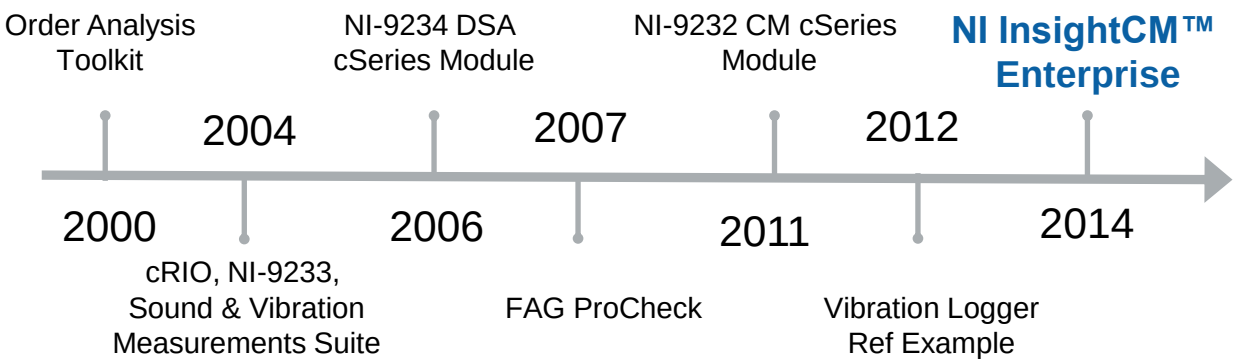
New Enterprise Solution for Condition Monitoring Applications

NI InsightCM™ Enterprise

NATIONAL INSTRUMENTS

NI History of Condition Monitoring



Sound & Vibration Toolkit
– Signal Analysis for Vibration –

Graphic	Signal Characteristic	Analysis Methods	Machine Example
	Narrow frequency band lasting for a long time	Frequency Analysis Fourier Transform Power Spectrum	Unbalance in a single speed machine
	Narrow frequency band with harmonics lasting for a long time	Quefrency Cepstrum	Damaged bearing in a machine with roller element bearings
	Time varying frequency band	Time-frequency analysis Order analysis	Unbalance in a variable speed pump
	Wide frequency band signal lasting for a short time	Wavelet analysis AR Modeling	Low speed machine with compressor valve impacts
	Narrow frequency band signal lasting for a short time	Wavelet Analysis	Electrical motor driven machine with rub and knock noise

Members of / Participants

- MFPT
- Vibration Institute
- IMS Center
- NIRE
- PHM Society
- TurboMachinery Lab
- Awea
- IEEE Reliability

Certified Vibration Analysts on Staff

eZ-TOMAS/ Iotech DSA

300+ Case Studies on ni.com

NI InsightCM™ Enterprise software suite

A deployment software solution with tightly integrated hardware options for online condition monitoring that allows companies to gain insight into the health of rotating machinery for operations and maintenance programs.


Acquire Dynamic & Static Data


Manage Data


Analyze Waveform Data


Configure and Monitor Nodes

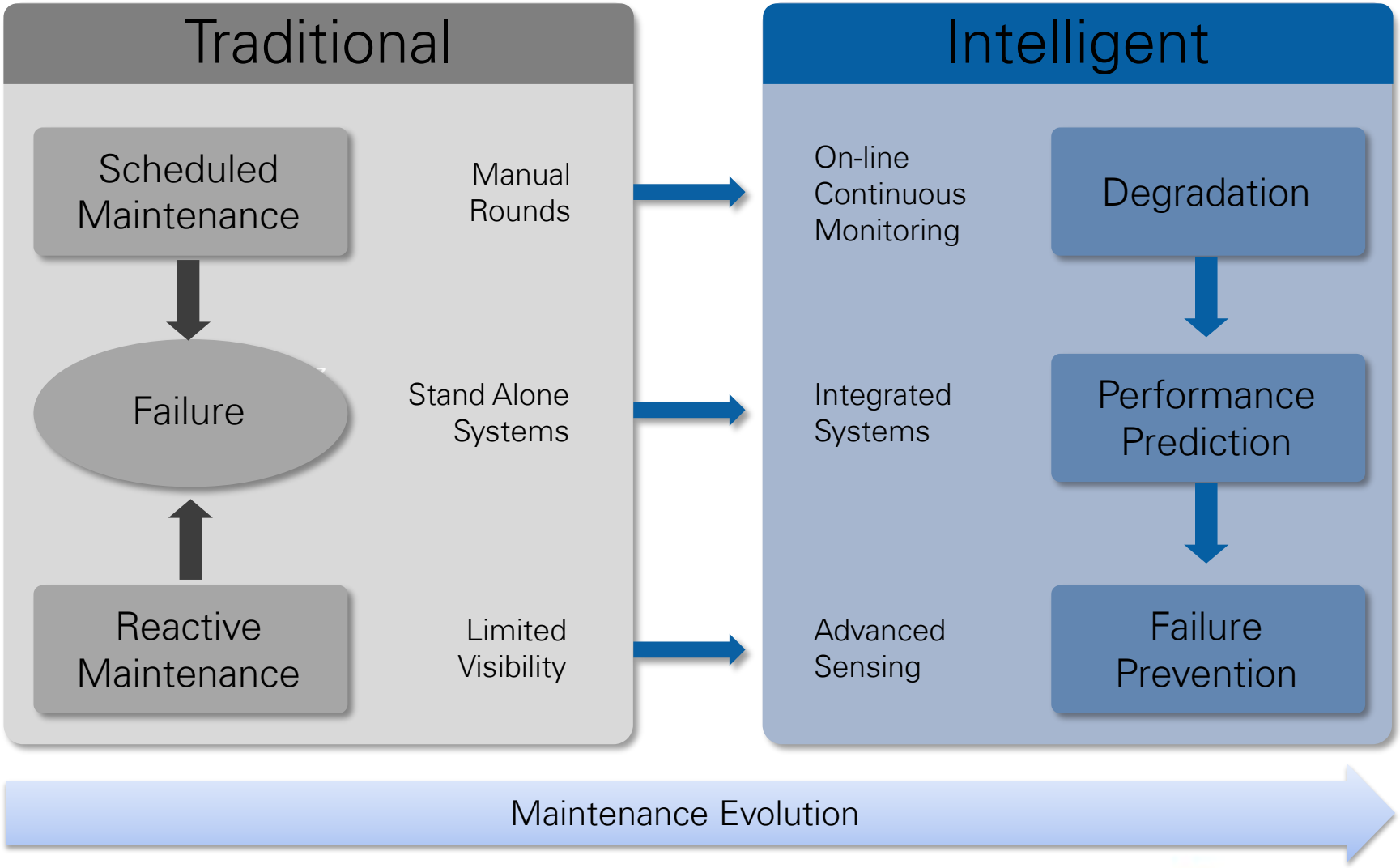

Visualize Raw Data & Results


Authenticate Users & Devices


Generate & Manage Alarms


Integrate with IT Infrastructure

Intelligent Maintenance Systems



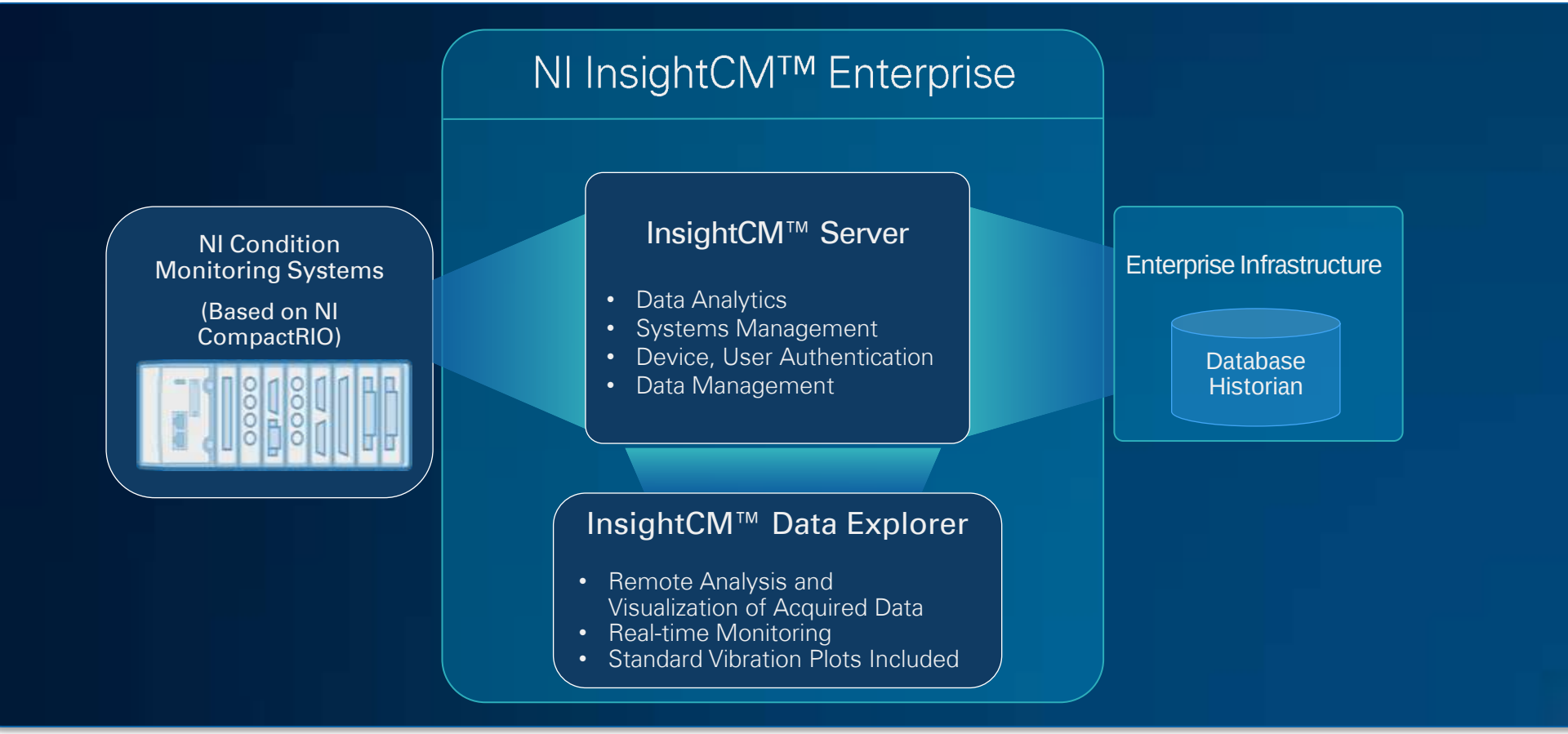
Standard Approach to Machinery Diagnostics

60,000 rounds/month

Traditional Approach

- Labor intensive and inefficient
- Shrinking workforce
- People being sent into hazardous locations

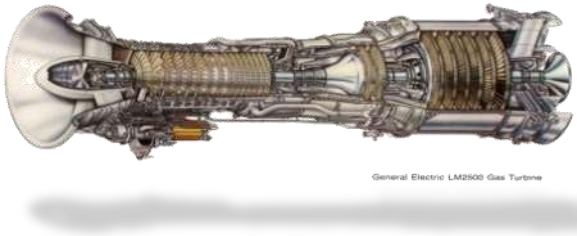
NI Condition Monitoring Solution Architecture



Two Classes of Machinery

Ancillary, Balance of Plant type equipment

High Value, Critical to Business Operations



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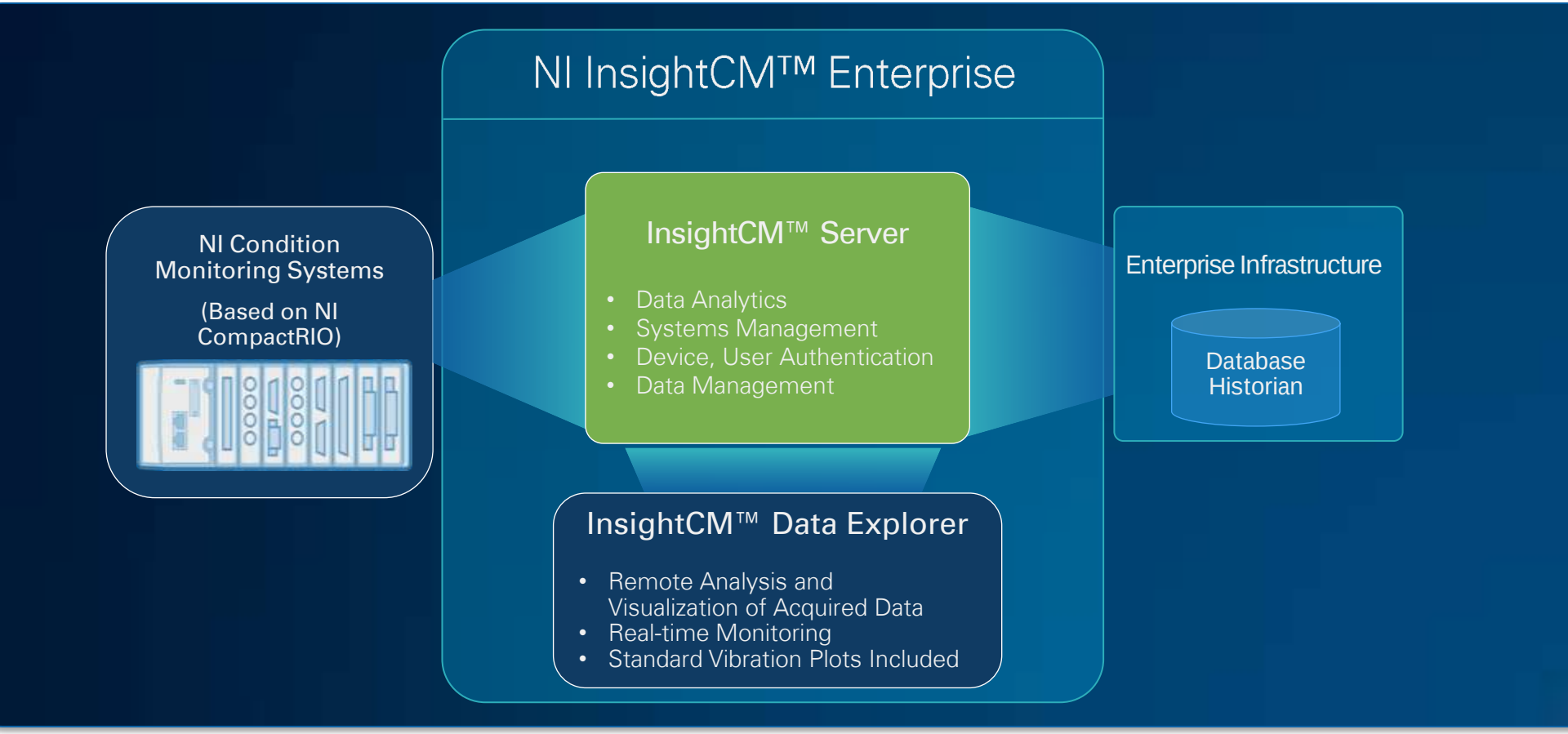
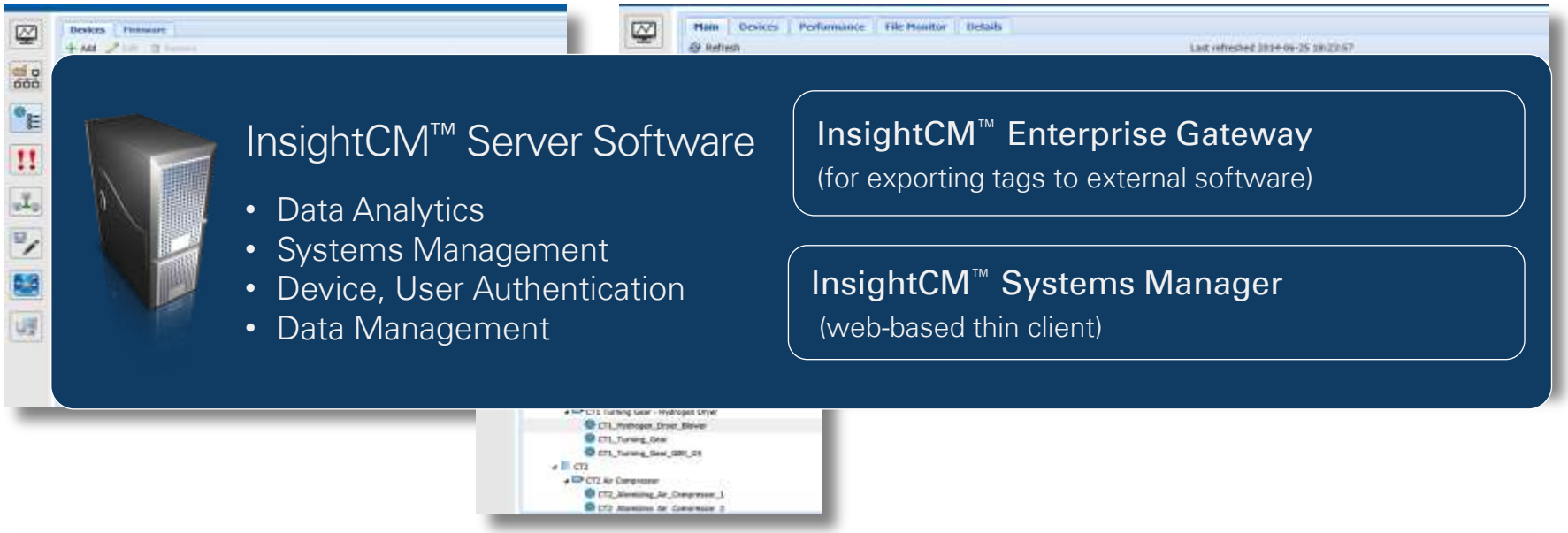
NI Condition Monitoring Solution Architecture



Integrated Enterprise Software

NI InsightCM™ Server



InsightCM™ Server Software

- Data Analytics
- Systems Management
- Device, User Authentication
- Data Management

InsightCM™ Enterprise Gateway
(for exporting tags to external software)

InsightCM™ Systems Manager
(web-based thin client)

Enterprise software runs on Windows-based servers

Systems Management

- System health & status monitoring of CompactRIO systems
- Deployment image management for large system counts
- Device Configuration

Security

- Secure communication
- User and device authentication
- User profile management

Data Analytics

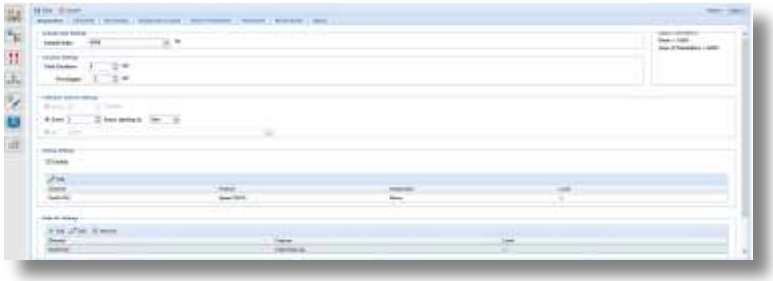
- Vibration-specific data analytics & algorithms

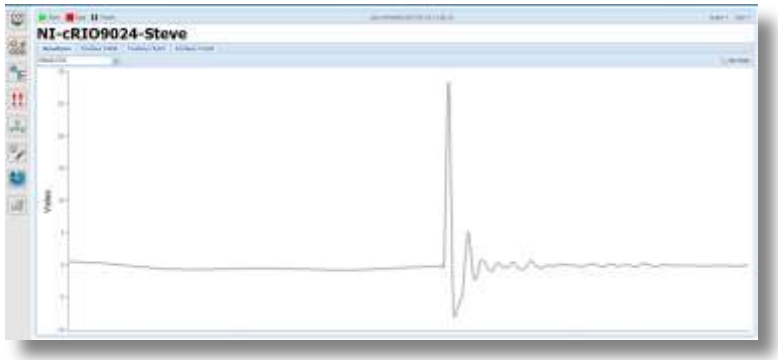
Data Management

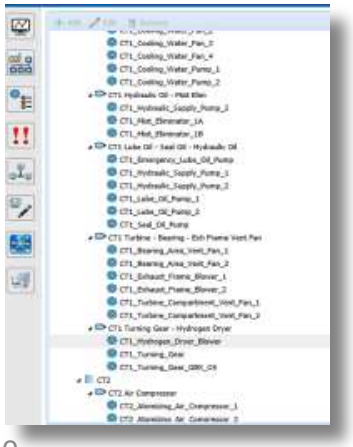
- Alarming
- Integration into 3rd party historians
- Data aging and storage rules

Systems Management Features

- Web Based Acquisition Node Configuration
  - Automatic module discovery
  - Template based configuration
- Web based test panels for commissioning support
- Equipment Layout definition page

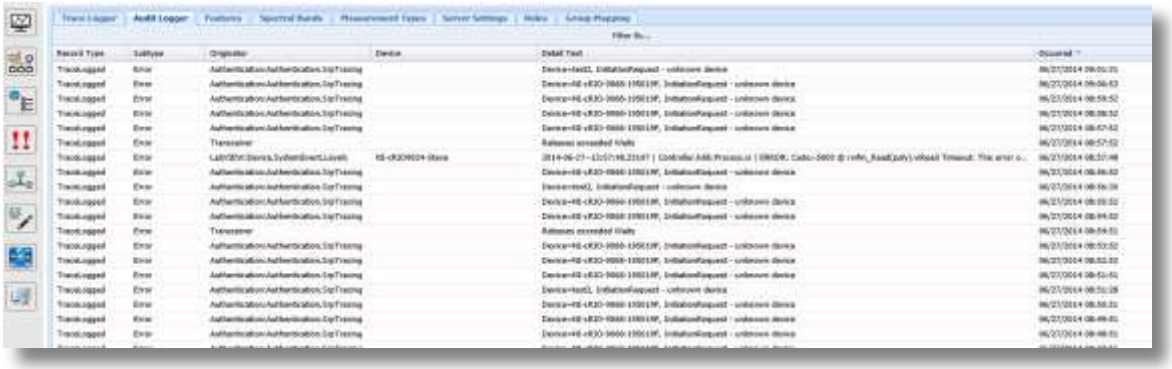


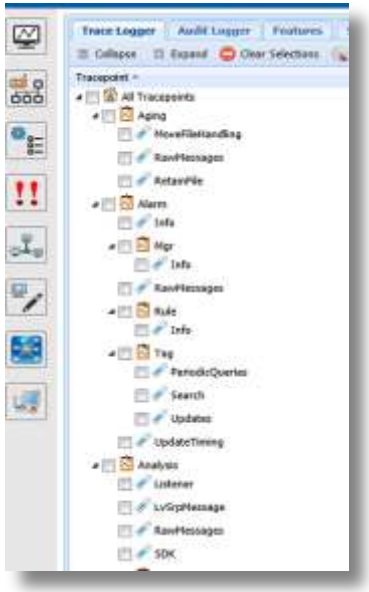




Systems Management Features

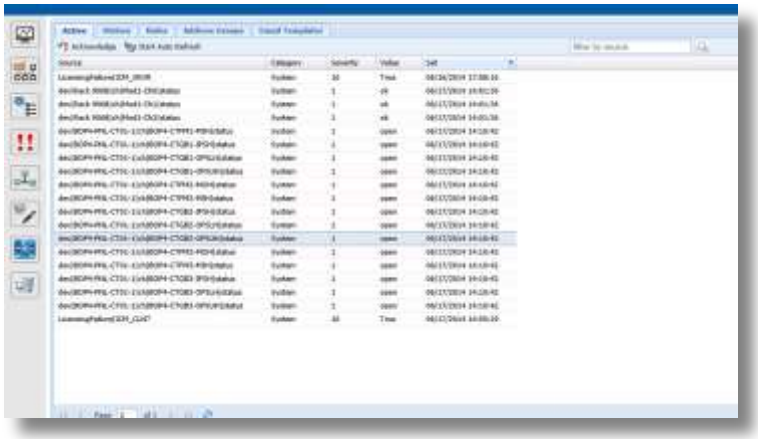
- Remotely update acquisition systems when enhanced capabilities are released
- Configuration management for firmware revisions
- IT system console
  - Logging of errors, messages, tracepoints
  - System configuration
  - Historian management

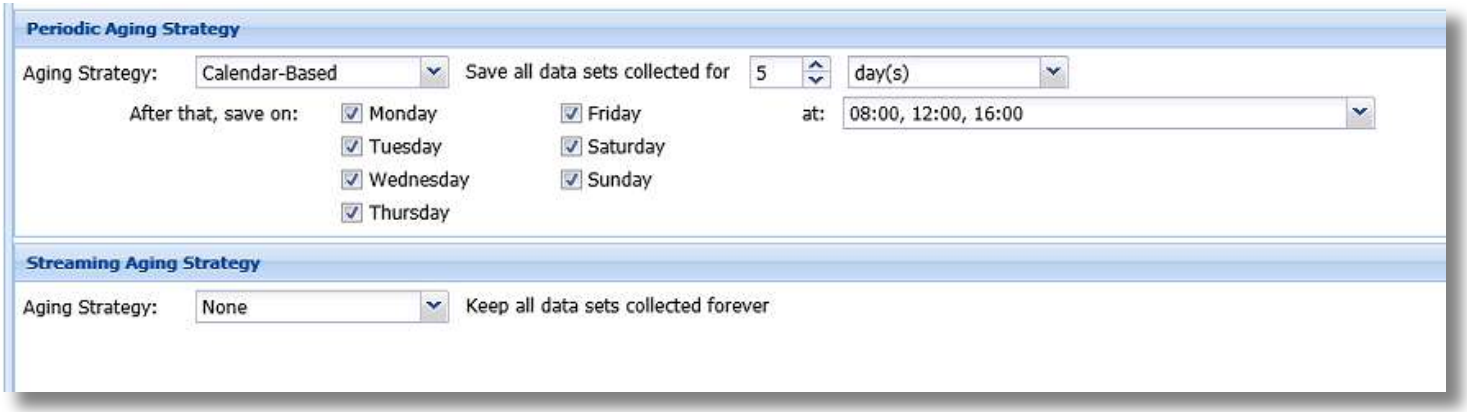




Data Management & Analytics Features

- Alarming Dashboard
- Data Historian Integration
- Aging of data to automatically reduce data





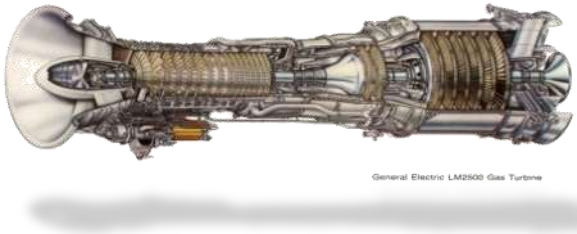
User Security and Authentication

- Uses existing corporate LDAP/Active Directory for authentication and centralized role management
- Built-in roles defined for authorized users
  - Everyone
  - Technician
  - VibAnalyst
  - VibExpert
- Secure Remote Password (SRP) & Credentialing of cRIOs for secure, device connections
- SSL encryption between browser and server

Two Classes of Machinery

Ancillary, Balance of Plant type equipment

High Value, Critical to Business Operations



NATIONAL INSTRUMENTS

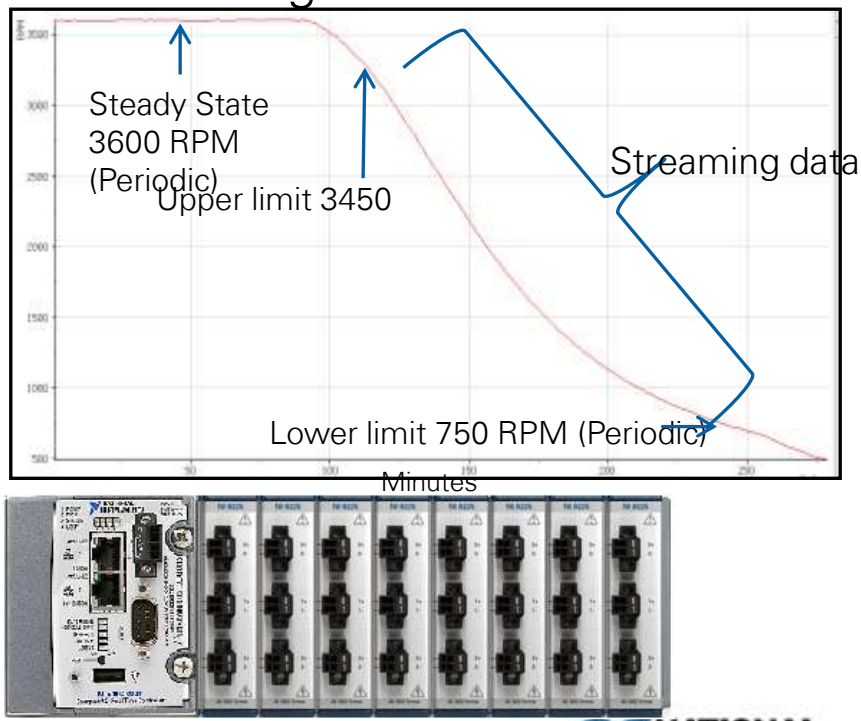
Monitoring Systems Functionality

Periodic & Event Recording

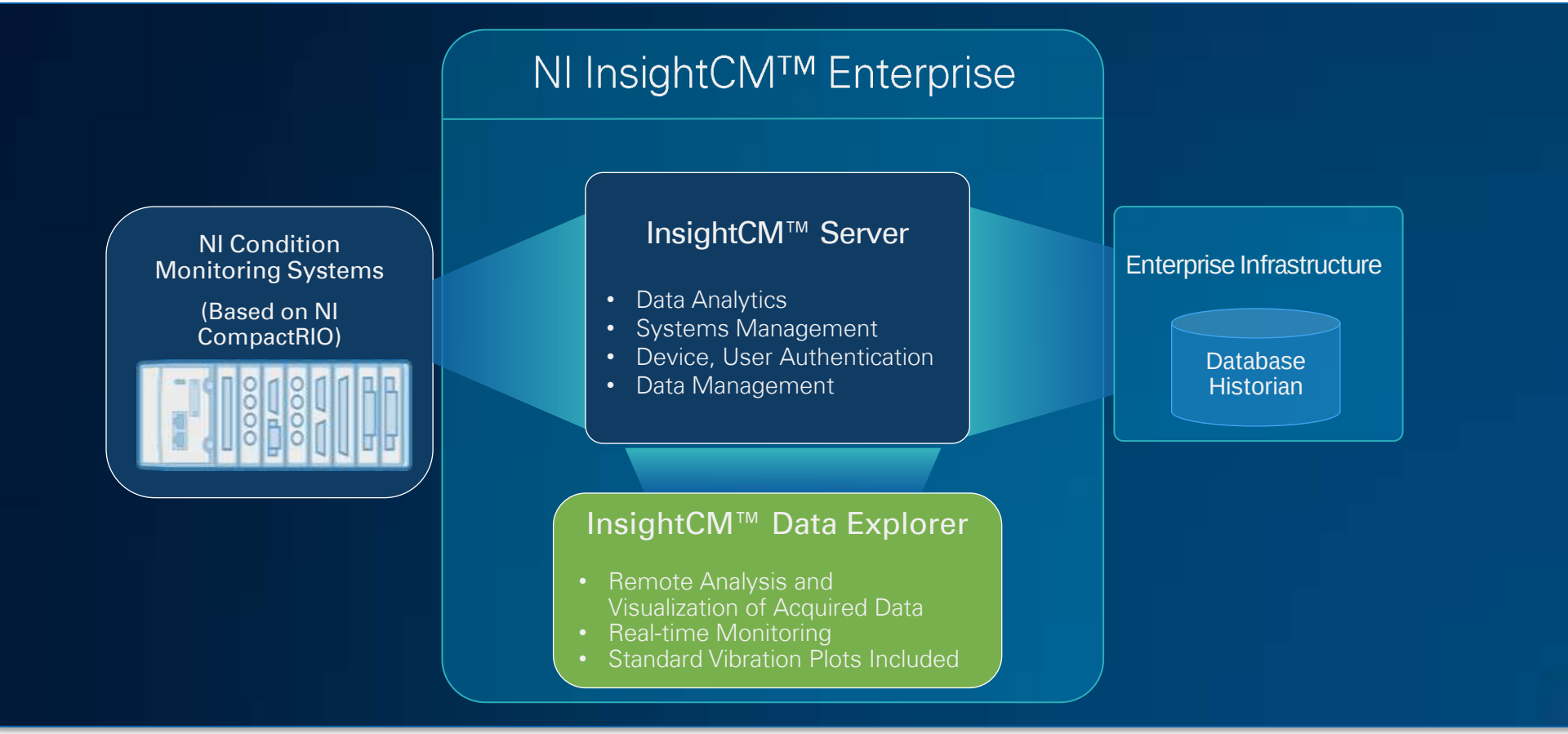
- Continuous monitoring with intelligent logging
- Various Triggering Modes: User Initiated, Time, and Operating conditions
- Gated Acquisition ensures collect data only when machine is in known state
- On board buffering to capture events leading up to event

Transient, Periodic & Event Recording

- Periodic & Event Recording functionality + automatic streaming of data



NI Condition Monitoring Solution Architecture



Gathering conclusions out of your data

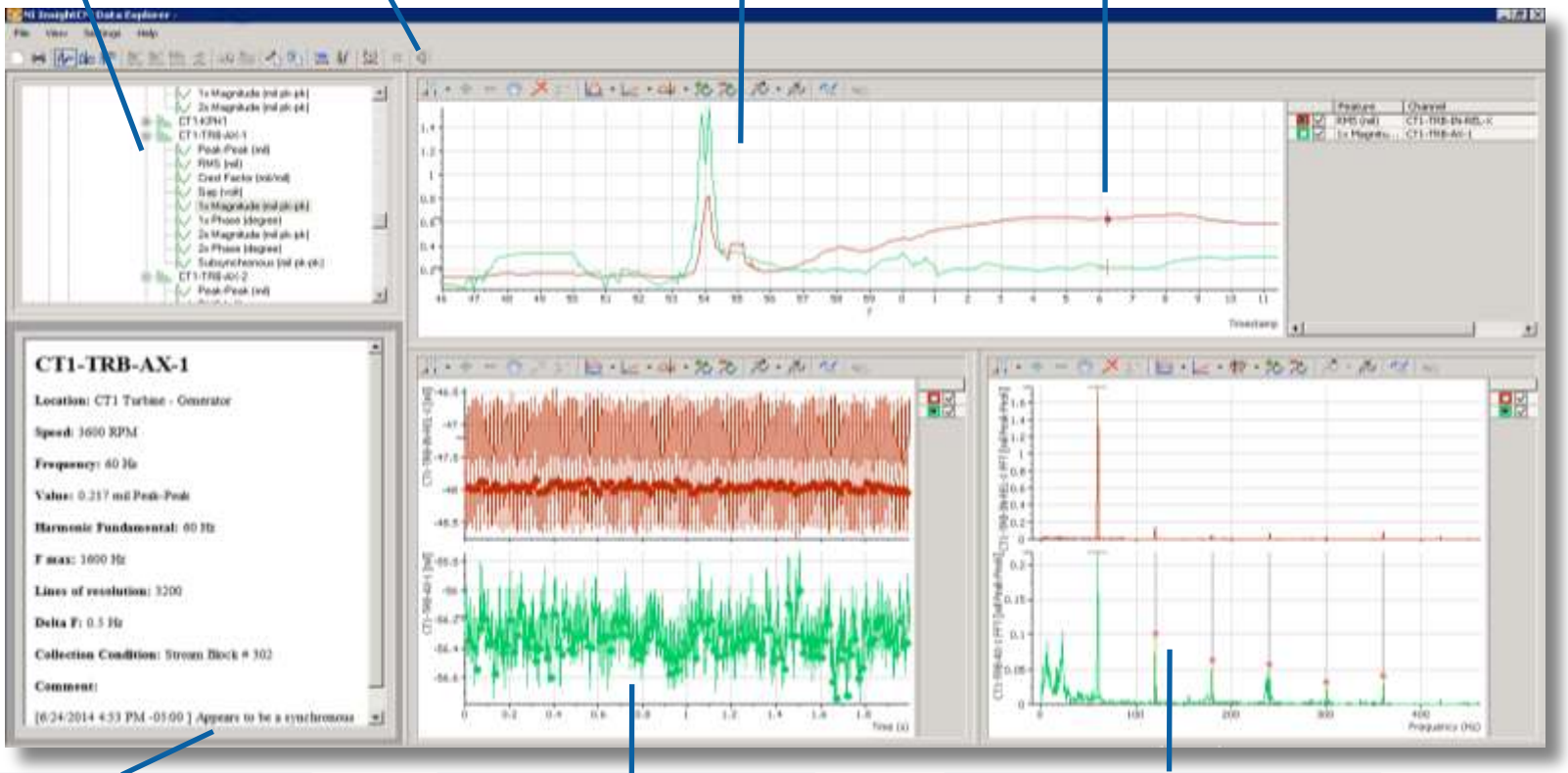
NI InsightCM™ Data Explorer

Site Hierarchy

Hear your data

Feature Trend Viewer

Data Annotations



Detailed Data Description

Time Waveform Viewer

Spectrum View
- Includes Waterfall, Orbit and Full Spectrum Plots
- Harmonic/Sideband Cursors

NATIONAL INSTRUMENTS

Gathering conclusions out of your data

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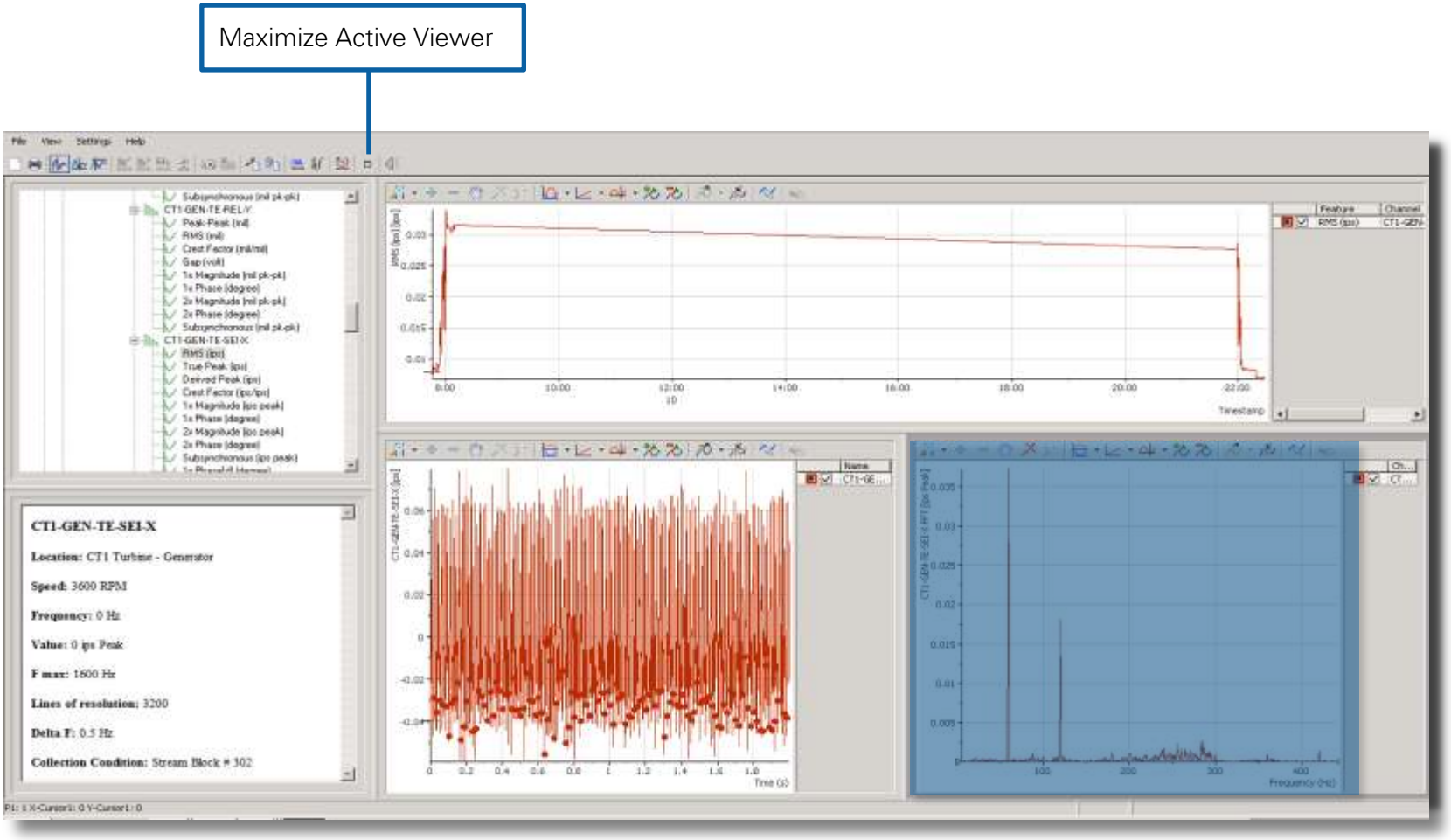
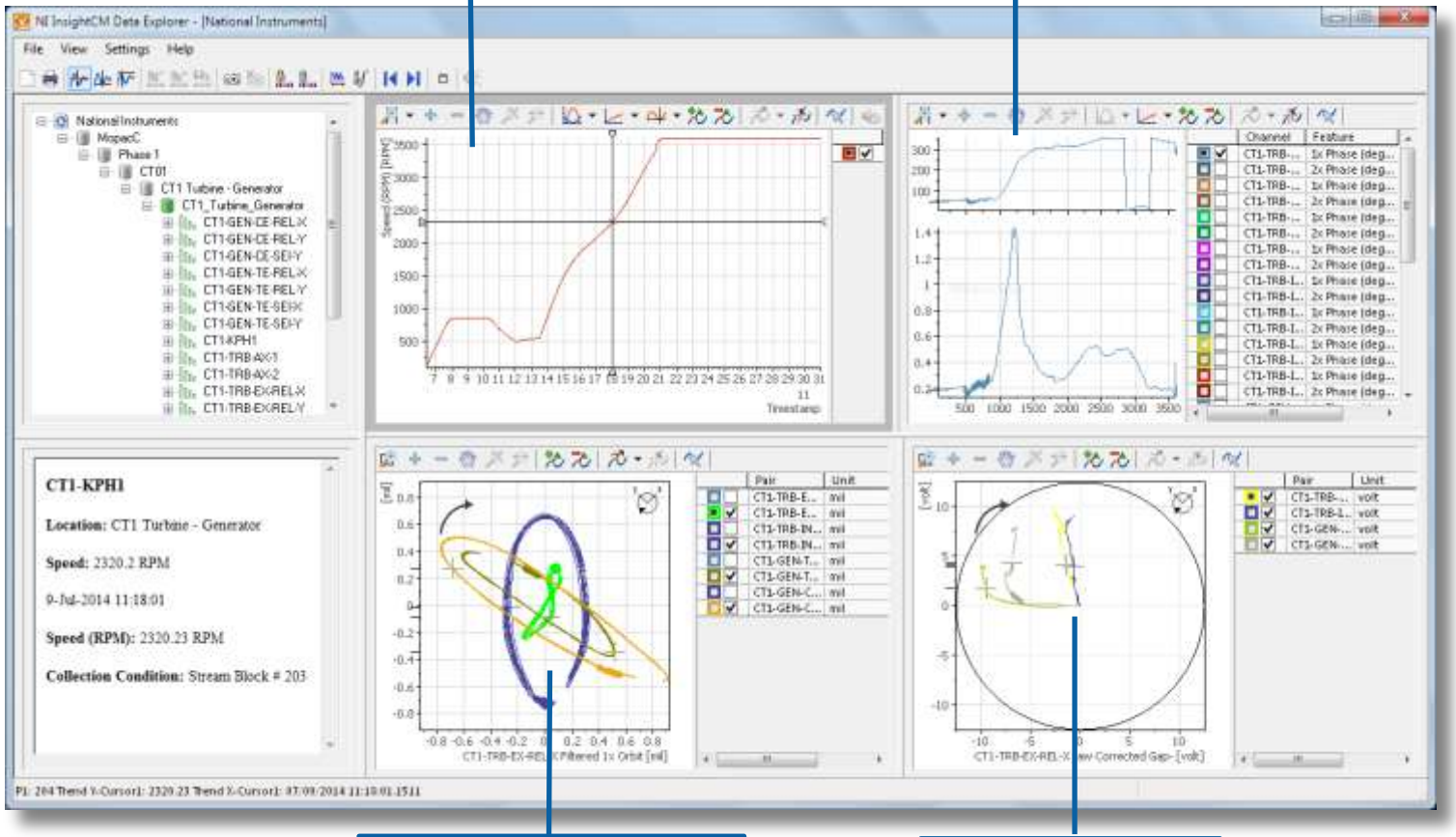


Gathering conclusions out of your data:

NI InsightCM™ Data Explorer

Speed Trend

Bode Plot

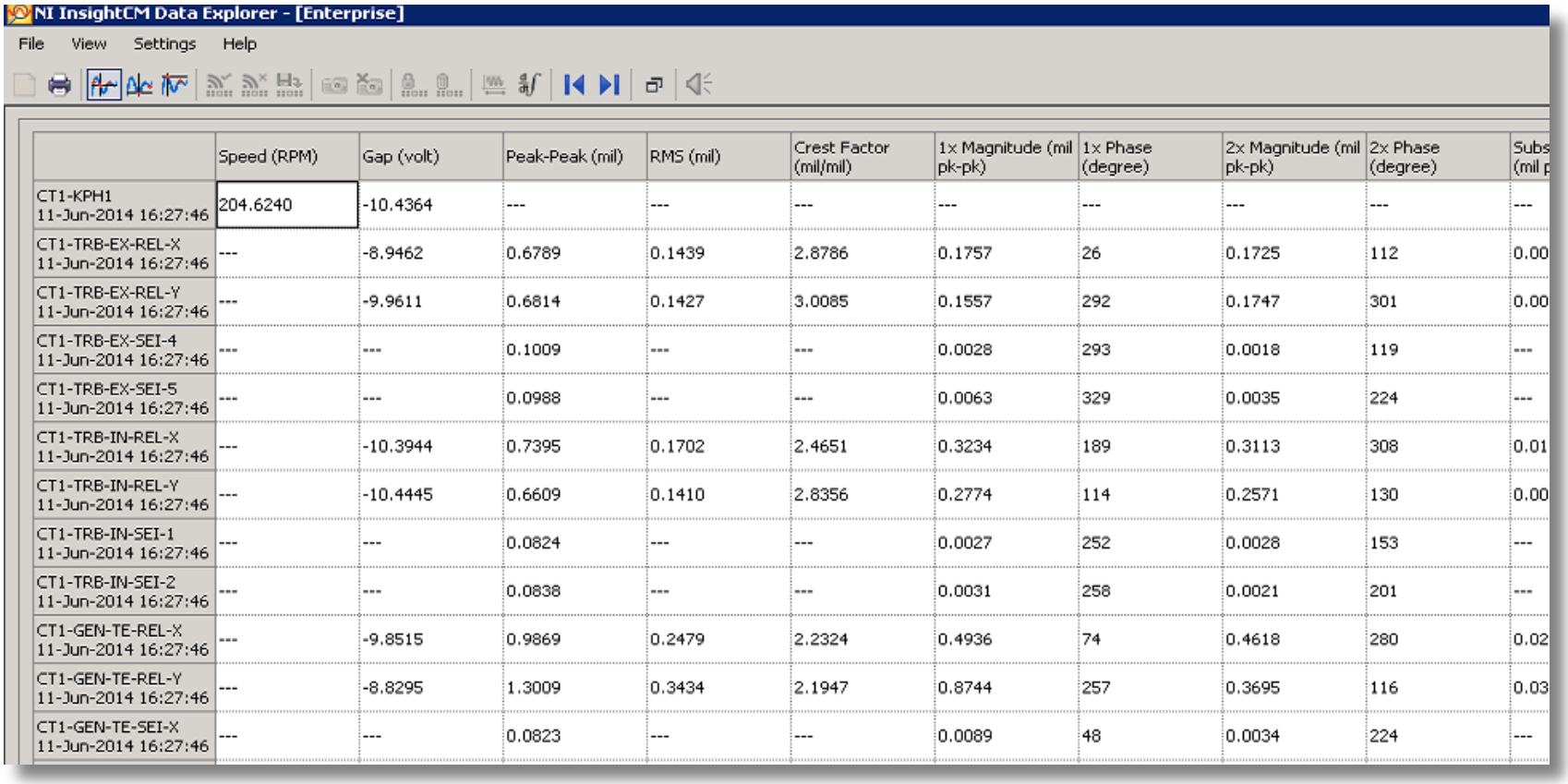


Orbit
- Display Multiple Orbits across multiple planes

Shaft Centerline

Gathering conclusions out of your data

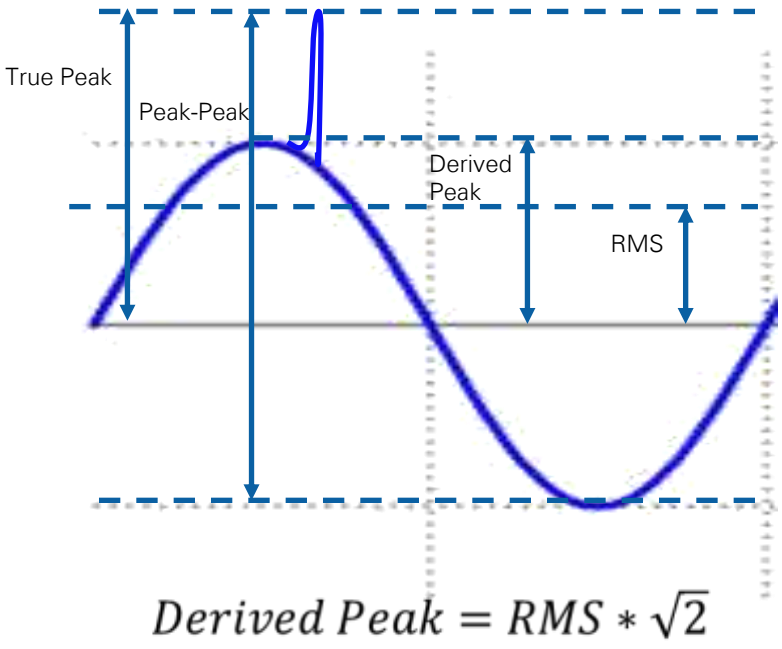
NI InsightCM™ Data Explorer



	Speed (RPM)	Gap (volt)	Peak-Peak (mil)	RMS (mil)	Crest Factor (mil/mil)	1x Magnitude (mil pk-pk)	1x Phase (degree)	2x Magnitude (mil pk-pk)	2x Phase (degree)	Subs (mil p
CT1-KPH1 11-Jun-2014 16:27:46	204.6240	-10.4364	---	---	---	---	---	---	---	---
CT1-TRB-EX-REL-X 11-Jun-2014 16:27:46	---	-8.9462	0.6789	0.1439	2.8786	0.1757	26	0.1725	112	0.00
CT1-TRB-EX-REL-Y 11-Jun-2014 16:27:46	---	-9.9611	0.6814	0.1427	3.0085	0.1557	292	0.1747	301	0.00
CT1-TRB-EX-SEI-4 11-Jun-2014 16:27:46	---	---	0.1009	---	---	0.0028	293	0.0018	119	---
CT1-TRB-EX-SEI-5 11-Jun-2014 16:27:46	---	---	0.0988	---	---	0.0063	329	0.0035	224	---
CT1-TRB-IN-REL-X 11-Jun-2014 16:27:46	---	-10.3944	0.7395	0.1702	2.4651	0.3234	189	0.3113	308	0.01
CT1-TRB-IN-REL-Y 11-Jun-2014 16:27:46	---	-10.4445	0.6609	0.1410	2.8356	0.2774	114	0.2571	130	0.00
CT1-TRB-IN-SEI-1 11-Jun-2014 16:27:46	---	---	0.0824	---	---	0.0027	252	0.0028	153	---
CT1-TRB-IN-SEI-2 11-Jun-2014 16:27:46	---	---	0.0838	---	---	0.0031	258	0.0021	201	---
CT1-GEN-TE-REL-X 11-Jun-2014 16:27:46	---	-9.8515	0.9869	0.2479	2.2324	0.4936	74	0.4618	280	0.02
CT1-GEN-TE-REL-Y 11-Jun-2014 16:27:46	---	-8.8295	1.3009	0.3434	2.1947	0.8744	257	0.3695	116	0.03
CT1-GEN-TE-SEI-X 11-Jun-2014 16:27:46	---	---	0.0823	---	---	0.0089	48	0.0034	224	---

Analysis Features

- RMS, Peak-Peak, True Peak, Derived Peak,
- DC Gap, Crest Factor
- Spectral Bands
  - 1x Mag/Phase
  - 2x Mag/Phase
  - High Frequency (1kHz→Fmax)
  - Subsynchronous (.2→.8 Orders)
  - Custom: Good for defining bearing fault frequencies (BPFO, BPFI, etc.)
- Integration/Differentiation
- English and Metric unit support



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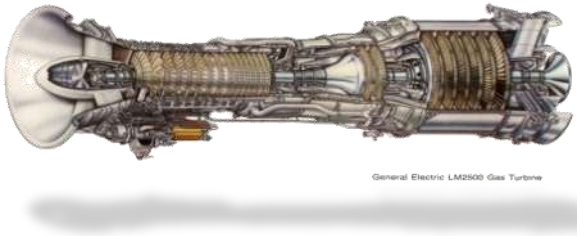

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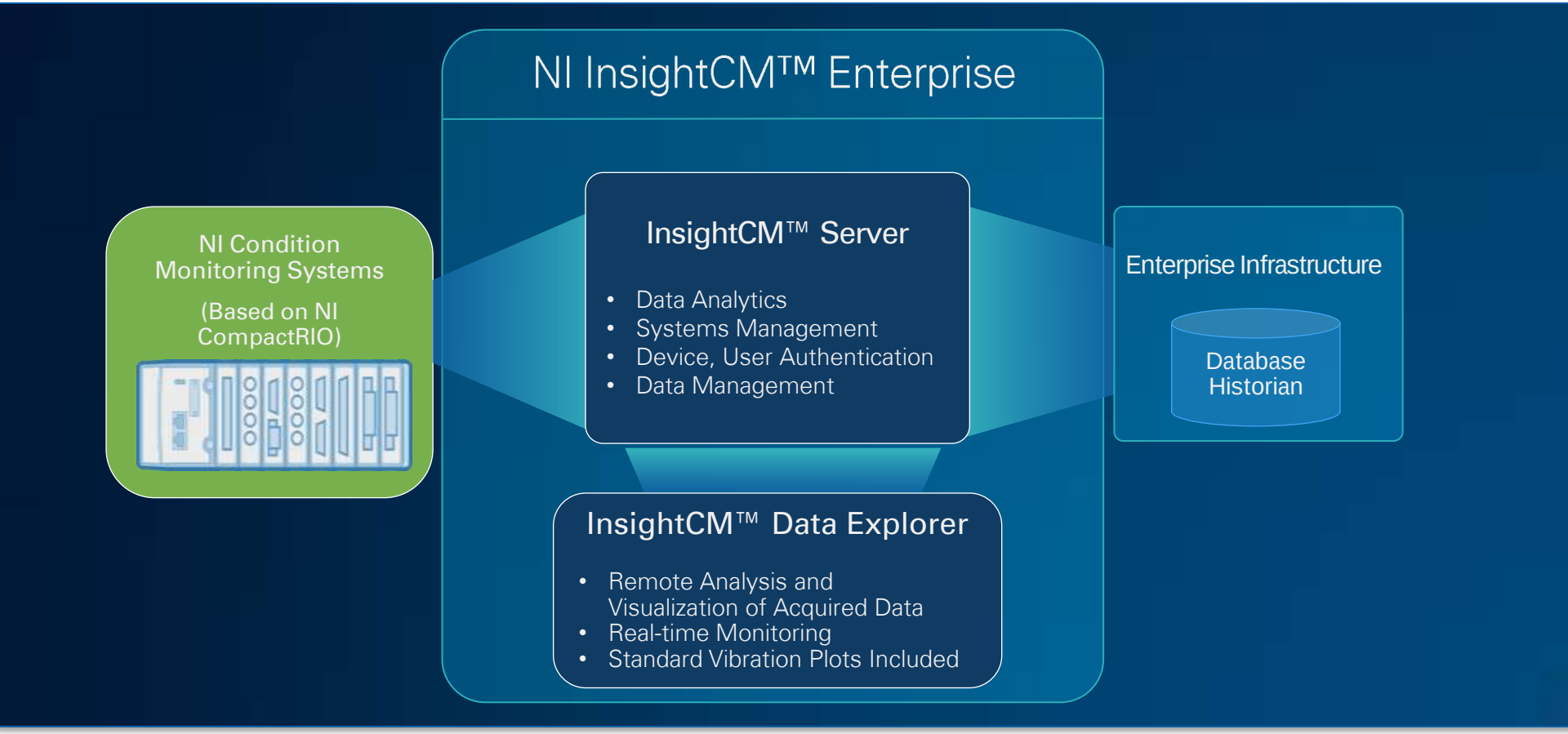


Periodic & Event Recording CompactRIO Systems

Numerous Configuration Options

Dynamic Modules	Static Modules
Up to 8 (24 Channels)	---
Up to 6 (18 Channels)	1 or 2
Up to 2 (6 Channels)	Up to 6
---	Up to 8

- Based on NI cRIO-9068
- Accounts for 75-80% of equipment types
- Cost Effective Enterprise Deployments

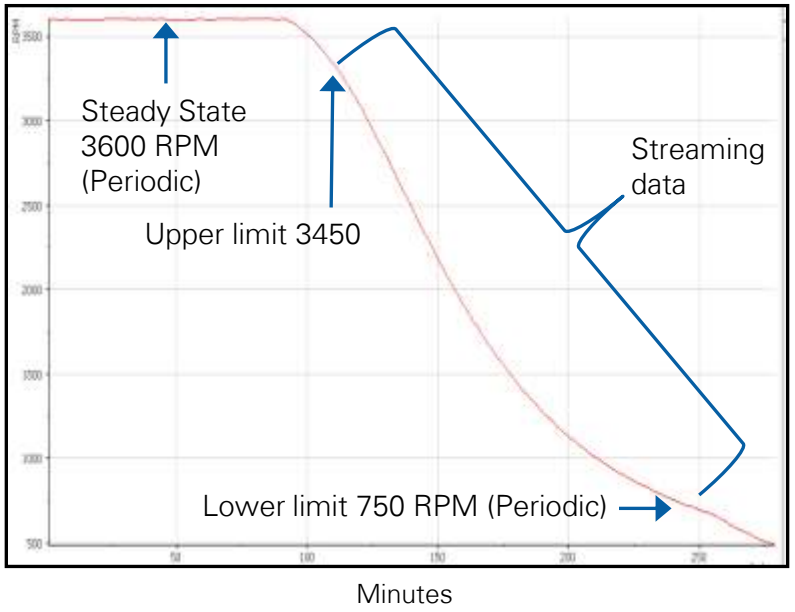
Variety of Sensor Types

Dynamic Acceleration, Velocity, Proximity, & Voltage Waveform Module	
9232	3 Channel DSA +/-30V
Static Voltage	
9205	16 Channel diff inputs
9207	8V / 8 Current
9229	4 Channel AI +/- 60V
9239	4 Channel AI +/- 10V
Current	
9207	8V / 8 Current
9208	16 channel 4-2-mA
Temperature	
9211	4 Channel Thermocouple
9213	16 Channel Thermocouple
9214	16 Channel high accuracy Thermocouple
9217	4 Channel RTD
Digital Input	
9425	32 Channel sinking DI
9426	32 Channel sourcing DI
Miscellaneous	
9219	Universal support for (V, mA, Ω, Open Contact, DI, Thermo, RTD)

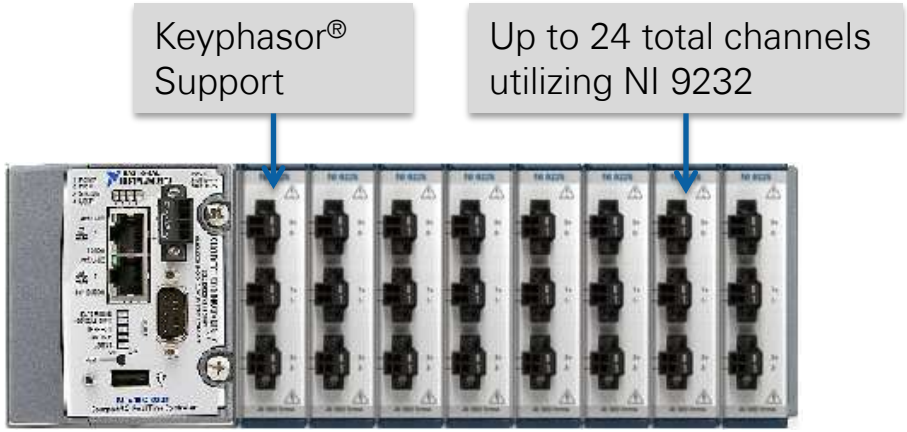
Pump Example

Transient, Periodic & Event Recording CompactRIO Systems

- Periodic & Event Recording System + Transient Capabilities
- Support for accelerometers, velocity, and proximity probe (including up to 3 Keyphasor®) sensors
- Can utilize Buffered Outputs from common protection systems
- Larger on-board hard-drive for locally storing transient/streaming events



Model	Description
NI cRIO-9024	• Real-time multi-order calculations/channel • 800 Mhz processor • Store multiple transients • 4Gb on board storage



Transient, Periodic & Event Recording CompactRIO Systems

DIN Rail Mounting Option

Rack Mount Option

Conclusion

- NI now offering a more complete CM Solution
  - NI InsightCM™ Server
  - NI InsightCM™ Data Explorer
- System supports all types of rotating machinery
  - Periodic & Event recording system
  - Transient, Periodic & Event recording system
- System designed to be open, flexible, and cost effective for plant wide deployments