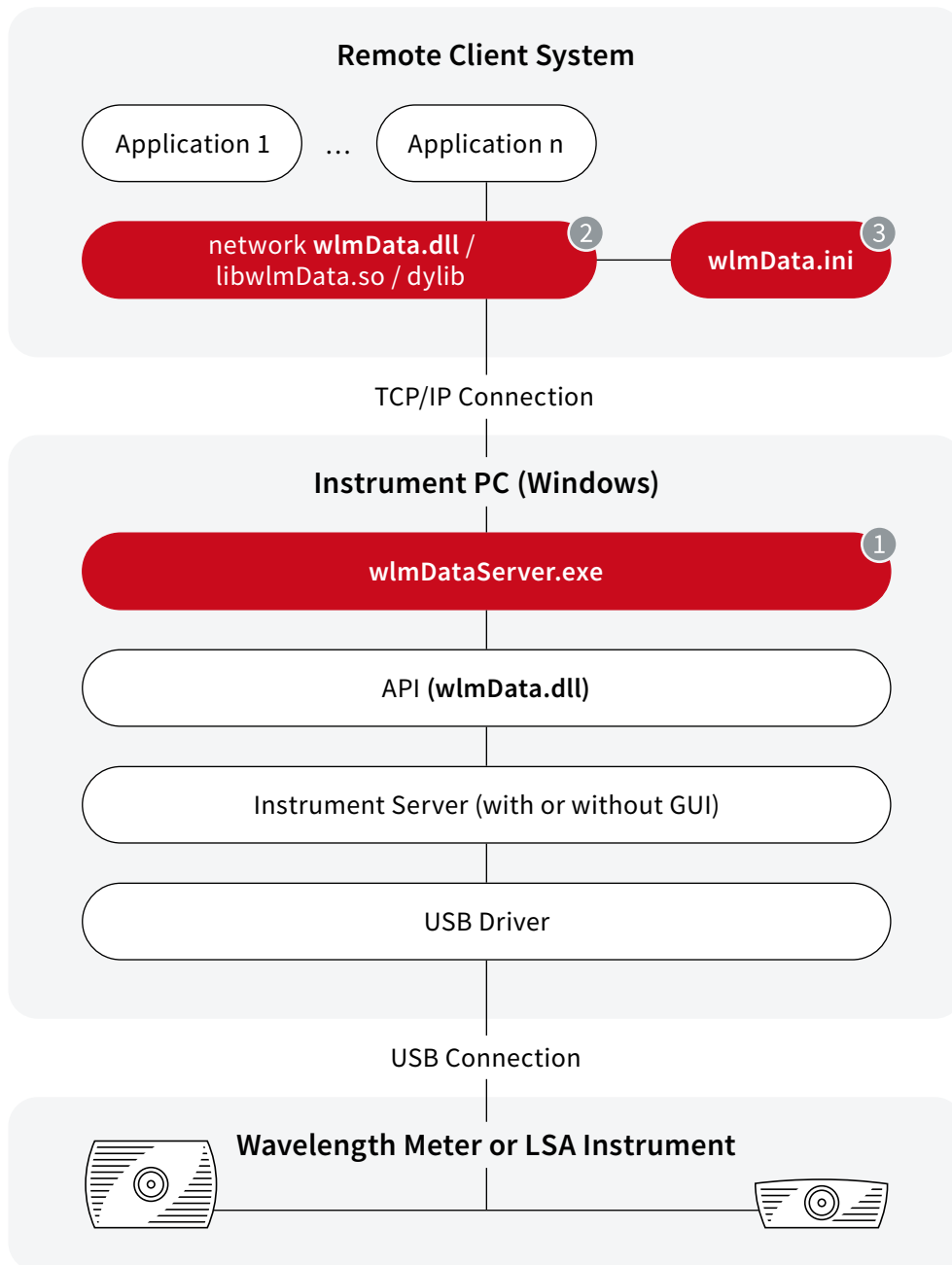
NetAccess is a fast and lightweight networking extension for the existing Wavelength Meter (WLM) and Laser Spectrum Analyzer (LSA) product lines. Contrary to the conventional remote desktop (VNC, Teamviewer, etc.) applications, it provides compatible API's on the remote side over reliable TCP/IP networks; therefore the existing / legacy softwares can be run without any modification or selfmade network solutions.

**Typical applications:**

- Test and measurement automation
- Remote laboratories
- Measurement instrument sharing

## 1.1. Components

NetAccess network solution is based on the Client-Server model and contains the following software components (highlighted in red):



- ① wlmDataServer.exe executable (server side)
- ② wlmData.dll, libwlmData.so or libwlmData.dylib network API library (client side)
- ③ wlmData.ini (configuration file for the wlmData network API)

Figure 1: NetAccess software components

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## 2. Installation

### 2.1. Compatibility

The software components are tested on the following Operating systems and (architectures):

- **wlmDataServer.exe** and **wlmData.dll**: Windows 10 (Intel 32/64 bit)
- **libwlmData.so**: Ubuntu 18.04 LTS / 20.04 LTS, Fedora 29 and Debian 9 (Intel 64 bit, ARM 32/64 bit: armv7l, aarch64)
- **libwlmData.dylib**: macOS Big Sur version 11.2.1 (Intel 64 bit)

The Linux ARM 32/64bit support makes possible to use single-board computers like RedPitaya, RaspberryPi or Nvidia Jetson family on client side.

### 2.2. Network Recommendation

Virtual private network (VPN) or a separate Fast or Gigabit Ethernet measurement network segment is recommended by reason of security and performance.

### 2.3. Package Contents

The installation package structured in the manner shown in Figure 2 (next page).

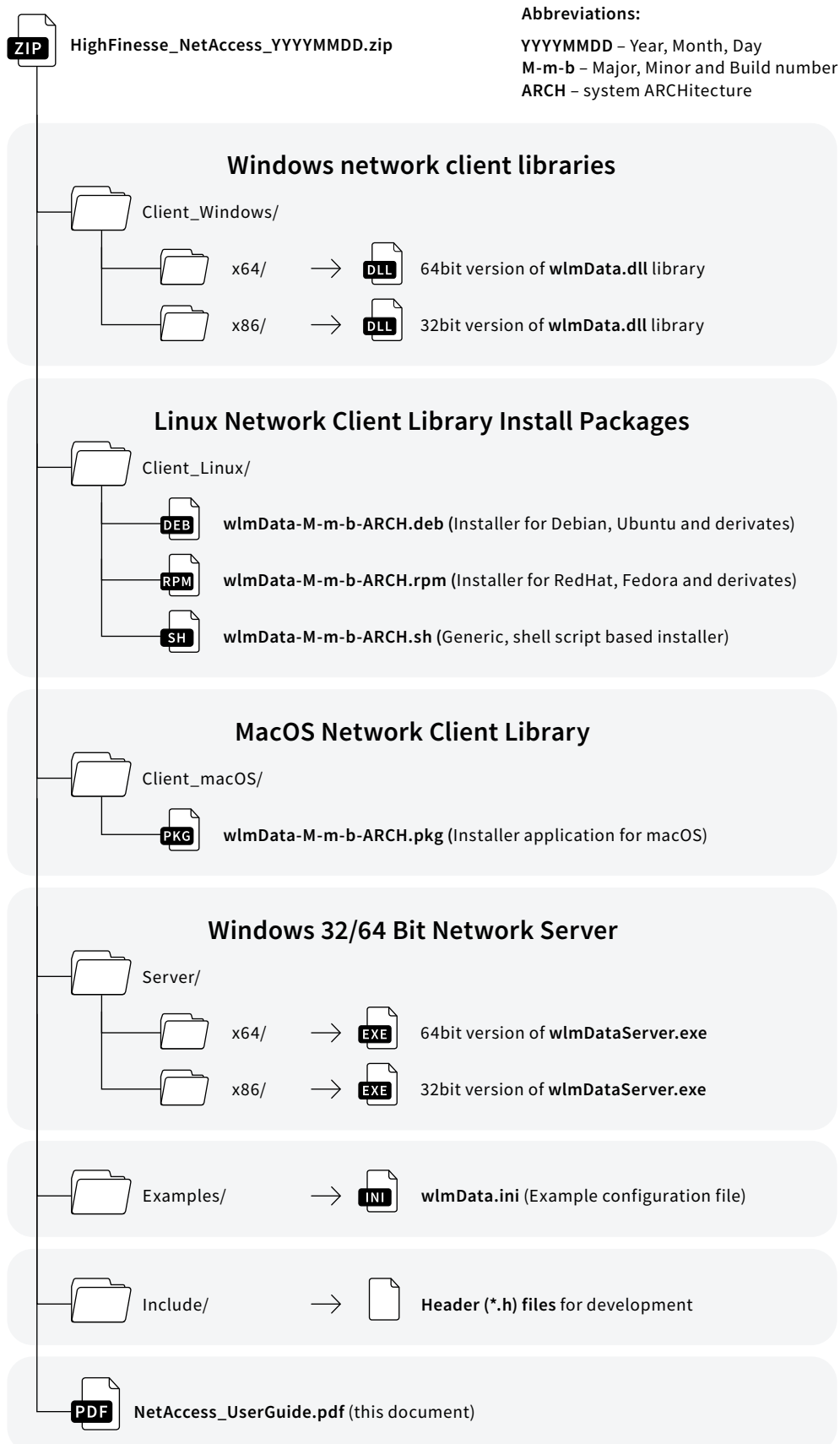


Figure 2: Package contents



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## 2.4. Server Side Installation

### 2.4.1. Prerequisites

1. The proper 32/64 bit version of Visual C++ Redistributable for Visual Studio 2017 is required to run **wlmDataServer.exe**:

- **vc\_redist.x86.exe (32 bit)**
- **vc\_redist.x64.exe (64 bit)**

🔗 <https://support.microsoft.com/en-us/help/2977003/the-latest-supported-visual-c-downloads>

2. An installed Wavelength Meter (WLM) or Laser Spectrum Analyzer (LSA) software package

### 2.4.2. Server Side Installation

The server side implemented as a portable application, and it can be run from any location. Copy the **wlmDataServer.exe** into a directory of choice on the Instrument PC. At the first start, allow the firewall access for the **wlmDataServer.exe** at the Windows Security Alert dialog.

## 2.5. Client Side Installation – Windows

### 2.5.1. Prerequisites

1. The proper version of Visual C++ Redistributable for Visual Studio 2017 is required to use networked version of **wlmData.dll**:

- **vc\_redist.x86.exe (32 bit)**
- **vc\_redist.x64.exe (64 bit)**

### 2.5.2. System Wide Installation

**In case of using 32 bit Windows operating system:**

Copy the 32 bit version of **wlmData.dll** into the folder:

 %SYSTEMROOT%\System32\

**In case of using 64 bit Windows operating system:**

Copy the 32 bit version of **wlmData.dll** into the folder:

 %SYSTEMROOT%\SysWoW64\

Copy the 64 bit version of **wlmData.dll** into the folder:

 %SYSTEMROOT%\System32\

 **PLEASE NOTE:**

**32/64-bit versions of wlmData.dll are interoperable with  
32/64 bit wlmDataServer.exe**

## 2.6. Client Side Installation – Linux

### 2.6.1. System Wide Installation

The system wide deployment requires root privileges / password.  
Copy the **appropriate deb / rpm / sh package** into the home directory  
and use the following command from terminal prompt:

■ **Debian, Ubuntu or derivative distributions:**

```
[user@host]$ su
Password:
[root@host]# dpkg -i ./wlmData-M-m-b-ARCH.deb
[root@host]# exit
```

■ **RedHat, Fedora or derivative distributions:**

```
[user@host]$ su
Password:
[root@host]# rpm -i ./wlmData-M-m-b-ARCH.deb
[root@host]# exit
```

■ **In generic case:**

```
[user@host]$ su
Password:
[root@host]# chmod +x ./wlmData-M-m-b-ARCH.sh
[root@host]# ./wlmData-M-m-b-ARCH.sh -prefix=/usr -exclude-subdir
[root@host]# exit
```

### 2.6.2. User level Installation

Without root permissions the client library can be deployed to the user's home directory.

Copy the appropriate **deb / rpm / sh package** into the home directory and use the following command from terminal prompt:

■ **Debian, Ubuntu or derivative distributions:**

```
dpkg -x ./wlmData-M-m-b-ARCH.deb ./
```

■ **RedHat, Fedora or derivative distributions:**

```
rpm2cpio ./wlmData-M-m-b-ARCH.deb | cpio -i -d
```

■ **In other case:**

```
chmod +x ./wlmData-M-m-b-ARCH.sh  
./wlmData-M-m-b-ARCH.sh -prefix=./usr -exclude-subdir
```

 **PLEASE NOTE:**

32/64 bit of **wlmData.so** is interoperable with  
32/64 bit **wlmDataServer.exe**

### 2.7. Client side installation – macOS

- The installation requires Admin user / password.
- Copy the **wlmData-M-m-b-ARCH.pkg** installer package to the computer.
- Double click on package icon and follow the instructions of GUI based installer.

## 3. Operation

### 3.1. Server (Instrument) Side

The server side of the solution is the **wlmDataServer.exe** program. Starting without any additional parameter it will listen on TCP port 7171 and 7172, IPv4/6 addresses of using all available network interfaces including the loopback adapter (127.0.0.1>::1).

The default behaviour can be modified by the following command line parameters and switches:

```

/p<Set/Get function TCP port>
/c<CallBack function TCP port>
/a<IPv4/6 address>
/v<verbosity level [0-6]>
/? Usage

```

**Verbosity levels are:**

Cfg.	Level	Description
0	NONE	No messages
1	FATAL	Any error that makes impossible the application run
2	ERROR	Any error that prevents the network service
3	WARNING	Potential problems
4	INFO	Useful information about normal operation (Default setting)
5	DEBUG	Displays API function calls
6	TRACE	Most detailed, protocol level information for debugging

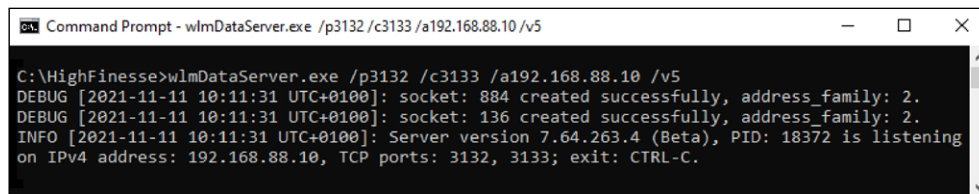
**Table 1:** Server side verbosity levels

Find an example on the next page (Figure 3).

**EXAMPLE:**

**wlmDataServer.exe** to be listening on 192.168.88.10 IPv4 address using 3132, 3133 TCP ports, verbosity level: debug.

```
wlmDataServer.exe /p3132 /c3133 /a192.168.88.10 /v5
```



```
Command Prompt - wlmDataServer.exe /p3132/c3133/a192.168.88.10/v5
C:\HighFinesse>wlmDataServer.exe /p3132 /c3133 /a192.168.88.10 /v5
DEBUG [2021-11-11 10:11:31 UTC+0100]: socket: 884 created successfully, address_family: 2.
DEBUG [2021-11-11 10:11:31 UTC+0100]: socket: 136 created successfully, address_family: 2.
INFO [2021-11-11 10:11:31 UTC+0100]: Server version 7.64.263.4 (Beta), PID: 18372 is listening
on IPv4 address: 192.168.88.10, TCP ports: 3132, 3133; exit: CTRL-C.
```

Figure 3: Starting wlmDataServer.exe with parameters

**⚠ PLEASE NOTE:**

Unique port numbers must be used for each server instances.

## 3.2. Network Client Library

### 3.2.1. Compatibility

The network version of the wlmData.dll (Windows) libwlmData.so (Linux) or libwlmData.dylib (macOS) is designed to be drop-in compatible with the original API, and can be re-used by existing code or applications without modification.

**Compatible features:**

- Full support of Set/Get functions.
- Full support of user defined CallbackProc/CallbackProcEx procedures.
- Full support of raw data transfer GetPattern(), GetAnalysis().. functions.

**⚠ PLEASE NOTE:**

For the detailed API information please refer to the instrument's User Manual.

### 3.2.2. Error Signaling Modes

To ensure the highest level of compatibility with existing applications, there is no network error specific return code in the API. Network error detection can be done in the following ways:

Cfg.	Mode	Description
0	NONE	Errors are discarded
1	LOG	Errors are sent to the Logging system (see below)
2	DIALOG	Errors are displayed as a Dialog Box (Windows only)
4	CALLBACK	Errors are signaled via user provided callback function
8	EXIT	Application will be terminated with error specific exit code

**Table 2:** Error signaling mode configuration codes (bit fields)

#### PLEASE NOTE:

Configuration codes are bit fields, more signaling modes can be used in parallel.

#### **Default configuration:**

The default setting for error signaling is LOG + EXIT (1+8=9) which can be modified in **wlmData.ini**.

### 3.2.3. Error Identification

The network client library uses triplets for identifying **Cause**, **Source** and **Error code** of the problem.

#### Cause IDs:

ID	Mode	Description
2	SEND_NETWORK	Socket function send() returned with error code
3	SEND_SIZE	Socket function send() transferred wrong number of bytes
4	RECV_NETWORK	Socket function recv() returned with error code
5	RECV_SIZE	Socket function recv() transferred wrong number of bytes
6	SESSION_ID	Session ID check failed
7	MAGIC_NUMBER	Protocol specific magic number check failed
8,9		Reserved for future usage
10	CONN_NETWORK	Socket function connect() returned with error code

**Table 3:** Error cause IDs

#### Source IDs:

Source IDs are unique to API functions. For the full list of Source IDs please refer to the **wlmDataNetworkConstants.h** header file.

#### Error codes:

Cause	Error code
SEND_NETWORK, RECV_NETWORK, CONN_NETWORK	Socket (OS) specific return code of connect(), send() or recv() function
SEND_SIZE, RECV_SIZE	Number of transferred bytes
SESSION_ID	Client side session ID
MAGIC_NUMBER	Client side magic number

**Table 4:** Error codes



### 3.2.4. Log Levels

The logging feature uses verbosity levels as the server side:

Cfg.	Level	Description
0	NONE	No messages
1	FATAL	Any error that makes impossible the application run
2	ERROR	Any error that prevents the network service
3	WARNING	Potential problems
4	INFO	Useful information about normal operation
5	DEBUG	Detailed information for debugging
6	TRACE	Most detailed, protocol level information for debugging

**Table 5:** Client side verbosity levels

#### Default configuration:

The default loglevel is WARNING (3), which can be modified in **wlmData.ini**.

### 3.2.5. Log Modes

The network client library has logging feature which uses any combination of the followings outputs:

Cfg.	Mode	Description
0	NONE	Messages are discarded
1	STDERR	Messages will be sent to the Standard Error Output
2	STDOUT	Messages will be sent to the Standard Output
4	DIALOG	Messages will be displayed as a Dialog Box (Windows only)
8	CALLBACK	Messages are transferred via user provided callback function

**Table 6:** Log mode configuration codes (bit fields)

#### Default configuration:

The default logging output is STDERR (1).

The default setting can be modified in **wlmData.ini**.

### 3.2.6. User Provided Callback Functions

The log and error behavior of the network API library can be customized by user-specified callback functions. Attaching and detaching is done by the appropriate Mode parameter of the Instantiate() API function.

```
long Instantiate(long RFC, long Mode, long *P1, long P2);
```

#### Parameters for attaching / detaching callbacks:

RFC: Use cInstNotification constant

Mode: cNotifyInstallLogEvent = 1000  
cNotifyInstallErrorEvent = 1001  
cNotifyRemoveLogEvent = 1002  
cNotifyRemoveErrorEvent = 1003

P1: Pointer to the callback function

P2: Don't Care, can be set to zero

#### Return value:

Function returns 1 in the case of success, otherwise 0.

#### 3.2.6.1. Log Callback Function

##### Declaration:

```
void vLogCallBack(int32_t xVerbosityLevel, const char* pcLogMessage);
```

##### Parameters:

xVerbosityLevel: Numerical code of Log-event severity (see section: 3.2.4.)

pcLogMessage: Pointer to the log message string terminated with zero, with maximum length of 1024 bytes

#### Return value:

vLogCallBack() function has no return value.

### 3.2.6.2. Error Callback Function

**Declaration:**

```
void vErrorCallBack(int32_t xCause, int32_t xSource, int32_t xCode);
```

**Parameters:**

xCause: Numerical code of error cause (see section: 3.2.3.)

xSource: Unique ID of error source (see section: 3.2.3.)

xCode: Cause and OS dependent error code (see section: 3.2.3)

**Return value:**

vErrorCallBack() function has no return value.

### 3.2.7. Network connection control

By default, the network API library automatically initiates, maintains and closes the network connection to the server (autoconnect = 1), which works well for the vast majority of applications. In other cases, the connection state and parameters can be controlled manually (autoconnect = 0) using the Instantiate() function.

```
long Instantiate(long RFC, long Mode, long *P1, long P2);
```

#### Parameters for network connection control:

RFC: Use cInstNetworkControl = 6 constant

Mode: cSetConnectState = 1000  
cGetConnectState = 1001  
cSetParameter = 1002  
cGetParameter = 1003

P1: Pointer to the parameter, direction and type depends on Mode parameter. Please refer to the wlmDataNetworkConstants.h header file for the details.

P2: Don't Care, can be set to zero

#### Return value:

Function returns 1 in the case of success, otherwise 0.

#### PLEASE NOTE:

The modified connection parameters will be applied at next connection attempt.

### 3.3. wlmData.ini Configuration File

**wlmData.ini** is optional and contains application level configuration for the networked API library.

#### 3.3.1. Search Path and Order – Windows

Search path order for the wlmData.ini file on Windows operating systems:

1. Application startup directory
2. DLL's directory
3. %LOCALAPPDATA%\HighFinesse\wlmData\wlmData.ini

#### 3.3.2. Search Path and Order – Linux and macOS

Search path order for the wlmData.ini file on Linux operating systems:

1. Application startup directory
2. \$HOME/.config/HighFinesse/wlmData.ini
3. /etc/HighFinesse/wlmData.ini

### 3.3.3. File Format

**wlmData.ini** is a human readable configuration file that follows the widely used informal ini file standard with **properties** and **sections**.

#### Comments:

Comment lines are ignored and can be marked with semicolon (;) at the beginning of the line.

```
; Comment line will be ignored
```

#### General property syntax:

Every property has a name and value field. Fields are case sensitive and delimited by equals sign (=)

```
; Property field with name and value  
name = value
```

#### General section syntax:

Property fields can be grouped into sections, which are to be defined with square brackets:

```
; Section1 contains name1 and name2 property fields.  
[Section1]  
name1 = valueA  
name2 = valueB  
  
; Section2 contains name1 and name2 property fields with  
different values.  
[Section2]  
name1 = valueC  
name2 = valueD
```

### 3.4. Settings

The following predefined properties and section names can be used in the **wlmData.ini**:

#### Properties:

Name	Values	Default	Description
version	[4 6 46 64]	4	preferred IP version if hostname is given
address	IPv4 IPv6 name	127.0.0.1	IPv4/6 address or hostname of the wlmData server
port	[0 – 65535]	7171	Set/Get function TCP port number
port2	[0 – 65535]	7272	Callback function port number
offload	[0   1]	0	Client side offload of Convert..() functions [0-off   1-on]
errormode	[0 – 15]	9	Selected error mode(s) (see section: 3.2.2.)
logmode	[0 – 15]	5	Selected log mode(s) (see section: 3.2.5.)
loglevel	[0 – 6]	3	Selected loglevel (see section: 3.2.4.)
autoconnect	[0 1]	1	Server connection method (see section 3.2.7)

**Table 7:** wlmData.ini defined property names

#### Sections:

**wlmData.ini** uses sections for application name based configuration. The “default” section fits all programs, otherwise use the application name for the specific settings.

```

; default settings for all application
[default]
address = 192.168.88.10

; Settings for Longterm.exe application
[Longterm.exe]
address = 192.168.88.12
loglevel = 6

```

#### Default configuration:

By default the networked client library tries to connect to a local server over IP 127.0.0.1, using TCP ports: 7171 and 7172.

## 4. Configuration Examples

### 4.1. Scenario 1 – Instrument Sharing

The Wavelength Meter is shared on the measurement network (192.168.10.0/24) by the Instrument PC. The WLM can be used by more clients in time multiplex way, the second client can be connected after the disconnection of the first client.

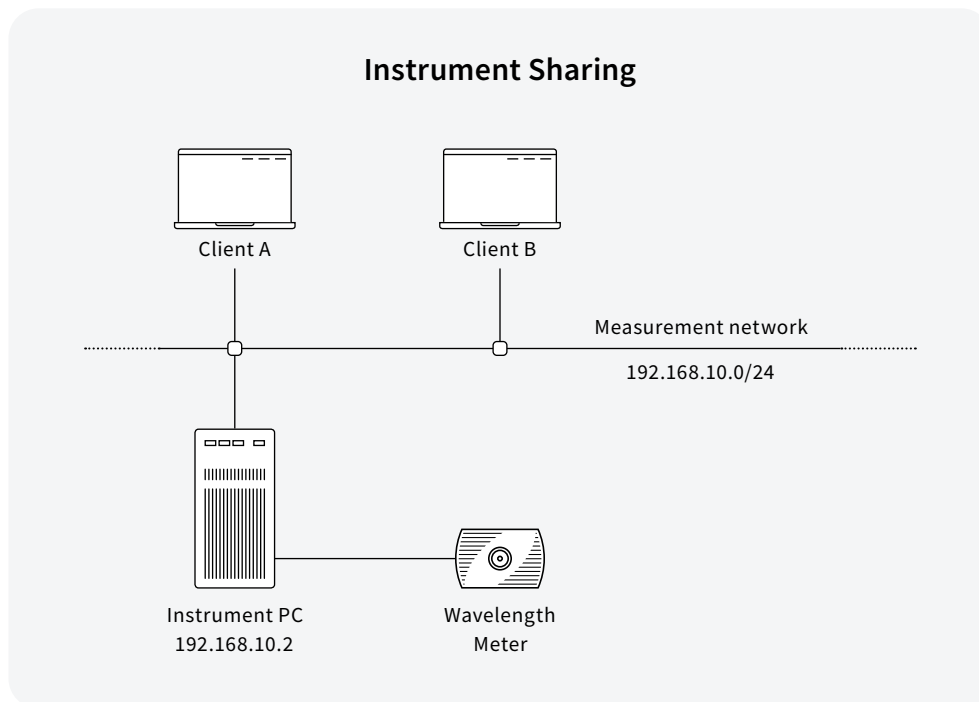


Figure 4: Scenario 1 – instrument sharing

#### Instrument PC configuration:

Start the `wlmDataServer.exe` on the instrument server without any additional command line switches.

```
Command Prompt - wlmDataServer.exe
C:\HighFinesse>wlmDataServer.exe
INFO [2021-11-26 09:27:52 UTC+0100]: Server version: 7.64.263.4 (Beta), PID: 29496 is listening on IPv4/6 addresses, TCP ports: 7171, 7172; exit: CTRL-C.
```

Figure 5: Starting `wlmDataServer.exe` with no parameters



**Client configuration:**

Use the following wlmData.ini file on Client "A" and Client "B"

```
; ===== CUT HERE =====  
  
; wlmData.ini example scenario 1 configuration file  
  
[default]           ; Default settings (it match with  
                    ; all measurement applications)  
address = 192.168.10.2 ; Instrument server IP address  
port    = 7171        ; Set/Get TCP Port number  
port2   = 7172        ; CallbackProc/Ex TCP Port number  
offload = 1           ; ConvertUnit / ConvertDeltaUnit functions  
                    ; network offload (1=On, 0=Off)  
  
; ===== CUT HERE =====
```

## 4.2. Scenario 2 – Multiple Instrument Access From Single Client

Two Wavelength Meters (① + ②) are shared on the measurement network (192.168.10.0/24) by Instrument PC 1 (192.168.10.2) and Instrument PC 2 (192.168.10.3). The client runs “LongTerm1.exe” and “LongTerm2.exe” for controlling Wavelength Meter 1 (①) and Wavelength Meter 2 (②).

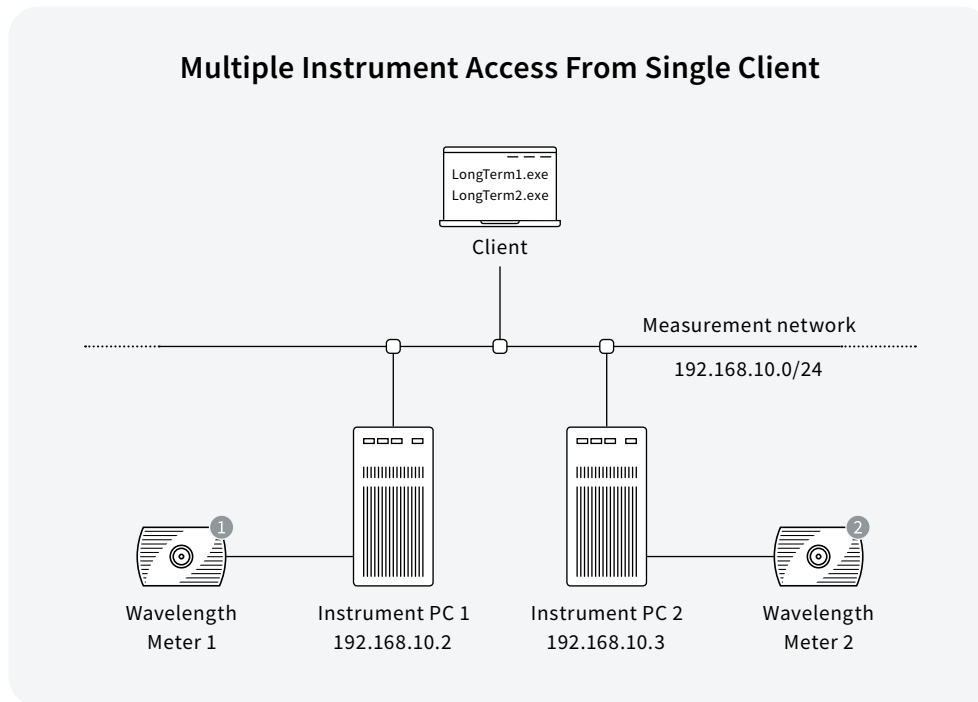


Figure 6: Scenario 2 – Multiple Instrument access from one client

### Instrument PC configuration:

Start the `wlmDataServer.exe` on the both Instrument PCs without any additional command line switches.

```

Command Prompt - wlmDataServer.exe
C:\HighFinesse>wlmDataServer.exe
INFO [2021-11-26 09:27:52 UTC+0100]: Server version: 7.64.263.4 (Beta), PID: 29496 is listening on
IPv4/6 addresses, TCP ports: 7171, 7172; exit: CTRL-C.

```

Figure 7: Starting `wlmDataServer.exe` with no parameters

**Client configuration:**

Use the following **wlmData.ini** file on Client side:

```
; ===== CUT HERE =====  
  
; wlmData.ini example scenario 2 configuration file  
  
[LongTerm1.exe]           ; Configuration section for LongTerm1.exe  
address = 192.168.10.2    ; Instrument server IP address  
port    = 7171            ; Set/Get TCP Port number  
port2   = 7172            ; CallbackProc/Ex TCP Port number  
offload = 1               ; ConvertUnit / ConvertDeltaUnit functions  
                           network offload (1=On, 0=Off)  
  
;  
  
[LongTerm2.exe]           ; Configuration section for LongTerm2.exe  
address = 192.168.10.3    ; Instrument server IP address  
port    = 7171            ; Set/Get TCP Port number  
port2   = 7172            ; CallbackProc/Ex TCP Port number  
offload = 1               ; ConvertUnit / ConvertDeltaUnit functions  
                           network offload (1=On, 0=Off)  
  
; ===== CUT HERE =====
```

---

## 5. Open Source Licences

The network client uses “inih” library:

<https://github.com/benhoyt/inih/>

The “inih” library is distributed under the New BSD license:

Copyright (c) 2009, Ben Hoyt

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