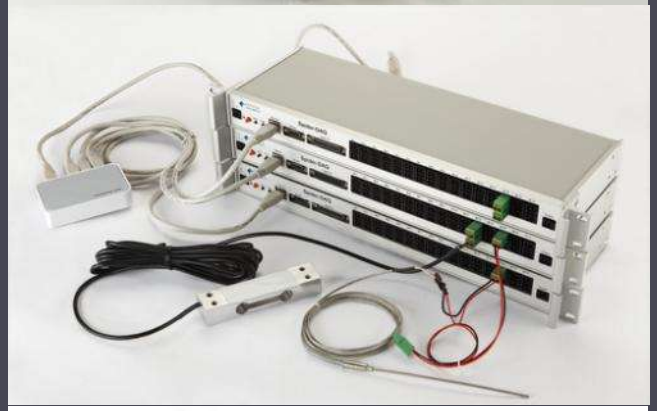
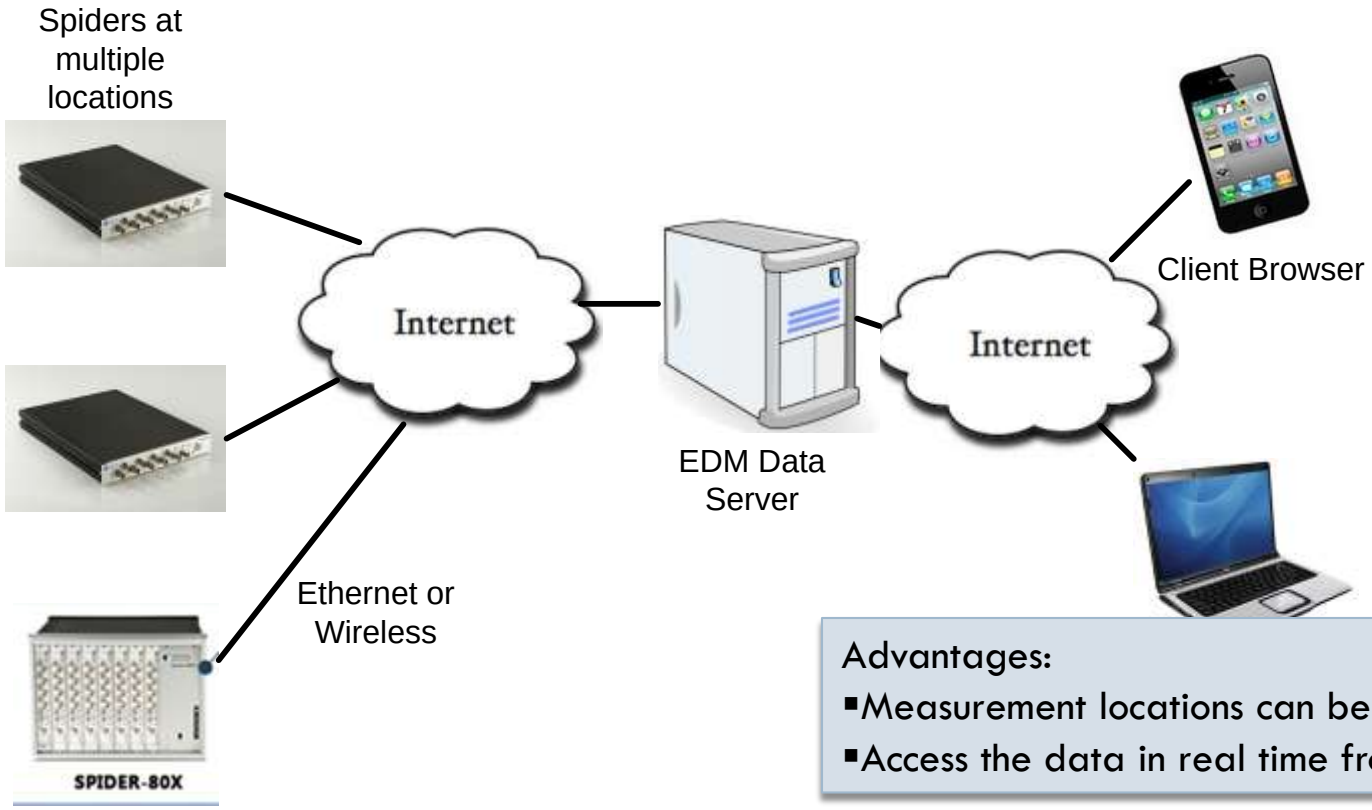


EDM Cloud

Remote Monitoring Solutions

© Crystal Instruments, January 2014

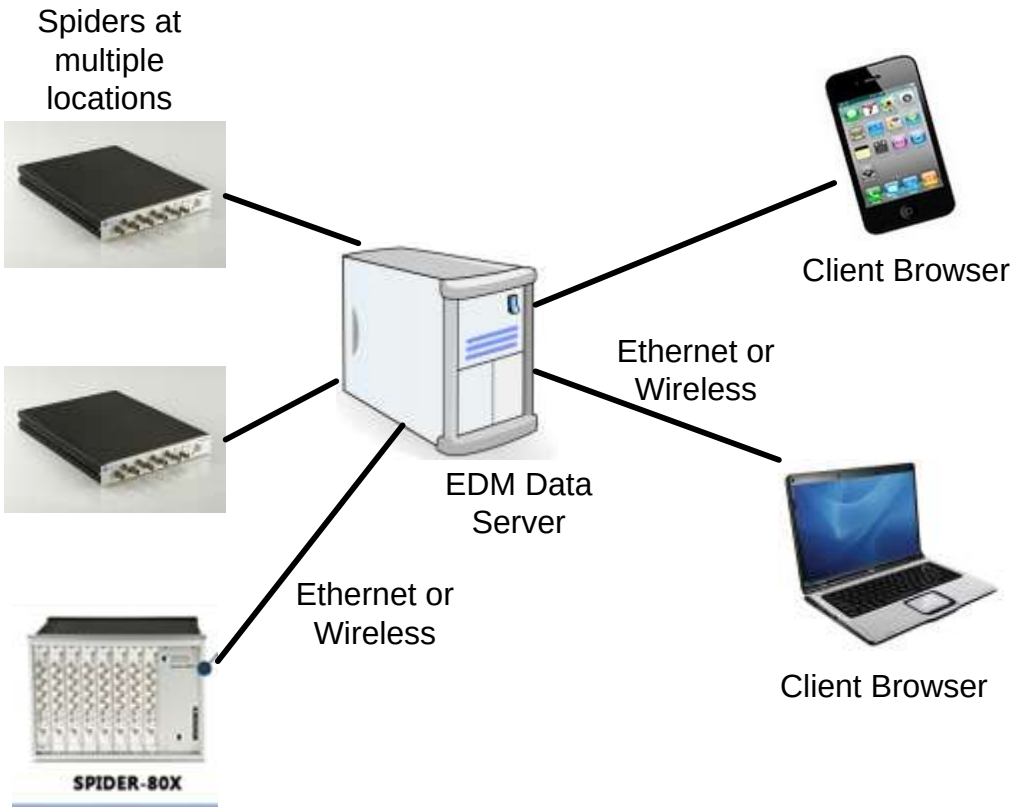
Architecture 1: EDM Cloud runs on the Internet



Advantages:

- Measurement locations can be far away from the users
- Access the data in real time from anywhere

Architecture 2: EDM Cloud runs on a Local Area Network (LAN)



Advantages:

- High speed data access and data transfer.
- Limitation: LAN might be limited by the physical installation

Typical Applications

- Wind Turbine Conditioning Monitoring
- Rotating Machine Monitoring
- Construction Noise
- Cooling Fan Vibration Monitoring
- Airport Noise
- Highway Tunnel, Railway Tunnel Vibration

What Can be Measured with a Spider System

- Vibrations with alarm limits
  - Time blocks
  - Long recording signals
  - RMS or peak levels
  - Harmonics level
  - Power spectra
  - FRF (Frequency response function)
  - Phase measurement
- Various sound levels with alarm limits
- Temperature, humidity, voltage, strain gage

Access Data and Instruments Anywhere

- Access the instruments and data center with history data online
- Hardware can be offline or online
- Web based client application (no software installation)
- Share online information with your stakeholders via Internet

Unique Hardware Solution

- Spider-80X has extremely compact packaging
  - Size approximately letter size
  - Full Ethernet connection
  - 150dBFS dynamic range: input range selection not needed
  - Onboard flash memory storage
- Spider-DAQ: Measure strain, high voltage, temperature, humidity
- Input channels expandable

Spider-80X Module

Front View: 8 input channels with control buttons

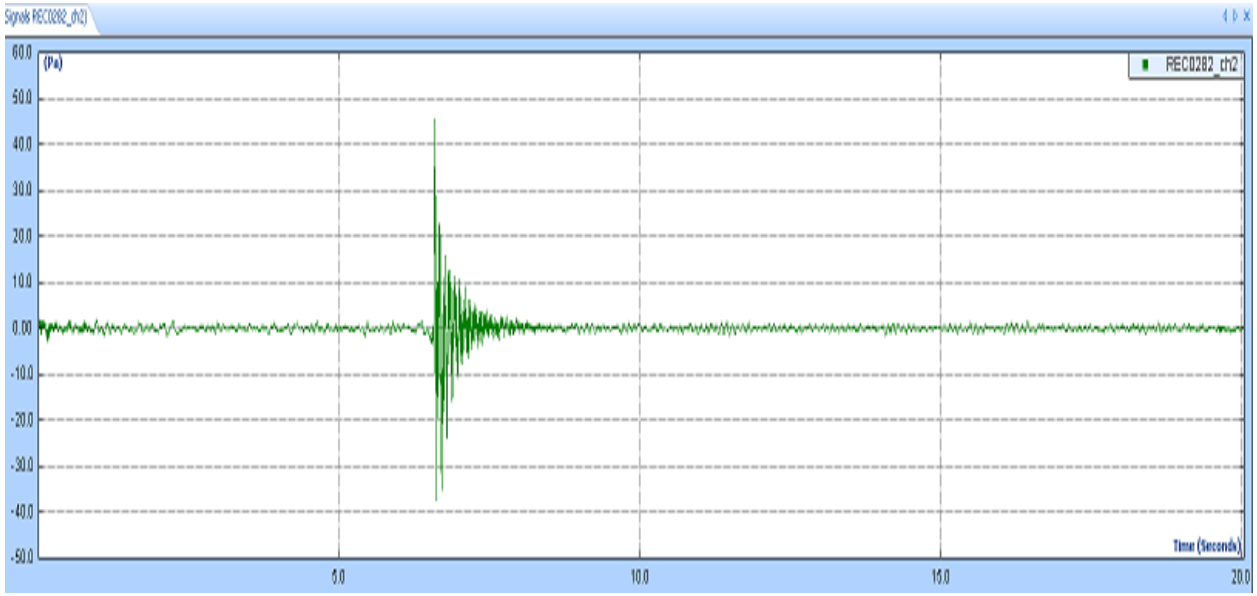
Back View: Power, Ethernet connector, GND, RS-485, reset button

A 64 channel System consists of Eight Spider-80X

Spider-DAQ Module

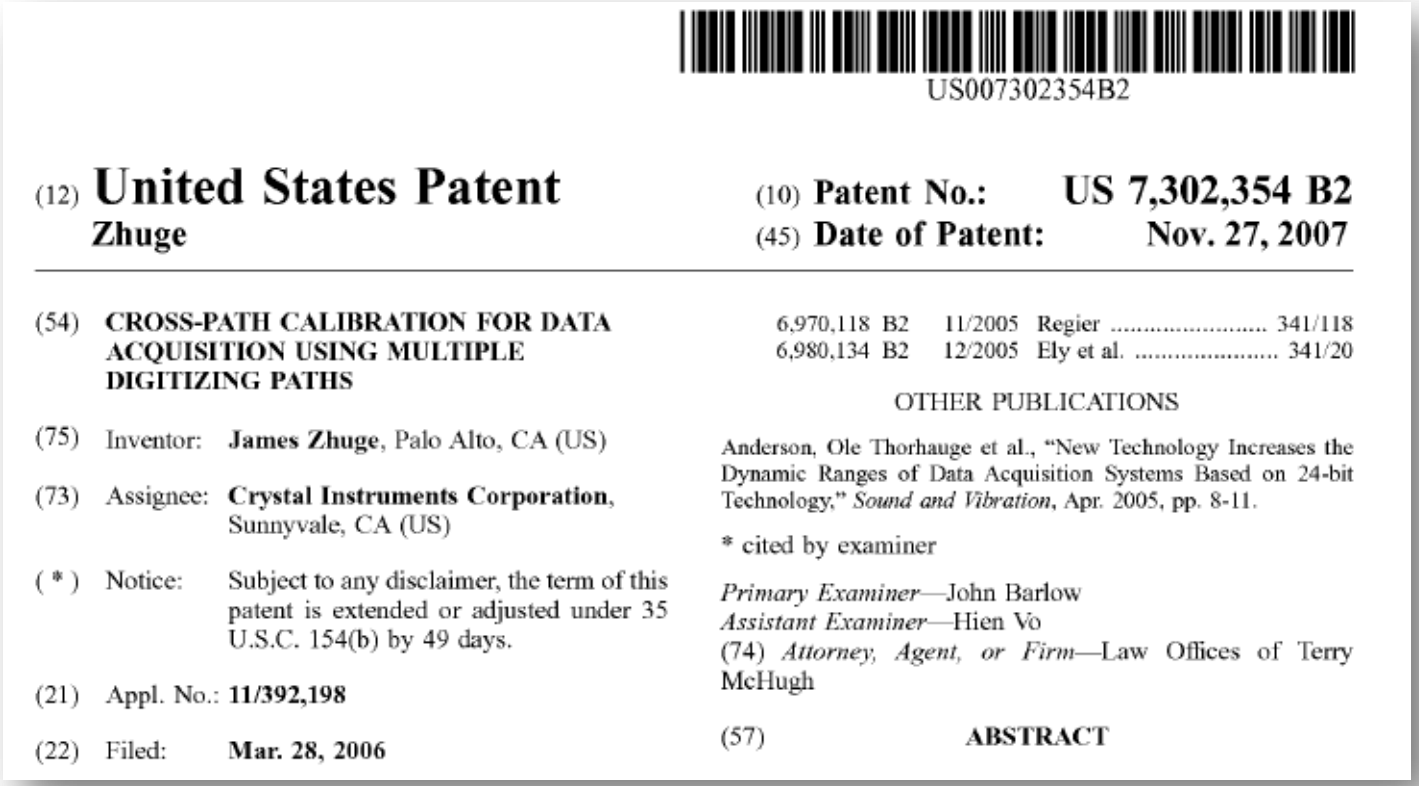
- The Spider-DAQ is a module that can either connect to a PC using an Ethernet connection or run without a PC. Using various 8B modules, the Spider-DAQ can measure voltage, strain, current, frequency, temperature, and many more physical quantities.

Dynamic Range is Critical



In machine condition monitoring, one of the biggest challenges is how to measure both large and small signals without changing the input settings

Patented Dual A/D Technology Provides 150 dB Dynamic Range for Input Measurement



US007302354B2

(12) **United States Patent**
Zhuge

(10) **Patent No.: US 7,302,354 B2**
(45) **Date of Patent: Nov. 27, 2007**

(54) **CROSS-PATH CALIBRATION FOR DATA ACQUISITION USING MULTIPLE DIGITIZING PATHS**

(75) Inventor: **James Zhuge**, Palo Alto, CA (US)

(73) Assignee: **Crystal Instruments Corporation**, Sunnyvale, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 49 days.

(21) Appl. No.: **11/392,198**

(22) Filed: **Mar. 28, 2006**

6,970,118 B2	11/2005	Regier	341/118
6,980,134 B2	12/2005	Ely et al.	341/20

OTHER PUBLICATIONS

Anderson, Ole Thorhauge et al., "New Technology Increases the Dynamic Ranges of Data Acquisition Systems Based on 24-bit Technology," *Sound and Vibration*, Apr. 2005, pp. 8-11.

* cited by examiner

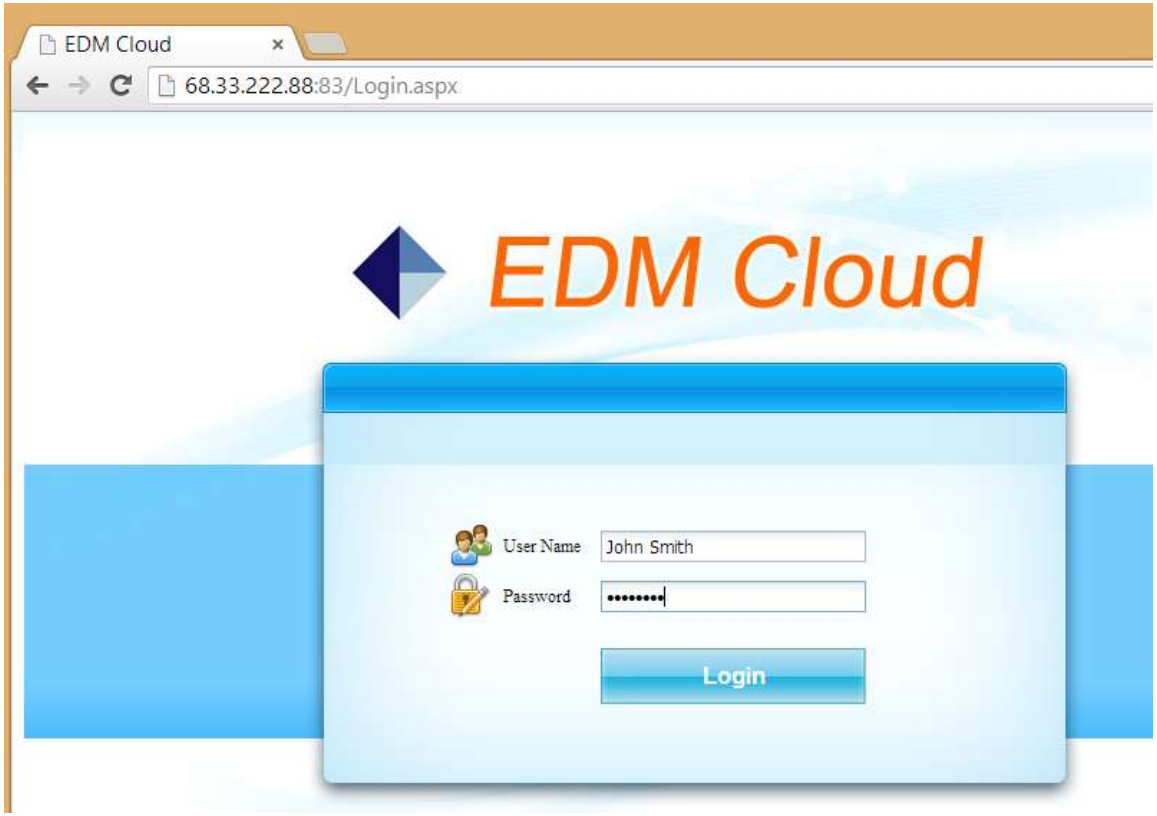
Primary Examiner—John Barlow
Assistant Examiner—Hien Vo
(74) *Attorney, Agent, or Firm*—Law Offices of Terry McHugh

(57) **ABSTRACT**

Multi-Level User Administration

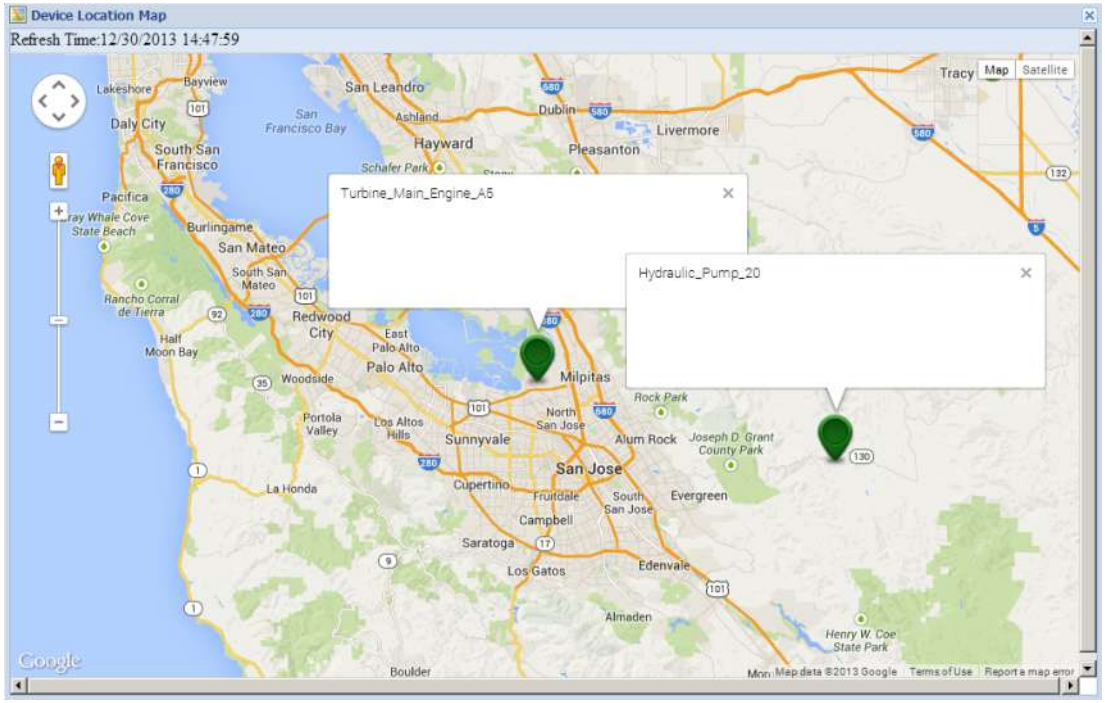
- **Super-Admin**: Has the rights to install, upgrade and configure the server software. Also has the rights of Admin and Users.
- **Admin:** Has the rights to configure the Project, Measurement List, Location of Spiders, Signal List and Runlog. Also has the rights of Users
- **User:** Only has the rights to view or download the measurement data, runlog, events. Does not have rights to change the settings

Log in anywhere with a Browser



Supports PC, iPod, Android Phone etc.

Device Location Map



Location of Spider device can be set by their longitude and latitude and then displayed on the Google Map.

Automated Schedule and Limiting Test

- Automated limit test function allows the Spider-80X to conduct automated limit checking for time or frequency signals.
- **Test Signals**: time block signals, auto spectrum, frequency response function, octave spectrum.
- **Limit Signals**: user defined upper or low limit signals. For spectra signal the spectrum type will also be assigned. Limit signals will be bound to testing signals. Maximum segments of each limit signal: 64; Maximum number of limit signals: 64.
- **Testing Schedule**: automatically control the test duration and automates the operation. Multiple testing schedules can be developed and one is executed at a time. Testing schedule event entries: loop/lend-loop, run duration, hold, limit check on, limit check off, start recording, stop recording, save signals, turn signal source on and turn signal source off.
- **Testing Log and Summary Report**: a log file is automatically created for each run of the schedule to record up to 1024 major events. A summary report is provided for the limiting check status for the last schedule run.
- **Limit Check Alarm Events**: beep, screen flashing, add event to testing log, send message to host PC, save signals, and send emails or text messages.

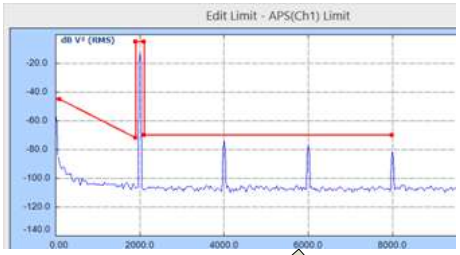
Data Recording with High Reliability

- Acquire time and frequency data continuously up to 102.4 kHz for all channels
- Record up to 4 GB data into internal flash memory
- Large buffers increase reliability
- Reserve power supply recovers data in the event of power loss

How Customized Event Strings work?

Step 1

EDM sets the alarm limit together with a special message string, such as “Exceeding Limit”



Step 2

When alarm event happens, the customized string, “Exceeding Limit” will be sent to the EDM Cloud email service

EDM Cloud Email Service

Step 3

User will receive an alarm email

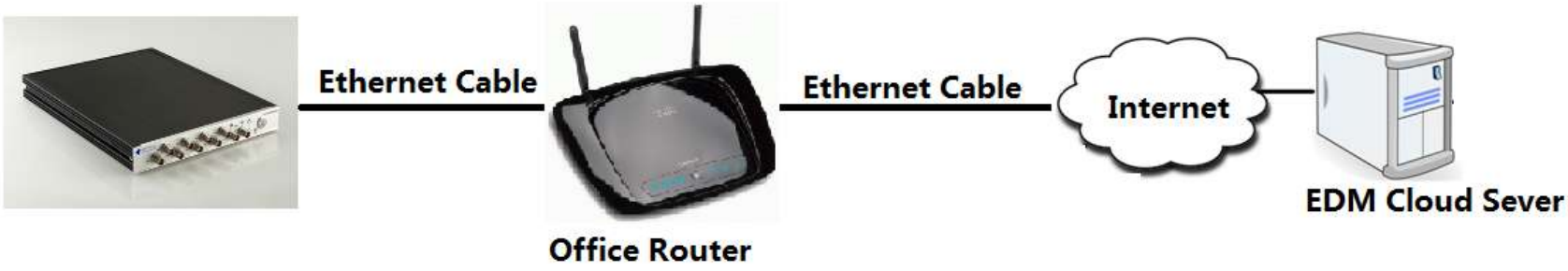
Reset Spider Devices Remotely

- Provide two ways to reset the Spider hardware devices remotely
  - A built-in watchdog can be used. In case software failure, watchdog can detect the hung-up and restart the system automatically
  - As long as the user can “ping” the Spider device remotely, the user can send a special command to the hardware to restart it

Step by Step Configuration

Hardware Configuration: Wired Connection

- The Spider devices are connected to the Ethernet routers
- Routers communicate to the server located on LAN or the Internet



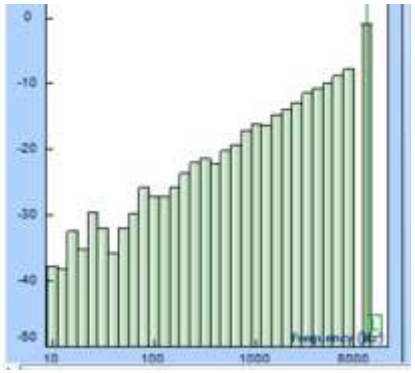
Hardware Configuration: Wireless Connection

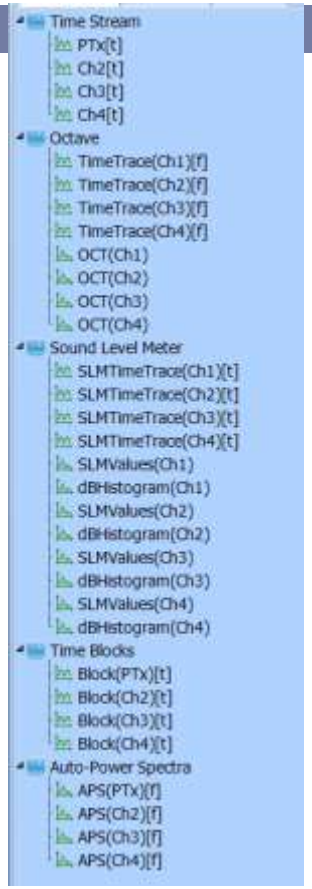
- The Spider devices are connected to the wireless modems
- Wireless modem communicates to the Internet
- Data plan for all major carrier providers are available

EDM: Setup the Measurement

Measured signals may include:

- Time recording signals
- Octave spectra
- Sound level measurement
- Auto-power spectra
- RMS, Peak measurement
- Time blocks

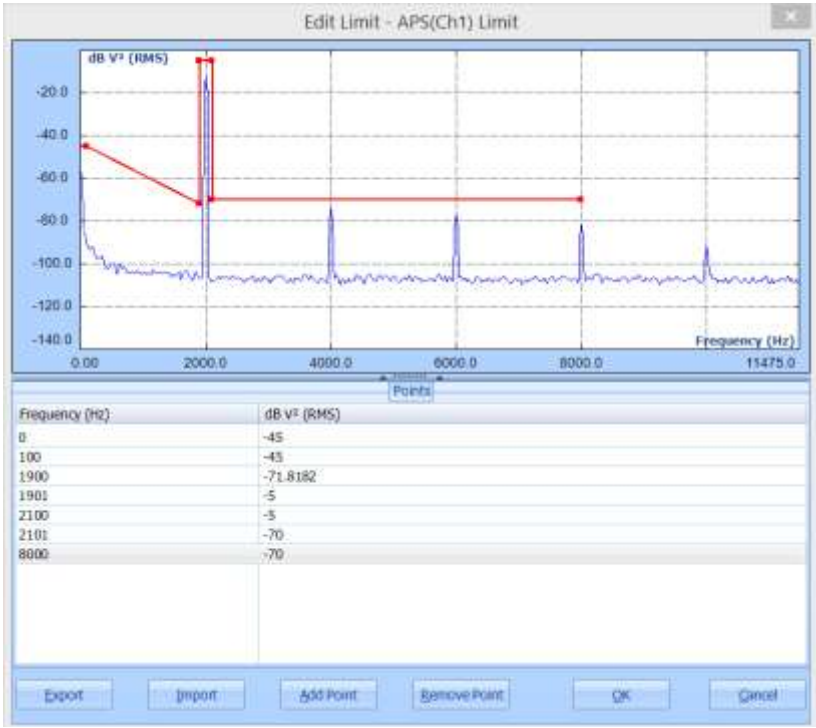




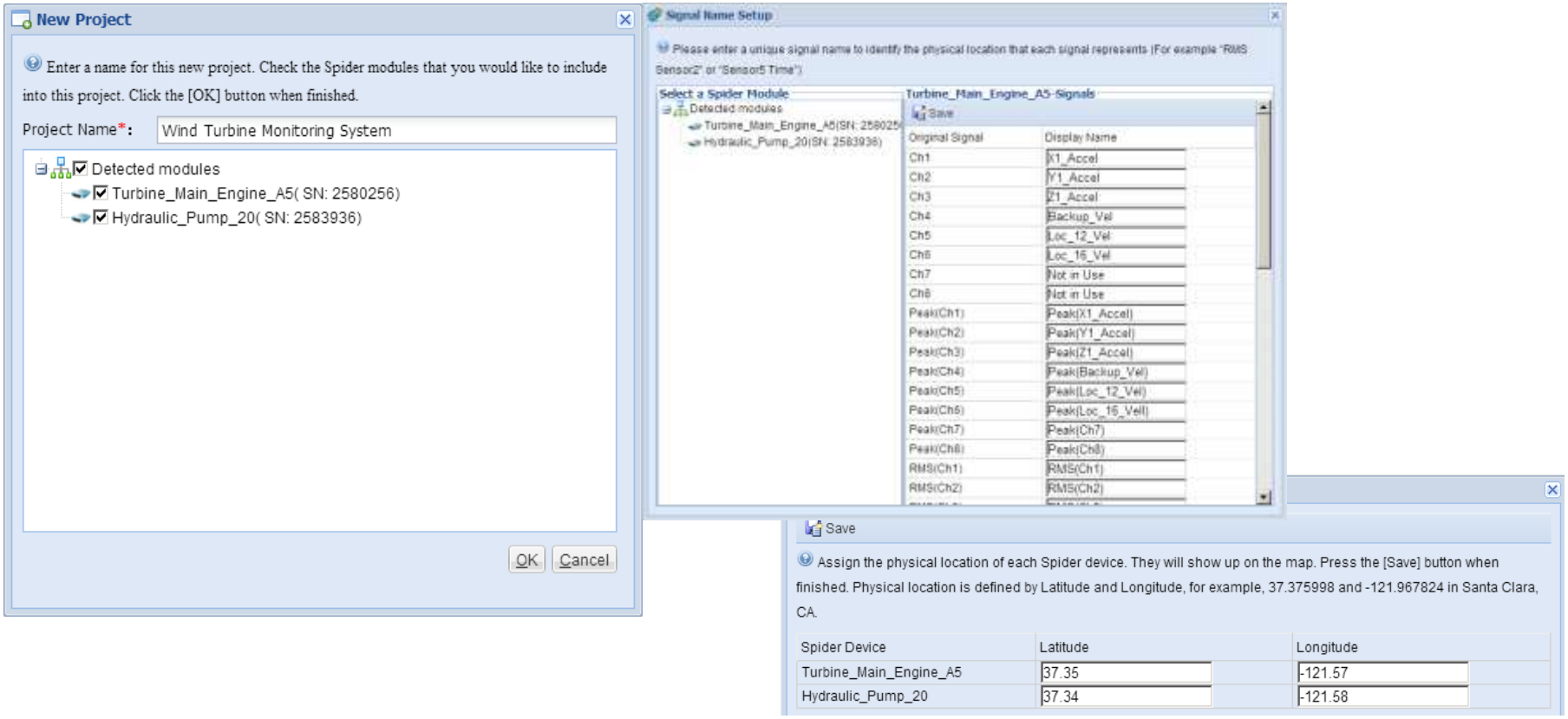
EDM: Set the Alarm Limits

Set up the alarm limits for measurement signals

- High alarm or low alarm
- With break points
- Check the value over the range with percentage

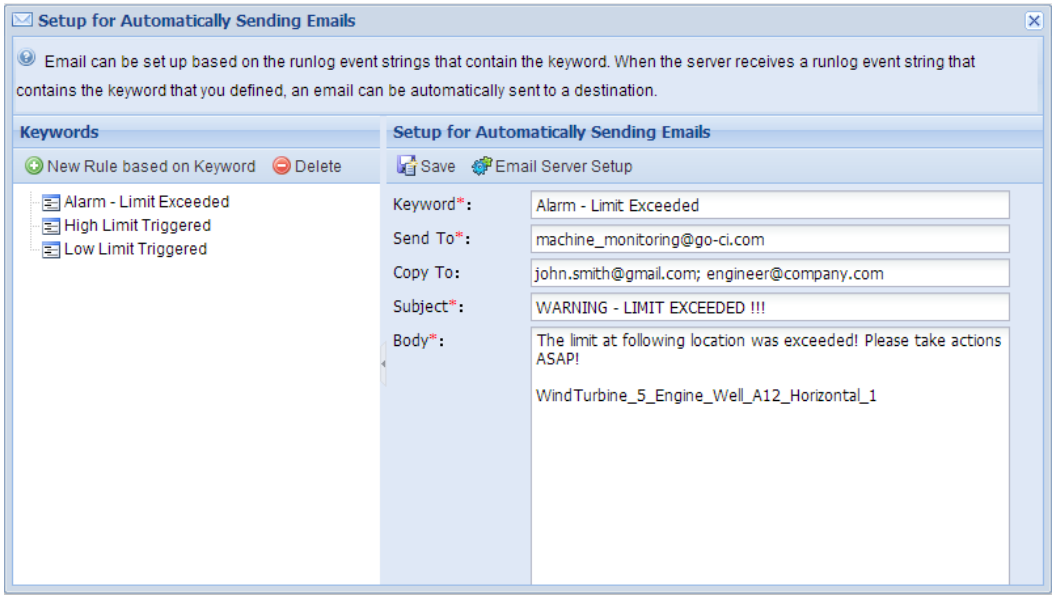


Project, Location, and Signal Setup

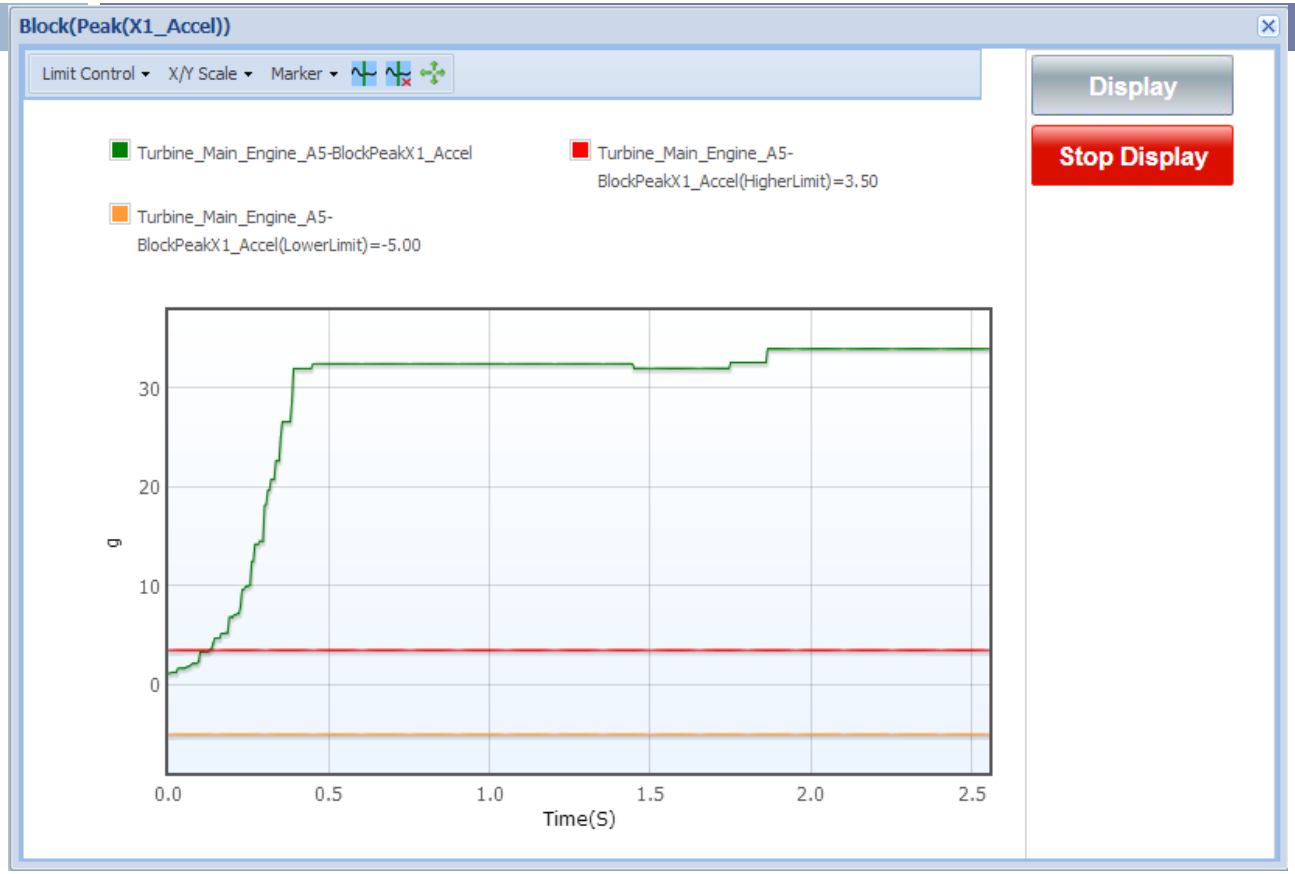


Email Setup at Cloud Server

Users can receive emails that contain the keywords that are preset by the users, for example, “limits exceeded”.

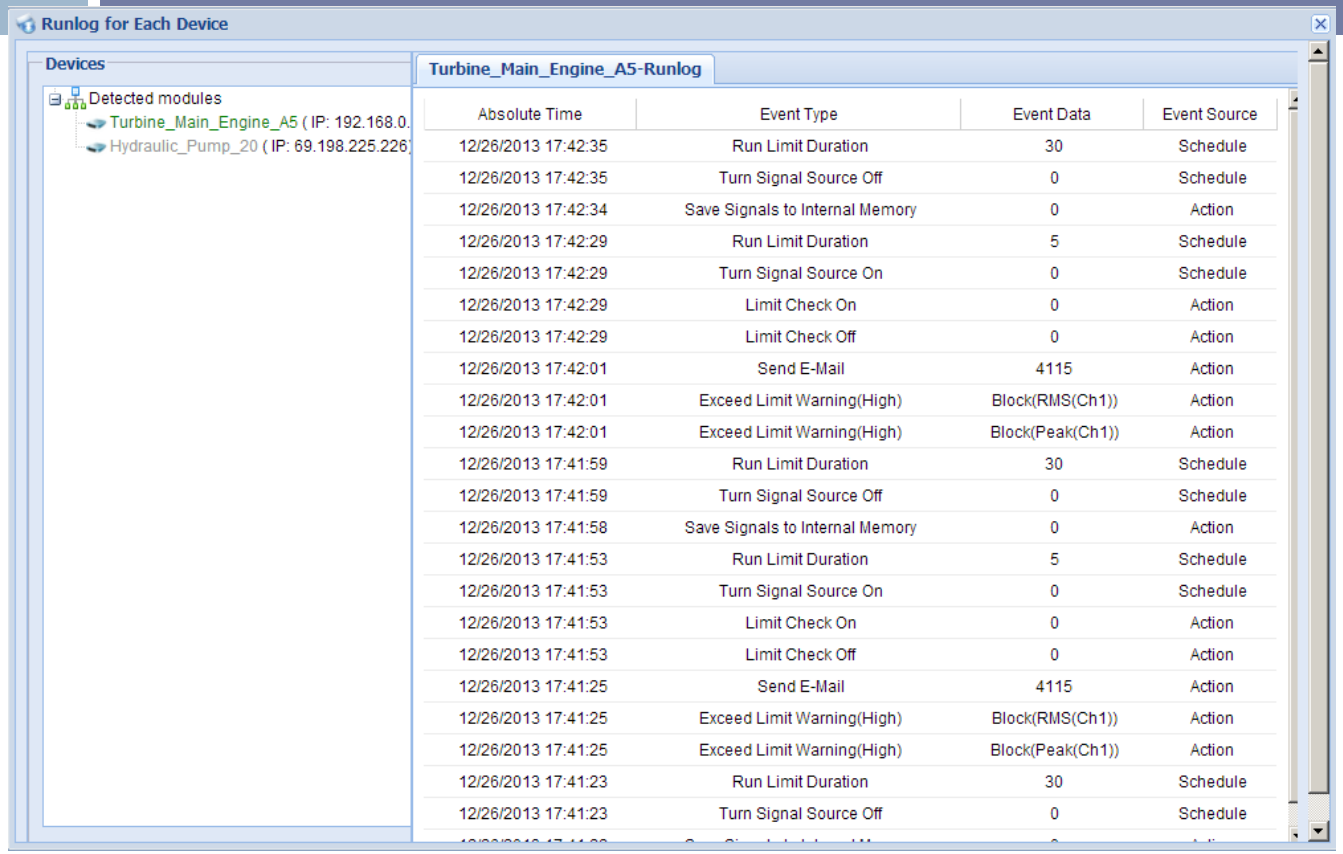


Run the EDM Cloud from Client Side



- View the measurement signals

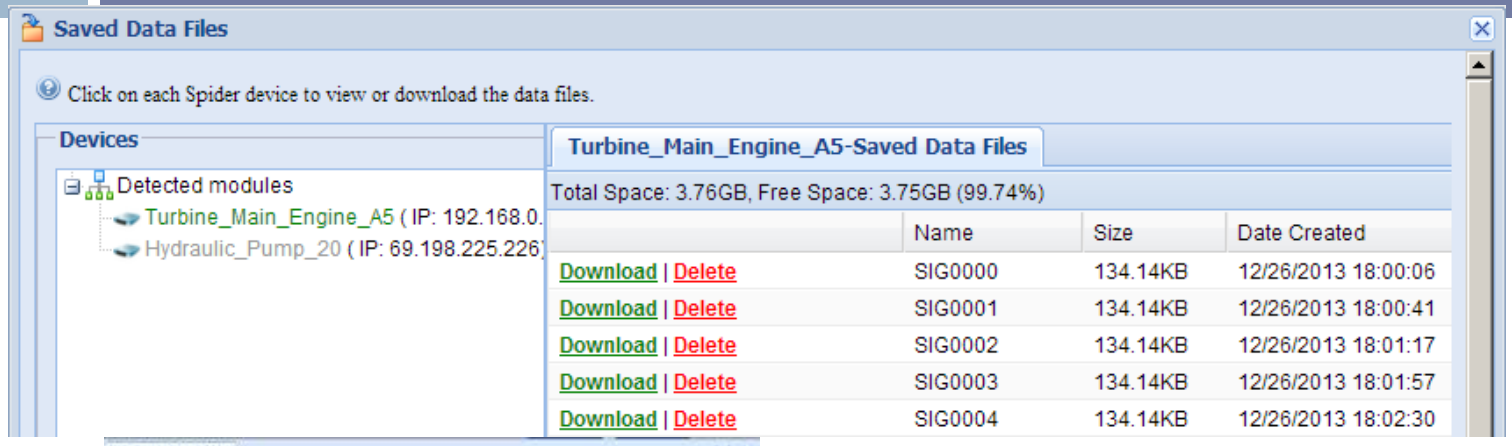
Run the EDM Cloud from Client Side

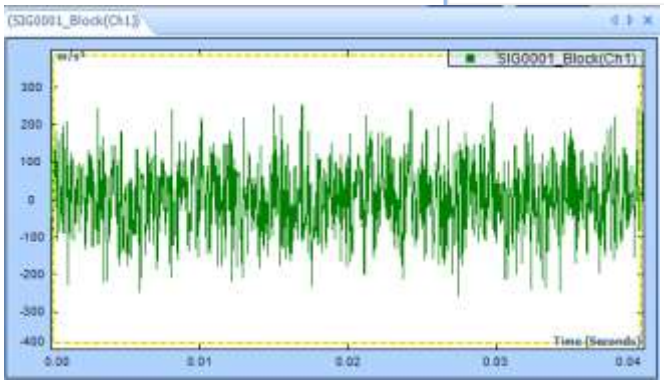


Absolute Time	Event Type	Event Data	Event Source
12/26/2013 17:42:35	Run Limit Duration	30	Schedule
12/26/2013 17:42:35	Turn Signal Source Off	0	Schedule
12/26/2013 17:42:34	Save Signals to Internal Memory	0	Action
12/26/2013 17:42:29	Run Limit Duration	5	Schedule
12/26/2013 17:42:29	Turn Signal Source On	0	Schedule
12/26/2013 17:42:29	Limit Check On	0	Action
12/26/2013 17:42:29	Limit Check Off	0	Action
12/26/2013 17:42:01	Send E-Mail	4115	Action
12/26/2013 17:42:01	Exceed Limit Warning(High)	Block(RMS(Ch1))	Action
12/26/2013 17:42:01	Exceed Limit Warning(High)	Block(Peak(Ch1))	Action
12/26/2013 17:41:59	Run Limit Duration	30	Schedule
12/26/2013 17:41:59	Turn Signal Source Off	0	Schedule
12/26/2013 17:41:58	Save Signals to Internal Memory	0	Action
12/26/2013 17:41:53	Run Limit Duration	5	Schedule
12/26/2013 17:41:53	Turn Signal Source On	0	Schedule
12/26/2013 17:41:53	Limit Check On	0	Action
12/26/2013 17:41:53	Limit Check Off	0	Action
12/26/2013 17:41:25	Send E-Mail	4115	Action
12/26/2013 17:41:25	Exceed Limit Warning(High)	Block(RMS(Ch1))	Action
12/26/2013 17:41:25	Exceed Limit Warning(High)	Block(Peak(Ch1))	Action
12/26/2013 17:41:23	Run Limit Duration	30	Schedule
12/26/2013 17:41:23	Turn Signal Source Off	0	Schedule

- View the RunLog Events

Run the EDM Cloud from Client Side





- Download data and view data through EDM