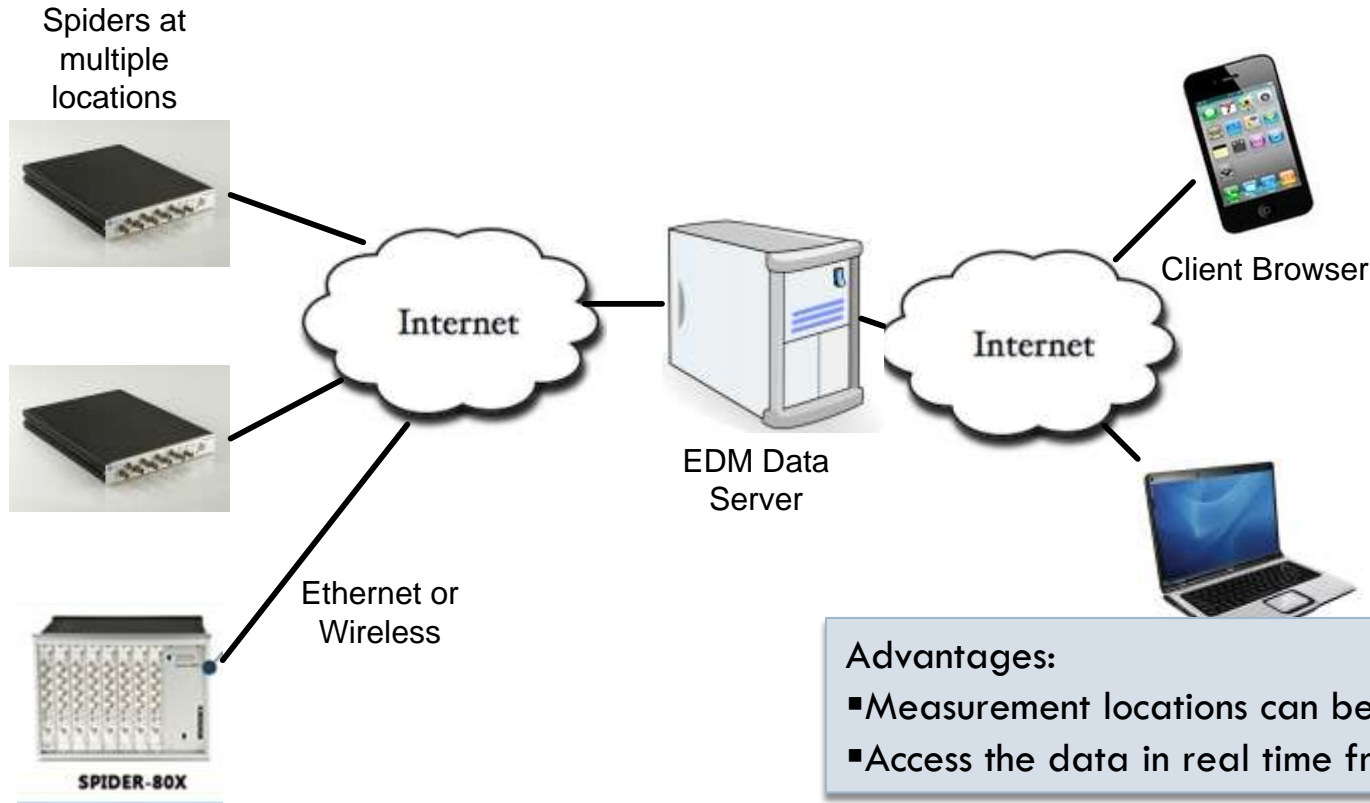


# EDM Cloud

Remote Monitoring Solutions

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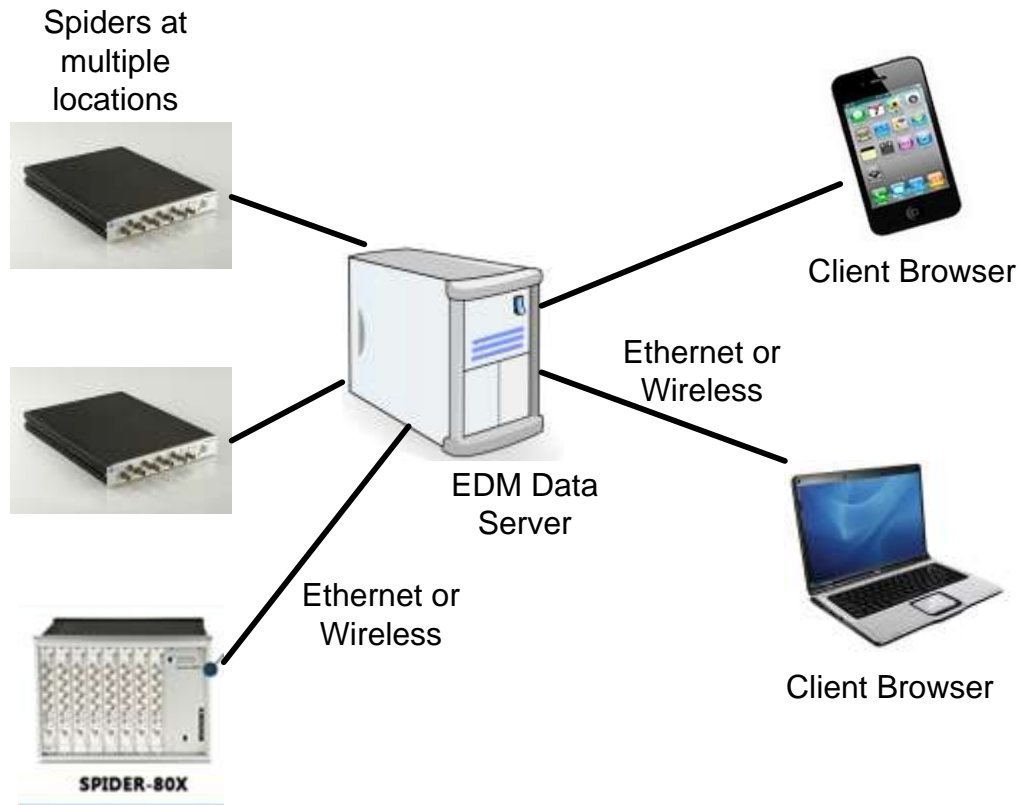
# Architecture 1: EDM Cloud runs on the Internet



## 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

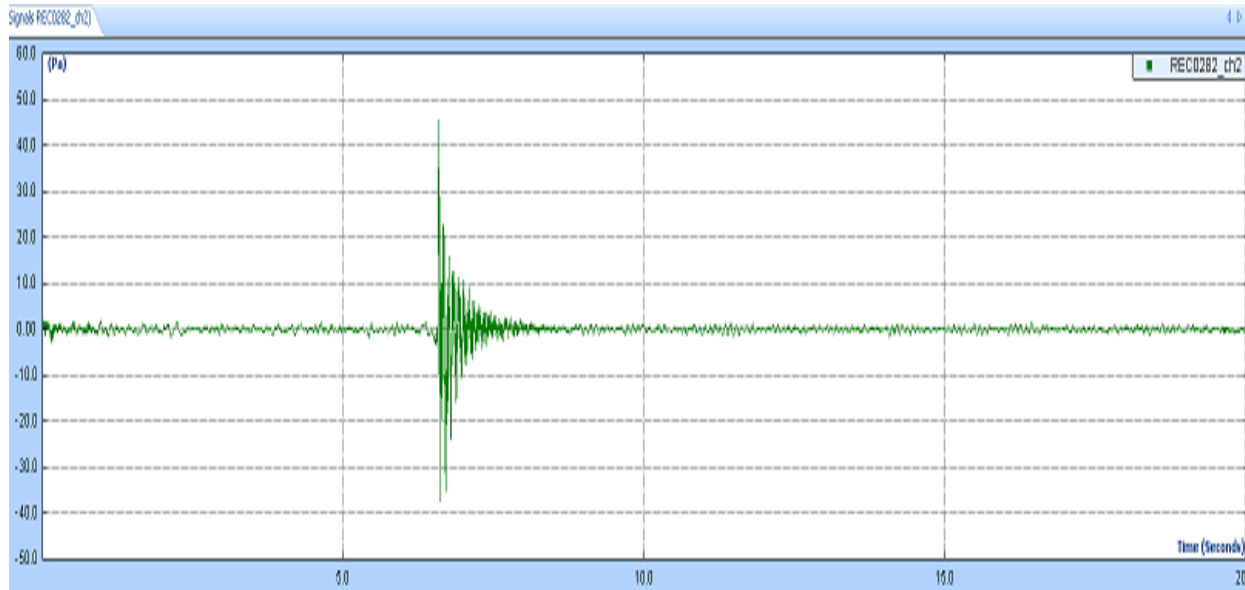


# Spider-DAQ Module

- 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**

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

#### OTHER PUBLICATIONS

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

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.

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

\* cited by examiner

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

*Primary Examiner*—John Barlow

*Assistant Examiner*—Hien Vo

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

(74) *Attorney, Agent, or Firm*—Law Offices of Terry McHugh

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

(57) **ABSTRACT**

# Multi-Level User Administration

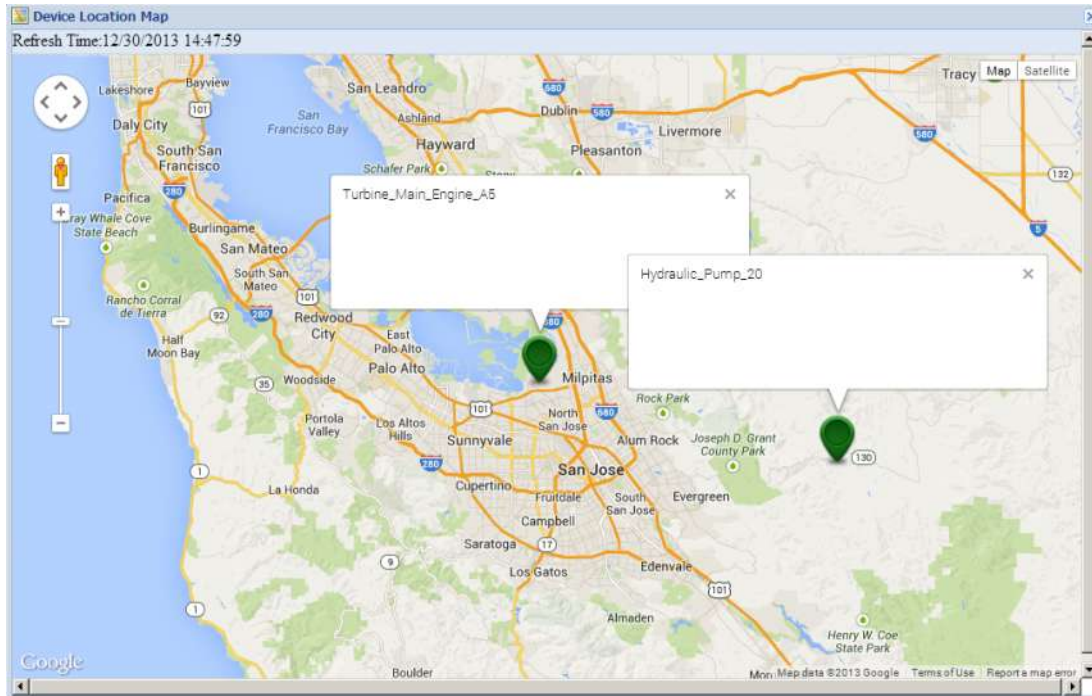
- **Super-Admin**: Has the rights to install, upgrade and configure the server software. Also has the rights of Admin and Users.
- **Admin**: Has the rights to configure the Project, Measurement List, Location of Spiders, Signal List and Runlog. Also has the rights of Users
- **User**: Only has the rights 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.



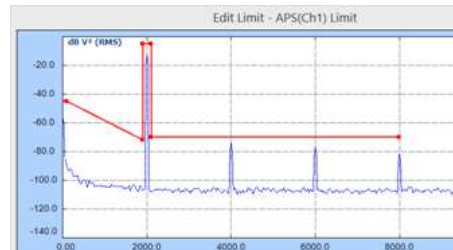
# Data Recording with High Reliability

- 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"



User will receive an alarm email

## Step 3



EDM Cloud Email Service

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

## Step 2

# 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

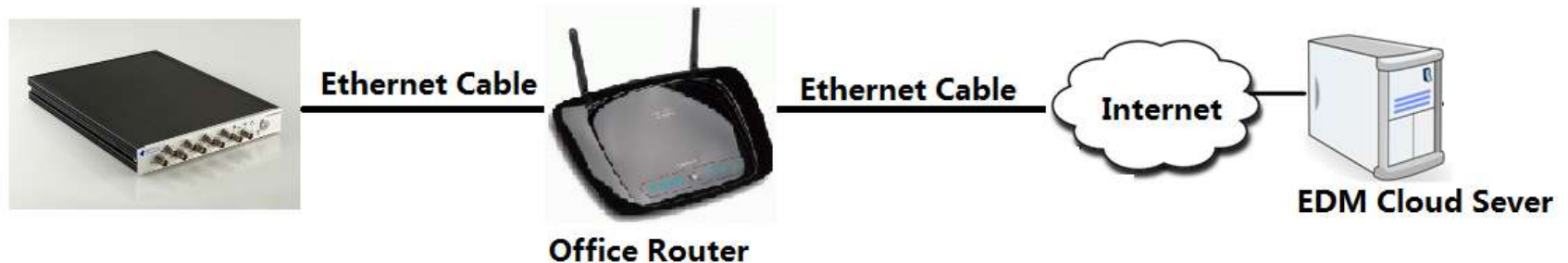


# Step by Step Configuration



# 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

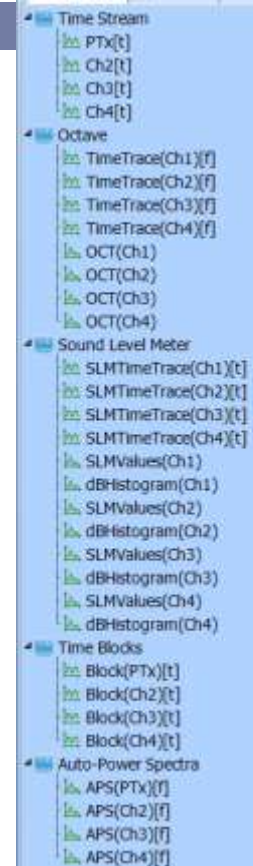
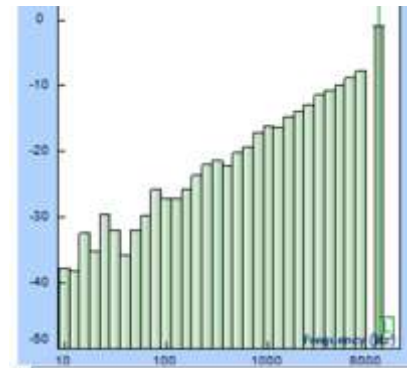
- The Spider devices are connected to the wireless modems
- Wireless modem communicates to the Internet
- Data plan for all major carrier providers are available



# 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

**New Project**

Enter a name for this new project. Check the Spider modules that you would like to include into this project. Click the [OK] button when finished.

Project Name\*: Wind Turbine Monitoring System

Detected modules

- ☒ Turbine\_Main\_Engine\_A5( SN: 2580256)
- ☒ Hydraulic\_Pump\_20( SN: 2583936)

OK Cancel

**Signal Name Setup**

Please enter a unique signal name to identify the physical location that each signal represents (For example "RMS Sensor2" or "Sensor5 Time")

Select a Spider Module

- Detected modules
  - Turbine\_Main\_Engine\_A5(SN: 2580256)
  - Hydraulic\_Pump\_20(SN: 2583936)

Turbine\_Main\_Engine\_A5-signals

Save

Original Signal	Display Name
Ch1	X1_Accel
Ch2	Y1_Accel
Ch3	Z1_Accel
Ch4	Backup_Vel
Ch5	Loc_12_Vel
Ch6	Loc_16_Vel
Ch7	Not in Use
Ch8	Not in Use
Peak(Ch1)	Peak(X1_Accel)
Peak(Ch2)	Peak(Y1_Accel)
Peak(Ch3)	Peak(Z1_Accel)
Peak(Ch4)	Peak(Backup_Vel)
Peak(Ch5)	Peak(Loc_12_Vel)
Peak(Ch6)	Peak(Loc_16_Vel)
Peak(Ch7)	Peak(Ch7)
RMS(Ch1)	RMS(Ch1)
RMS(Ch2)	RMS(Ch2)

Save

Assign the physical location of each Spider device. They will show up on the map. Press the [Save] button when finished. Physical location is defined by Latitude and Longitude, for example, 37.375998 and -121.967824 in Santa Clara, CA.

Spider Device	Latitude	Longitude
Turbine_Main_Engine_A5	37.35	-121.57
Hydraulic_Pump_20	37.34	-121.58

# Email Setup at Cloud Server

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

The screenshot shows a software window titled "Setup for Automatically Sending Emails". At the top, a blue header bar contains the title and a close button. Below the header, a light blue box contains an information icon and text explaining that emails can be set up based on runlog event strings containing a keyword. The main area is divided into two panes. The left pane, titled "Keywords", contains a list of keywords: "Alarm - Limit Exceeded", "High Limit Triggered", and "Low Limit Triggered". Above the list are buttons for "New Rule based on Keyword" (with a green plus icon) and "Delete" (with a red minus icon). The right pane, also titled "Setup for Automatically Sending Emails", contains a "Save" button and an "Email Server Setup" button. Below these are input fields for "Keyword\*", "Send To\*", "Copy To:", "Subject\*", and "Body\*". The "Keyword\*" field contains "Alarm - Limit Exceeded". The "Send To\*" field contains "machine\_monitoring@go-ci.com". The "Copy To:" field contains "john.smith@gmail.com; engineer@company.com". The "Subject\*" field contains "WARNING - LIMIT EXCEEDED !!!". The "Body\*" field contains "The limit at following location was exceeded! Please take actions ASAP!" and "WindTurbine\_5\_Engine\_Well\_A12\_Horizontal\_1".

**Setup for Automatically Sending Emails**

Email can be set up based on the runlog event strings that contain the keyword. When the server receives a runlog event string that contains the keyword that you defined, an email can be automatically sent to a destination.

**Keywords**

New Rule based on Keyword Delete

- Alarm - Limit Exceeded
- High Limit Triggered
- Low Limit Triggered

**Setup for Automatically Sending Emails**

Save Email Server Setup

Keyword\*: Alarm - Limit Exceeded

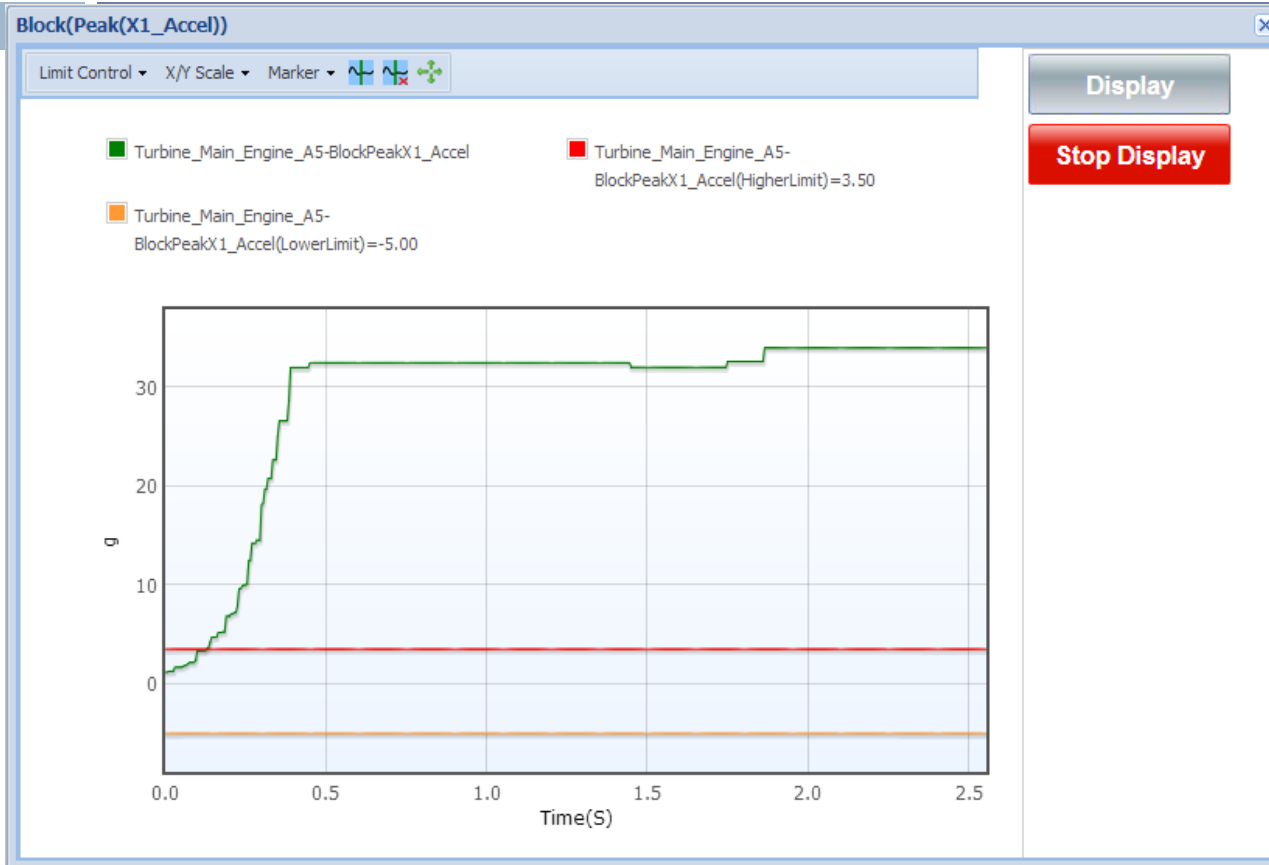
Send To\*: machine\_monitoring@go-ci.com

Copy To: john.smith@gmail.com; engineer@company.com

Subject\*: WARNING - LIMIT EXCEEDED !!!

Body\*: The limit at following location was exceeded! Please take actions ASAP!  
WindTurbine\_5\_Engine\_Well\_A12\_Horizontal\_1

# Run the EDM Cloud from Client Side



- View the measurement signals

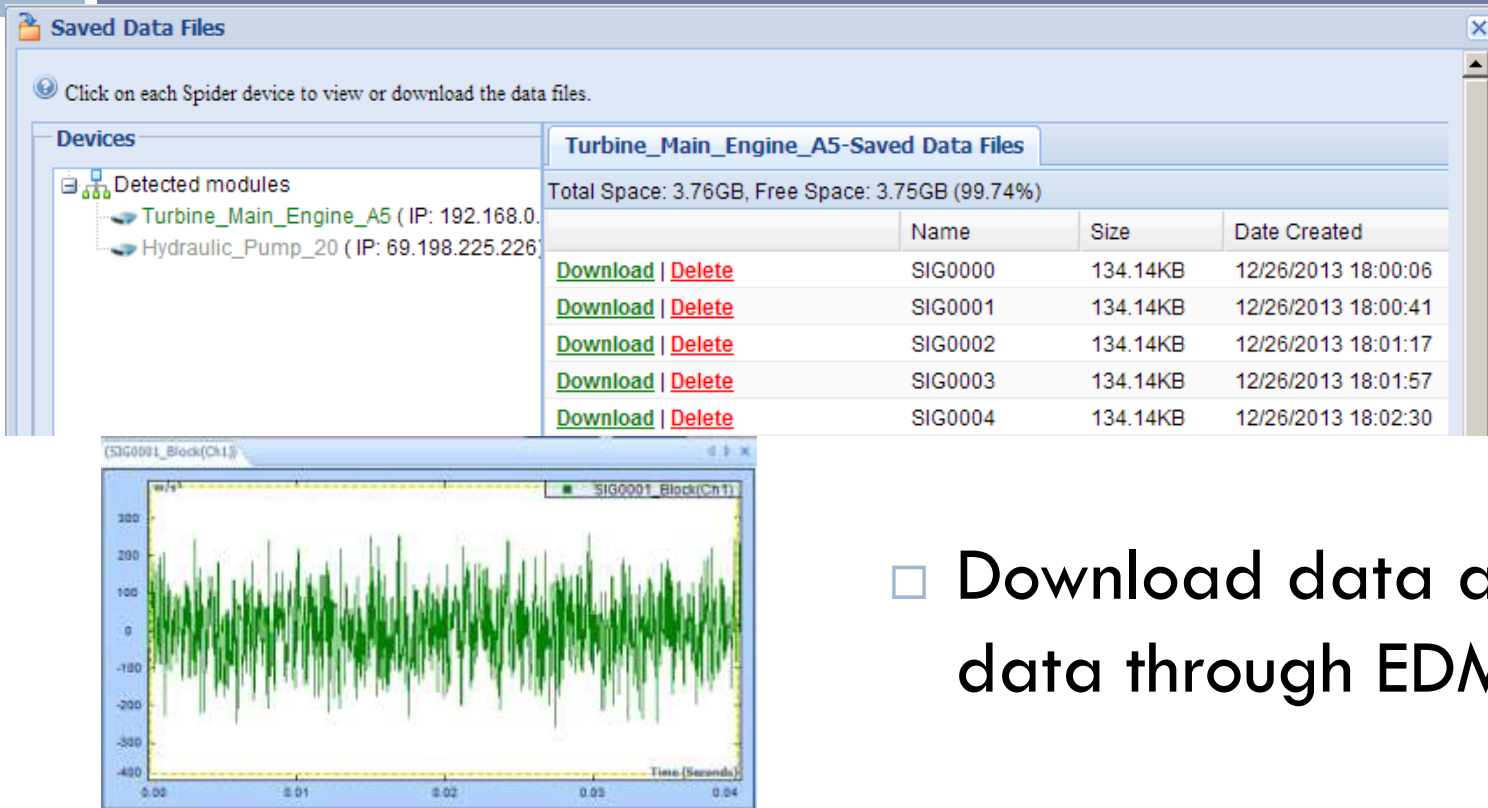
# Run the EDM Cloud from Client Side

Runlog for Each Device

Devices	Turbine_Main_Engine_A5-Runlog																																																																																												
<div>Detected modules</div> <div><div>Turbine_Main_Engine_A5 (IP: 192.168.0.10)</div><div>Hydraulic_Pump_20 (IP: 69.198.225.226)</div></div>	<table><tr><th>Absolute Time</th><th>Event Type</th><th>Event Data</th><th>Event Source</th></tr><tr><td>12/26/2013 17:42:35</td><td>Run Limit Duration</td><td>30</td><td>Schedule</td></tr><tr><td>12/26/2013 17:42:35</td><td>Turn Signal Source Off</td><td>0</td><td>Schedule</td></tr><tr><td>12/26/2013 17:42:34</td><td>Save Signals to Internal Memory</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:42:29</td><td>Run Limit Duration</td><td>5</td><td>Schedule</td></tr><tr><td>12/26/2013 17:42:29</td><td>Turn Signal Source On</td><td>0</td><td>Schedule</td></tr><tr><td>12/26/2013 17:42:29</td><td>Limit Check On</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:42:29</td><td>Limit Check Off</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:42:01</td><td>Send E-Mail</td><td>4115</td><td>Action</td></tr><tr><td>12/26/2013 17:42:01</td><td>Exceed Limit Warning(High)</td><td>Block(RMS(Ch1))</td><td>Action</td></tr><tr><td>12/26/2013 17:42:01</td><td>Exceed Limit Warning(High)</td><td>Block(Peak(Ch1))</td><td>Action</td></tr><tr><td>12/26/2013 17:41:59</td><td>Run Limit Duration</td><td>30</td><td>Schedule</td></tr><tr><td>12/26/2013 17:41:59</td><td>Turn Signal Source Off</td><td>0</td><td>Schedule</td></tr><tr><td>12/26/2013 17:41:58</td><td>Save Signals to Internal Memory</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:41:53</td><td>Run Limit Duration</td><td>5</td><td>Schedule</td></tr><tr><td>12/26/2013 17:41:53</td><td>Turn Signal Source On</td><td>0</td><td>Schedule</td></tr><tr><td>12/26/2013 17:41:53</td><td>Limit Check On</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:41:53</td><td>Limit Check Off</td><td>0</td><td>Action</td></tr><tr><td>12/26/2013 17:41:25</td><td>Send E-Mail</td><td>4115</td><td>Action</td></tr><tr><td>12/26/2013 17:41:25</td><td>Exceed Limit Warning(High)</td><td>Block(RMS(Ch1))</td><td>Action</td></tr><tr><td>12/26/2013 17:41:25</td><td>Exceed Limit Warning(High)</td><td>Block(Peak(Ch1))</td><td>Action</td></tr><tr><td>12/26/2013 17:41:23</td><td>Run Limit Duration</td><td>30</td><td>Schedule</td></tr><tr><td>12/26/2013 17:41:23</td><td>Turn Signal Source Off</td><td>0</td><td>Schedule</td></tr></table>	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
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- View the RunLog Events

# Run the EDM Cloud from Client Side



- Download data and view data through EDM