



ESenTRY

Earthquake SenTRY

User Manual

ESenTRY is a user-friendly graphical user interface based on Windows operation system and developed by using C# language and .NET Framework 4.7.2. The program is developed to read and analyze the Güralp Compressed Format (GCF) strong motion data in real-time, issue an alarm during an earthquake, and alert Modbus clients. The instrumental modified Mercalli intensity based algorithm is designed for on-site earthquake early warning operation.

The 30-day trial version can be downloaded from GitHub, a web-based repository hosting service: <https://github.com/ozkankafadar/ESenTRY>.

1. Quick Tutorial

Installation

ESenTRY is a Windows OS based software and requires .NET Framework 4.7.2 or later. The code can be used in two ways: **a)** installation using the setup file or **b)** use directly executable version. Although the code is developed for commercial purposes, the flowchart diagrams and detailed explanations are shared by the following article for scientists interested in the earthquake early warning systems:

Ö. Kafadar, S. Tunç, and B. Tunç, "ESenTRY: An on-site earthquake early warning system based on the instrumental modified Mercalli intensity," IEEE Sensors Journal, vol. xx, no. x, pp. xxxx-xxxx, 2024.

Please, download the 30-day trial version from GitHub repository.

GitHub repository: <https://github.com/ozkankafadar/ESenTRY>

For installation:

Option 1:

- If you have .NET Framework 4.7.2 or later versions, you can directly use the code utilizing the executable version in the program folder. Please, run **ESenTRY** executable file (ESenTRY_v1.0.exe) in the Executable_version folder.

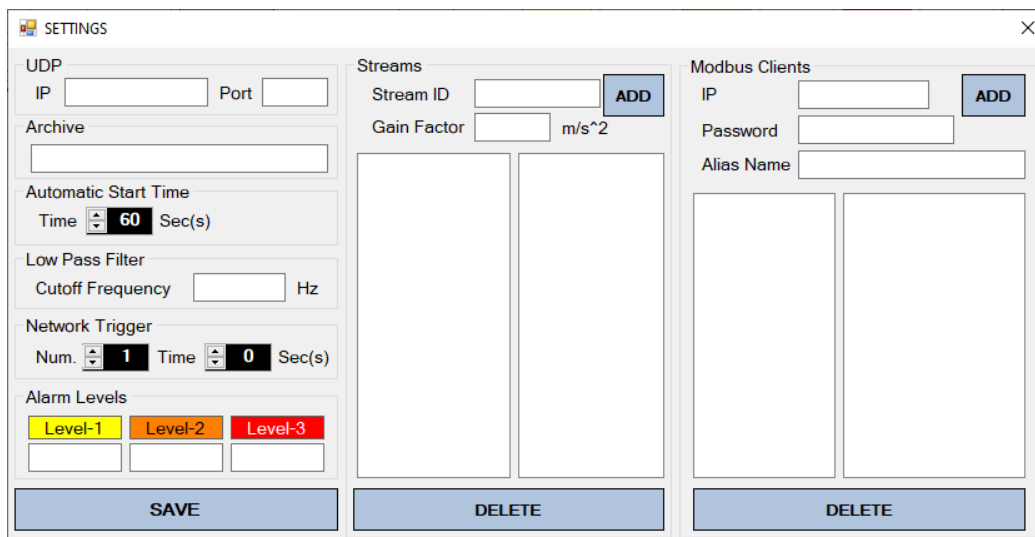
Option 2:

- If you have .NET Framework 4.7.2 or later versions, you can install the program via the setup file in the Setup folder. Please, run **ESenTRY** setup file (Setup.exe).

2. ESenTRY_v1.0 Graphical User Interfaces

2.1. Settings Window

ESenTRY needs several input parameters to connect the Host, read GCF strong motion data from accelerometers, analyze them and connect to Modbus clients. For these operations, firstly, the input parameters should be identified using the Settings window.



The Settings window allows to users for identifying the UDP parameters (IP and Port) for Host, archive directory to save the strong motion indices in real-time and estimated parameters during an alarm, automatic start time for the program, cutoff frequency of the low-pass filter, required minimum trigger number and trigger time to issue an alarm in case of multiple station analysis, alarm threshold levels for instrumental modified Mercalli intensity, streams (stream IDs and gain factors), and Modbus clients (IPs, passwords and alias names).

For example, the parameters used for the second simulation in the article are shown below graphical user interface.

SETTINGS

UDP
 IP: 127.0.0.1 Port: 2619

Archive
 D:\GCFData

Automatic Start Time
 Time: 60 Sec(s)

Low Pass Filter
 Cutoff Frequency: 5 Hz

Network Trigger
 Num.: 3 Time: 5 Sec(s)

Alarm Levels
 Level-1: 0.1 Level-2: 3 Level-3: 5

Streams
 Stream ID: ADD
 Gain Factor: m/s²

4533Z2	3E-6
4512Z2	3E-6
4531Z2	3E-6
4509Z2	3E-6
4535Z2	3E-6

Modbus Clients
 IP: ADD
 Password:
 Alias Name:

99.11.55.222	MODBUS1
5.66.111.222	MODBUS2

Buttons: SAVE, DELETE, DELETE

2.2. Main Window

ESenTRY main window is a multi-functional interface that allows to monitor the estimated strong motion indices in real-time and to control the other operations. The main menu consists of Settings, Close and About menu items.

ESenTRY (EARTHQUAKE SENTRY) TRIAL VERSION

File About

UDP
 IP: 127.0.0.1 Port: 2619 STOP

Low-Pass Filter
 Frequency: 5 Hz

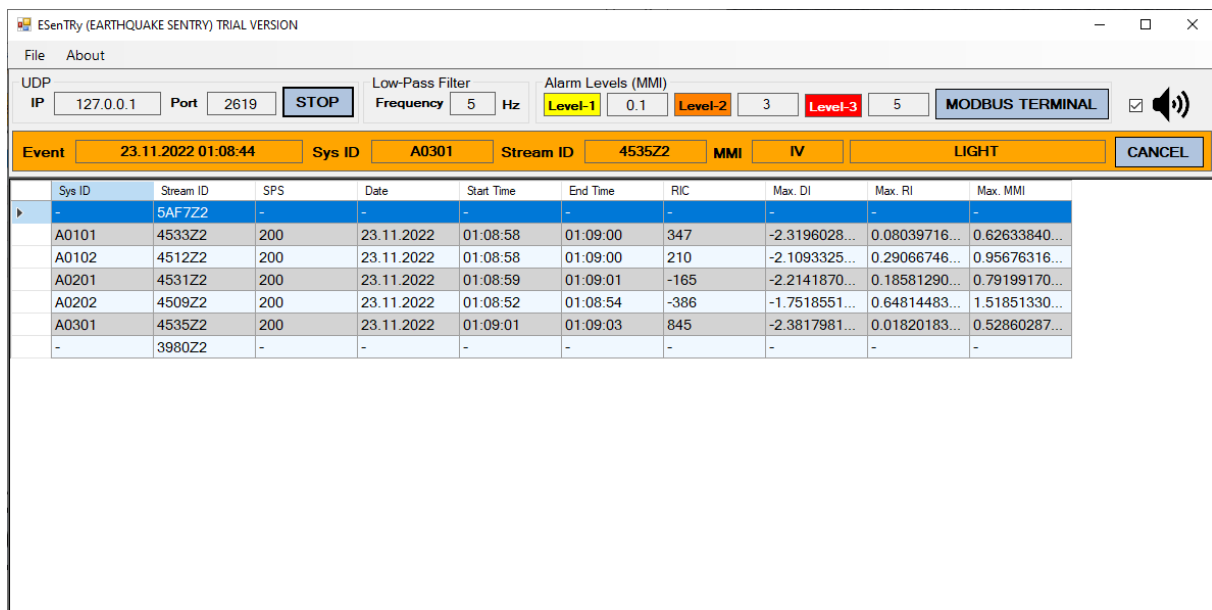
Alarm Levels (MMI)
 Level-1: 0.1 Level-2: 3 Level-3: 5 MODBUS TERMINAL [Speaker Icon]

Event: Sys ID: Stream ID: MMI: CANCEL

Sys ID	Stream ID	SPS	Date	Start Time	End Time	RIC	Max. DI	Max. RI	Max. MMI
-	5AF7Z2	-	-	-	-	-	-	-	-
A0101	4533Z2	200	23.11.2022	01:00:39	01:00:44	-9	-7.8773889...	-5.4773889...	-8.1073254...
A0102	4512Z2	200	23.11.2022	01:00:37	01:00:42	-10	-7.3164566...	-4.9164566...	-7.2258604...
A0201	4531Z2	200	23.11.2022	01:00:39	01:00:44	0	-7.2561297...	-4.8561297...	-7.1310610...
A0202	4509Z2	200	23.11.2022	01:00:39	01:00:41	-26	-7.2298157...	-4.8298157...	-7.0897104...
A0301	4535Z2	200	23.11.2022	01:00:39	01:00:44	-3	-7.1952982...	-4.7952982...	-7.0354687...
-	3980Z2	-	-	-	-	-	-	-	-

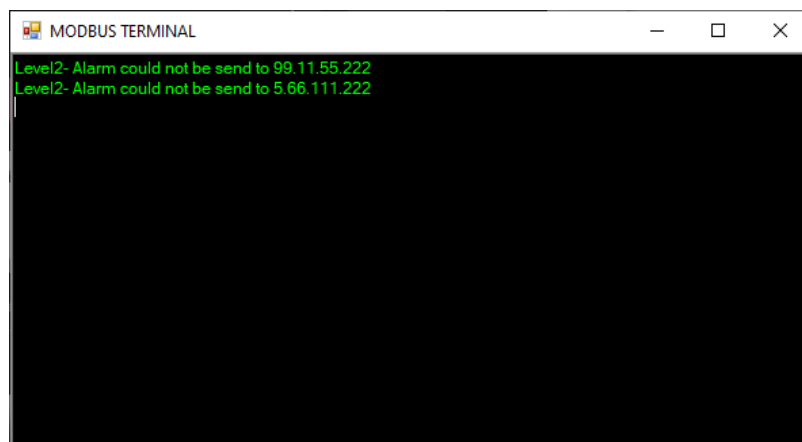
In the main window, a user should identify the required parameters above mentioned and click to START button. So, the code loads the identified Stream IDs to grid and starts to listening the Host. When a data package is received, it reads the GCF blocks and fill the grid with decoded and estimated parameters for each Stream ID. When the estimated maximum instrumental modified Mercalli intensity exceeds the identified alarm threshold levels, the code issues an alarm and alert the user. A user can be stop the alarm completely (CANCEL button)

or mute the alarm sound (Alarm Sound checkbox). The STOP button stops the listening operation.



2.3. Modbus Terminal Window

The Modbus Terminal window informs the user when an event is detected, and provides information about which clients can be alerted or not alerted.

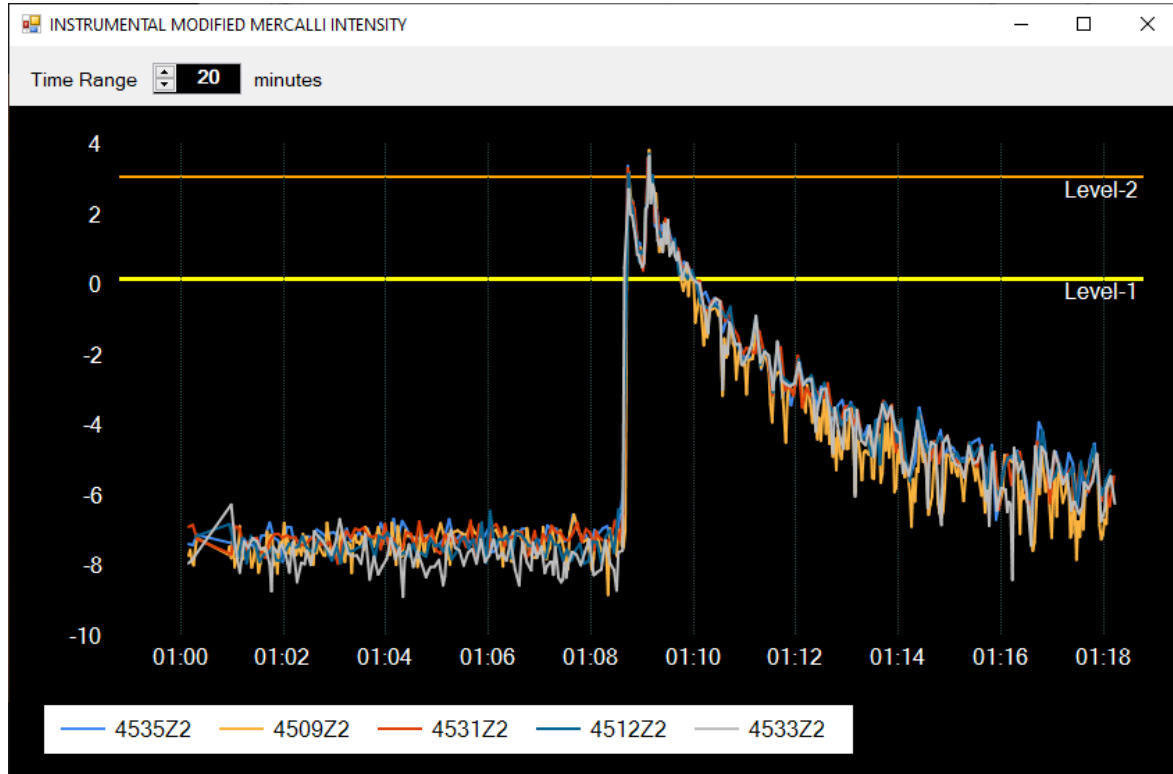


Additionally, if the alarm is canceled by the user or due to trigger delay time, the alarm cancelled message is displayed in the Modbus Terminal window.



2.4. Instrumental Modified Mercalli Intensity Window

In the Instrumental Modified Mercalli Intensity window, the estimated instrumental modified Mercalli intensities for each station are displayed graphically in real-time. Please, select one or more rows from the grid in the main window, and click the enter on keyboard to open the graphics window.

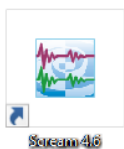


3. Scream! Installation and Settings

Scream!, a freely-available Windows and Linux application for Güralp instruments, is used in the data center for the configuration of the seismometers, real-time data acquisition and monitoring. In addition, Scream! can receive and transmit GCF (Güralp Compressed Format) data over serial or dial-up links, TCP/IP, UDP/IP or other file transfer protocols.

Please, send an email to scream@guralp.com, stating your name, organizational affiliation (if any) and equipment owned to obtain a free copy of Scream!, then you will receive a reply containing a download link.

Firstly, please install Scream!, and click to mouse right button on Scream! shortcut.



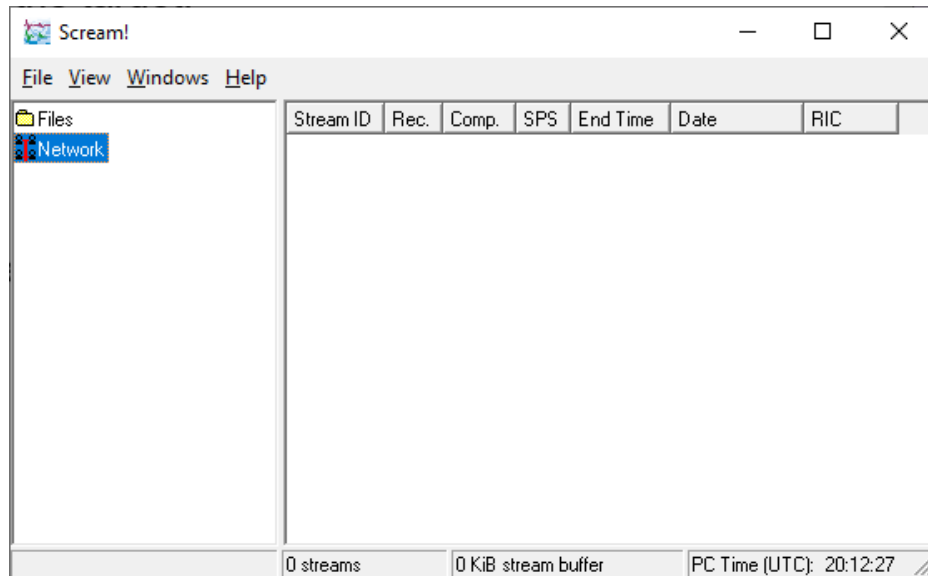
Then click to Properties menu item. In the opening window, go to shortcut panel and add the following string to end of the target:

`-i:c:\scr.ini -txFiles`

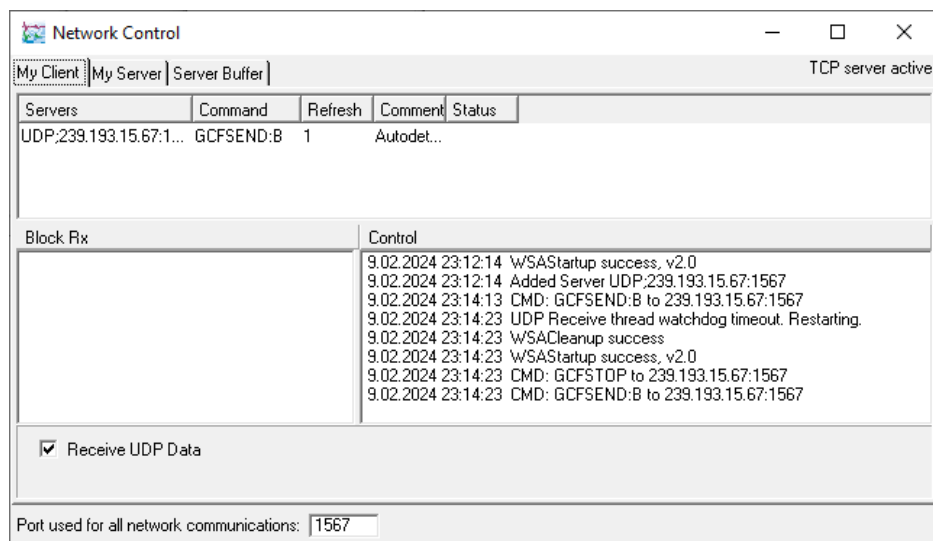
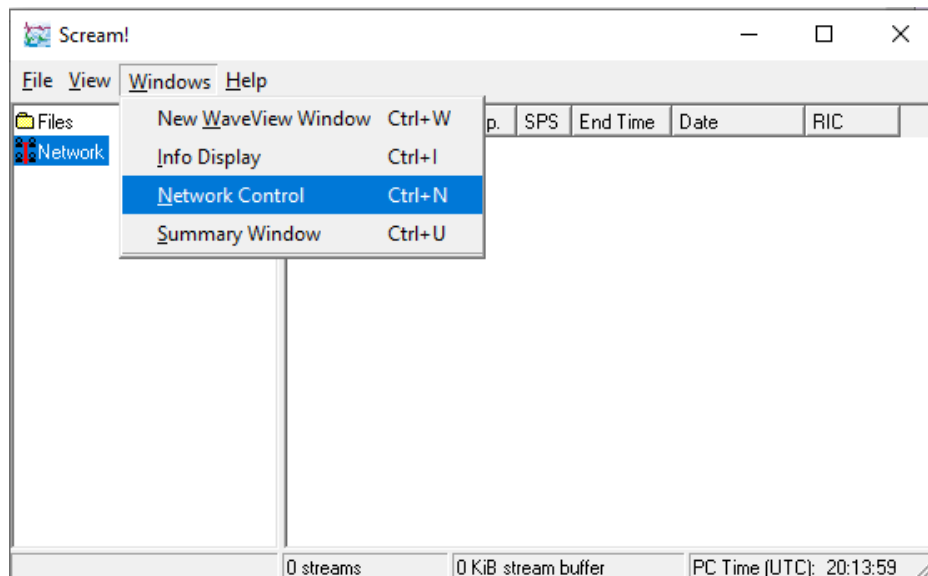
Finally click to OK button.

Please, apply the instructions below to configure the Scream! for ESenTRY simulations:

- Please, run Scream!



- Then click to “Windows” menu and click to “Network Control” menu item.



- Click to “My Server” tab page and add a GCF client.

Network Control

My Client **My Server** Server Buffer TCP server active

Clients	Params	Timeout

Block Tx	Control
	9.02.2024 23:12:14 WSAStartup success, v2.0
	9.02.2024 23:14:23 WSACleanup success
	9.02.2024 23:14:23 WSAStartup success, v2.0

☐ Allow remote control access
 ☐ Transmit data from local Com Ports

☐ Transmit data from Network
 1000 sps transmitted block limit

Port used for all network communications: 1567

Network Control

My Client My Server **Server Buffer** TCP server active

Clients	Params	Timeout

Block Tx	Control
	9.02.2024 23:12:14 WSAStartup success, v2.0
	9.02.2024 23:14:23 WSACleanup success
	9.02.2024 23:14:23 WSAStartup success, v2.0
	9.02.2024 23:16:37 WSACleanup success
	9.02.2024 23:16:37 WSAStartup success, v2.0

☐ Allow remote control access
 ☐ Transmit data from local Com Ports

☐ Transmit data from Network
 1000 sps transmitted block limit

Port used for all network communications: 1567

- Enter the IP and port: 127.0.0.1:2619, and click to OK button.

Add a GCF Client

Specify a client IP address and port number

127.0.0.1:2619

OK Cancel

- Finally, select all checkboxes in this window as follows and close the window.

Network Control

My Client My Server **Server Buffer** TCP server active

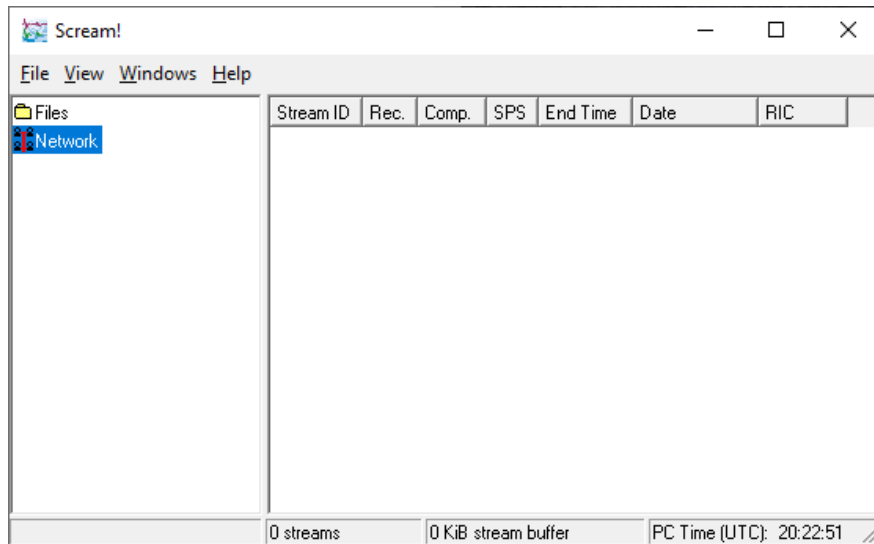
Clients	Params	Timeout
127.0.0.1:2619	B	None

Block Tx	Control
	9.02.2024 23:12:14 WSAStartup success, v2.0
	9.02.2024 23:14:23 WSACleanup success
	9.02.2024 23:14:23 WSAStartup success, v2.0
	9.02.2024 23:16:37 WSACleanup success
	9.02.2024 23:16:37 WSAStartup success, v2.0
	9.02.2024 23:18:47 WSACleanup success
	9.02.2024 23:18:47 WSAStartup success, v2.0
	9.02.2024 23:20:37 Added Client 127.0.0.1:2619

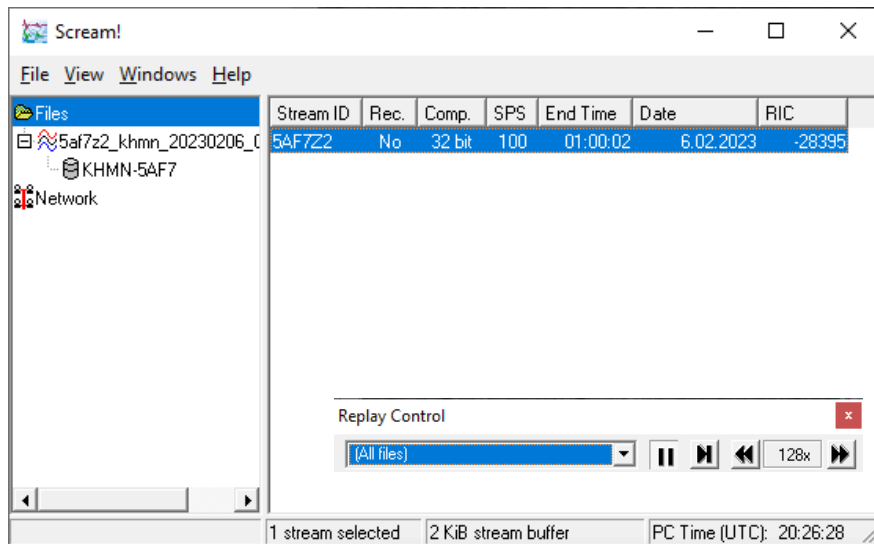
☒ Allow remote control access
 ☒ Transmit data from local Com Ports

☒ Transmit data from Network
 1000 sps transmitted block limit

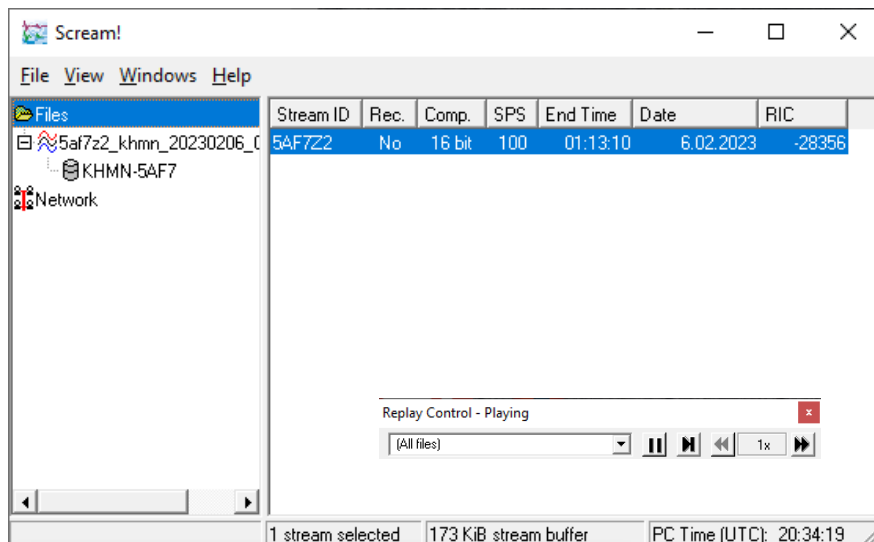
Port used for all network communications: 1567



- Please, drag the GCF file and drop it on Scream main window. The sample GCF file can be supplied from authors. It can be only used for test applications and can't be distributed without permission of Kandilli Observatory and Earthquake Research Institute.



- Then, decrease the data transfer speed as you desired and click to pause button to start the data transfer.



- To display the WaveView window, please select the Stream ID in Scream' window, and double click to mouse right button or click to enter on keyboard.

