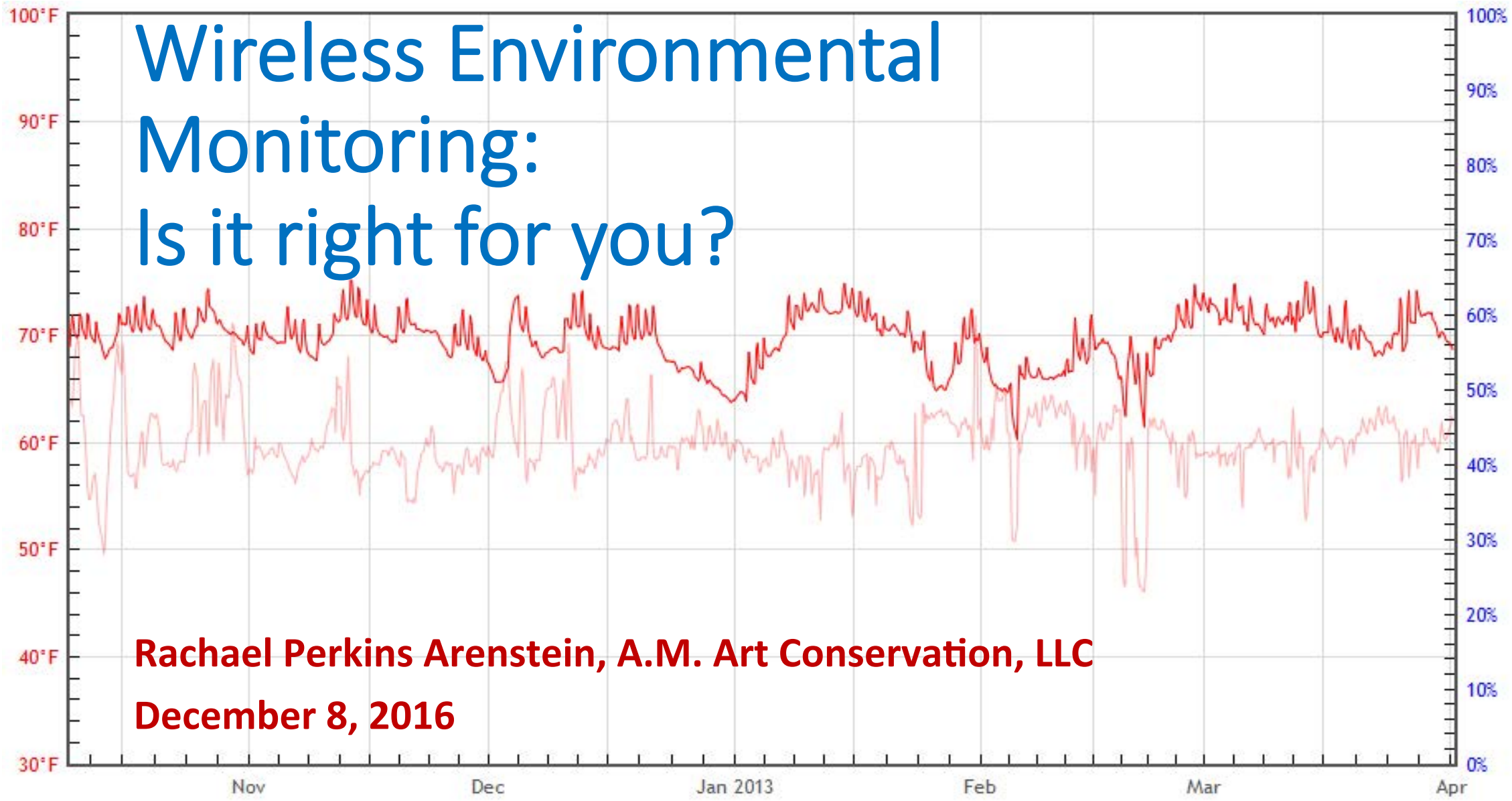
Wireless Environmental Monitoring: Is it right for you?

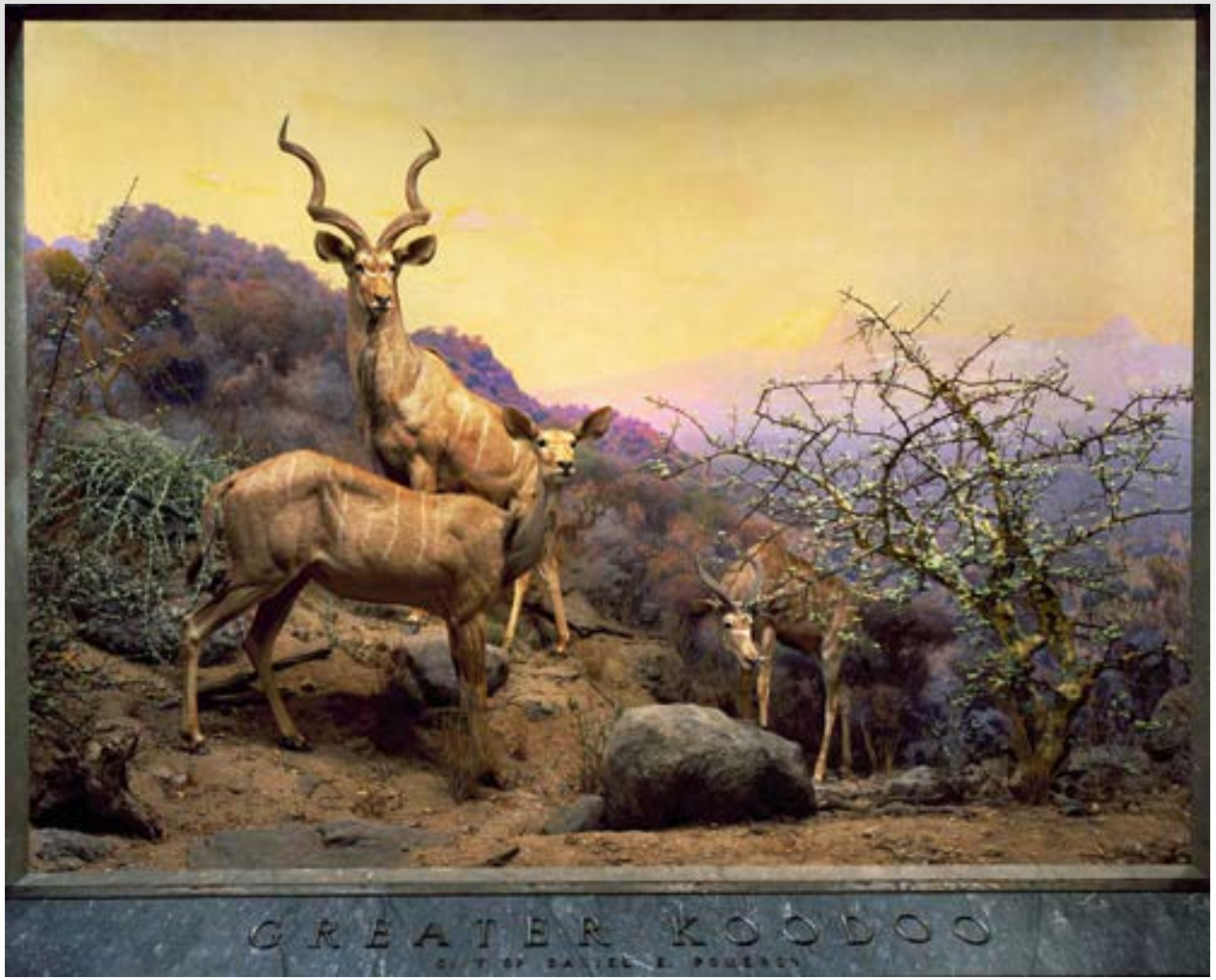


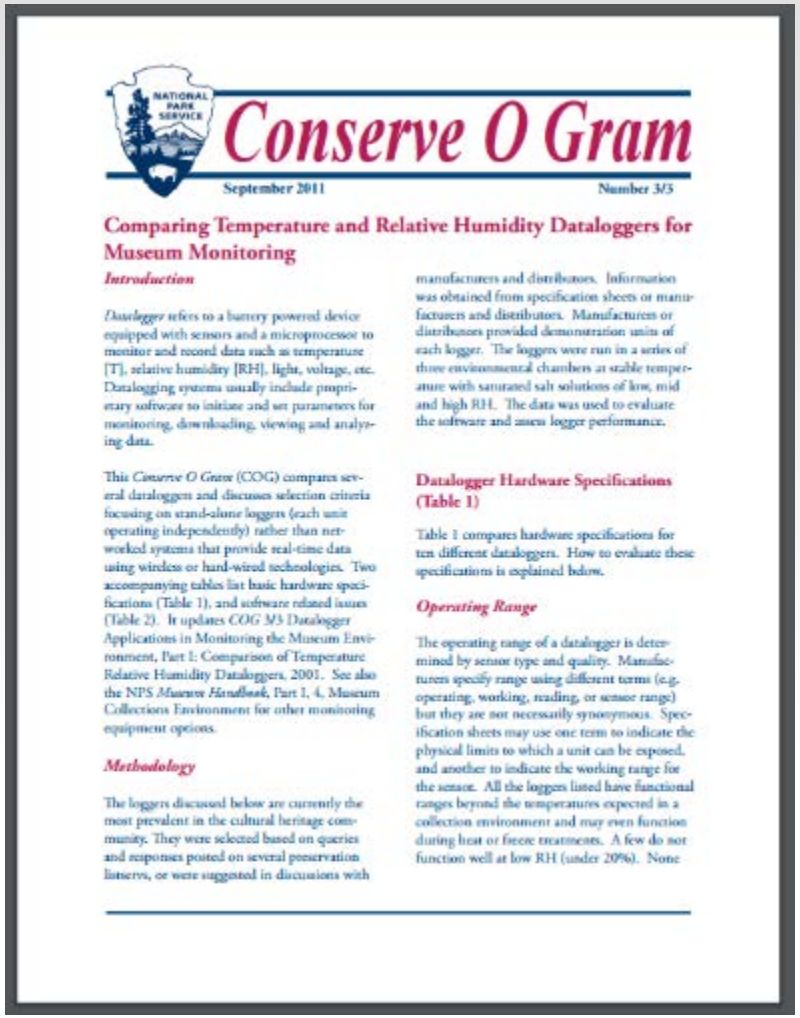
Rachael Perkins Arenstein, A.M. Art Conservation, LLC

December 8, 2016

Connecting to Collections Care Online Community

Introduction





NATIONAL PARK SERVICE

Conserve O Gram

September 2011 Number 3/3

Comparing Temperature and Relative Humidity Dataloggers for Museum Monitoring

Introduction

Datalogger refers to a battery powered device equipped with sensors and a microprocessor to monitor and record data such as temperature [T], relative humidity [RH], light, voltage, etc. Datalogging systems usually include proprietary software to initiate and set parameters for monitoring, downloading, viewing and analyzing data.

This *Conserve O Gram* (COG) compares several dataloggers and discusses selection criteria focusing on stand-alone loggers (each unit operating independently) rather than networked systems that provide real-time data using wireless or hard-wired technologies. Two accompanying tables list basic hardware specifications (Table 1), and software related issues (Table 2). It updates *COG 3/3* Datalogger Applications in Monitoring the Museum Environment, Part I: Comparison of Temperature Relative Humidity Dataloggers, 2001. See also the NPS *Museum Handbook*, Part I, 4, Museum Collections Environment for other monitoring equipment options.

Methodology

The loggers discussed below are currently the most prevalent in the cultural heritage community. They were selected based on queries and responses posted on several preservation listservs, or were suggested in discussions with manufacturers and distributors. Information was obtained from specification sheets or manufacturers and distributors. Manufacturers or distributors provided demonstration units of each logger. The loggers were run in a series of three environmental chambers at stable temperature with saturated salt solutions of low, mid and high RH. The data was used to evaluate the software and assess logger performance.

Datalogger Hardware Specifications (Table 1)

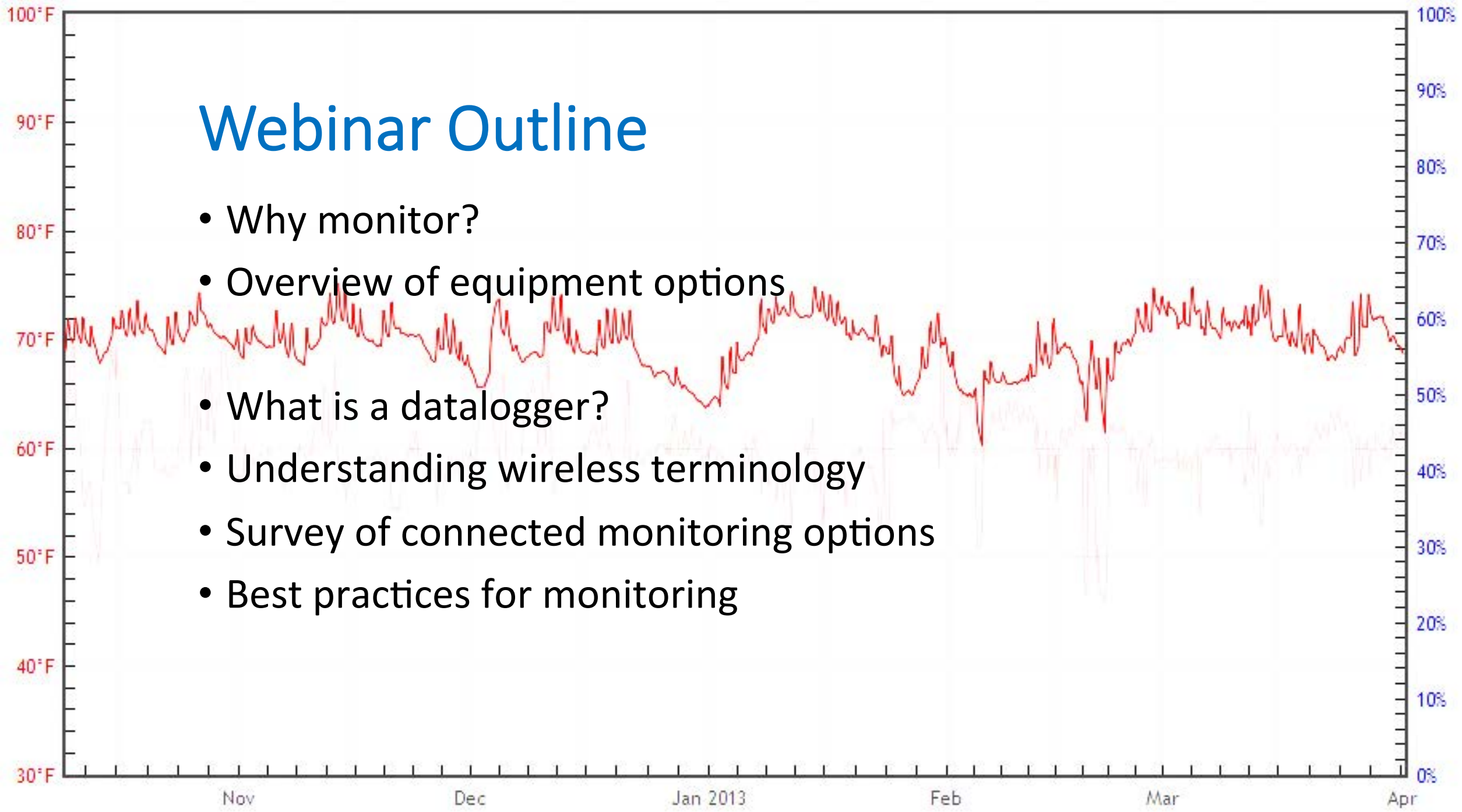
Table 1 compares hardware specifications for ten different dataloggers. How to evaluate these specifications is explained below.

Operating Range

The operating range of a datalogger is determined by sensor type and quality. Manufacturers specify range using different terms (e.g. operating, working, reading, or sensor range) but they are not necessarily synonymous. Specification sheets may use one term to indicate the physical limits to which a unit can be exposed, and another to indicate the working range for the sensor. All the loggers listed have functional ranges beyond the temperatures expected in a collection environment and may even function during heat or freeze treatments. A few do not function well at low RH (under 20%). None

Webinar Outline

- Why monitor?
- Overview of equipment options
- What is a datalogger?
- Understanding wireless terminology
- Survey of connected monitoring options
- Best practices for monitoring



Why Monitor?

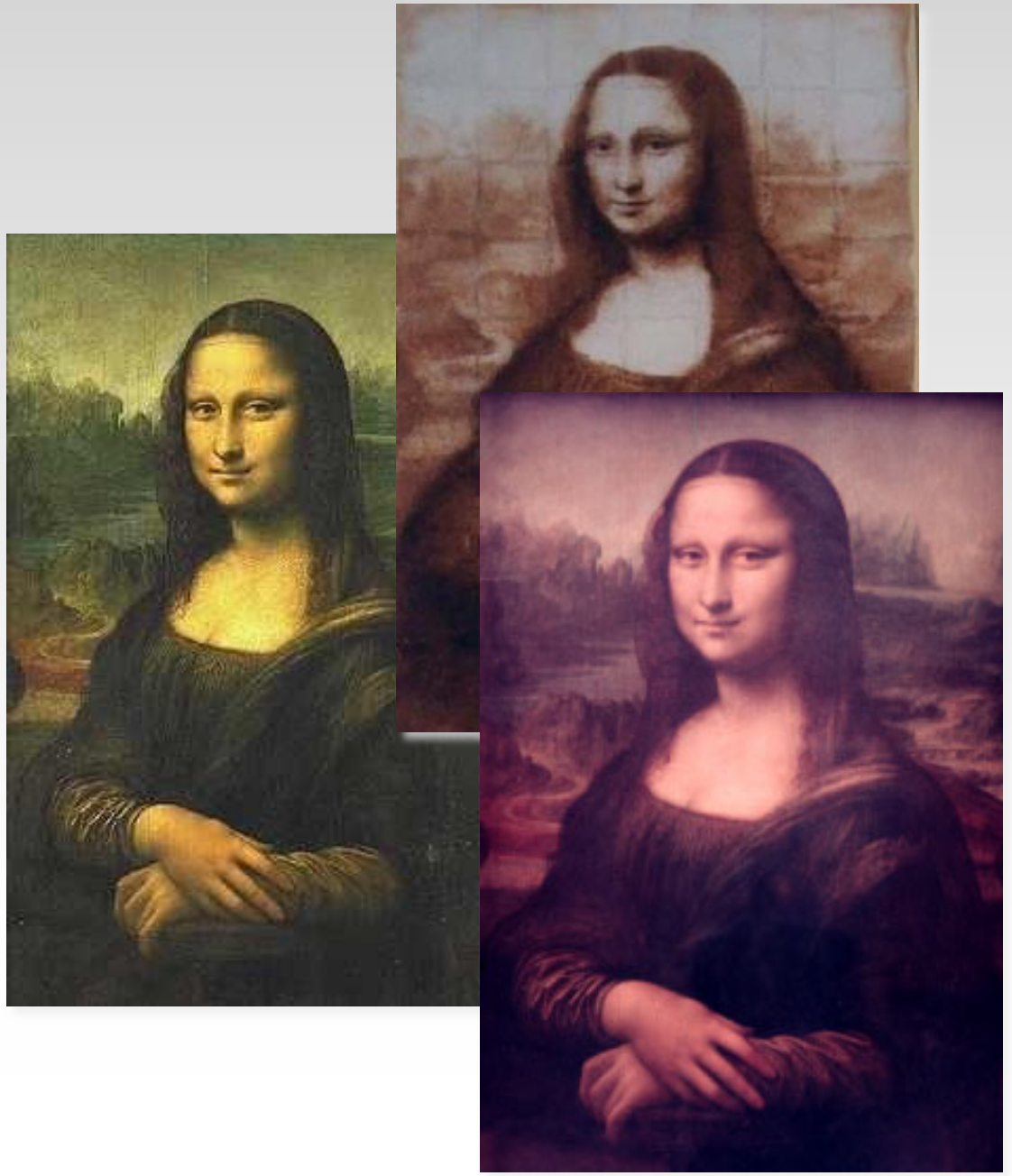
- Document and record the environment
  - Preservation analysis for items or collections
  - Space conditions
  - Seasonal trends
  - Building characteristics

- Basis of management decisions
  - Performance of AHU
  - Malfunctions
  - Improvements and optimization

What to Monitor?

We concentrate on T & RH

- Heat and humidity are primary drivers of decay
- Relates directly to the HVAC operation



Overview of Hardware Options

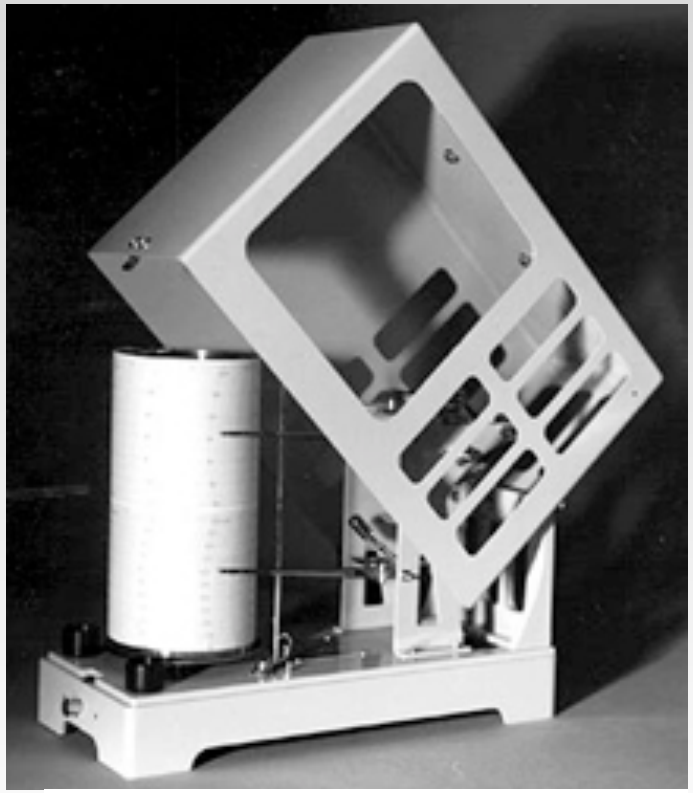
- Hygrometers
- Hygrothermographs
- Building management systems
- Dataloggers
- Connected systems

Hardware: Hygrometers

- Traditional monitoring device
- Difficult to examine long-term trends or statistically analyze data
- Precludes use of data in computational tools

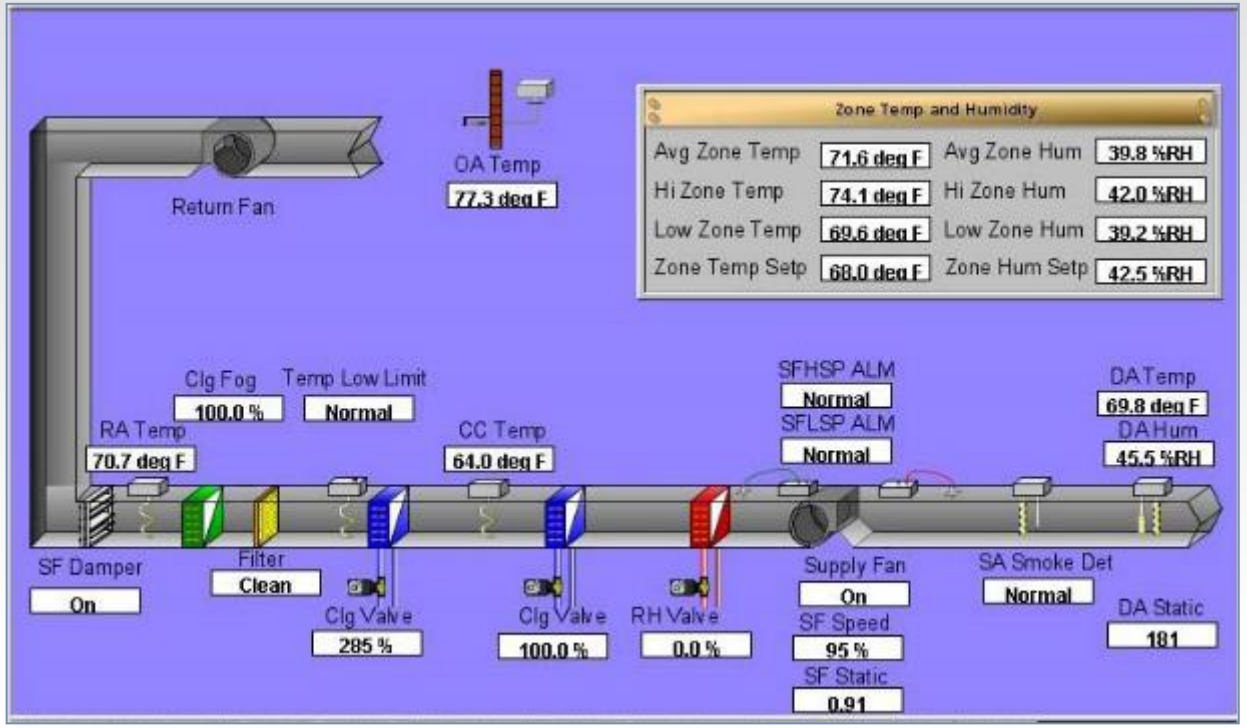
Hardware: Hygrothermographs

- Traditional monitoring device
- Difficult to examine long-term trends or statistically analyze data
- Precludes use of data in computational tools



Hardware: Building Management Systems

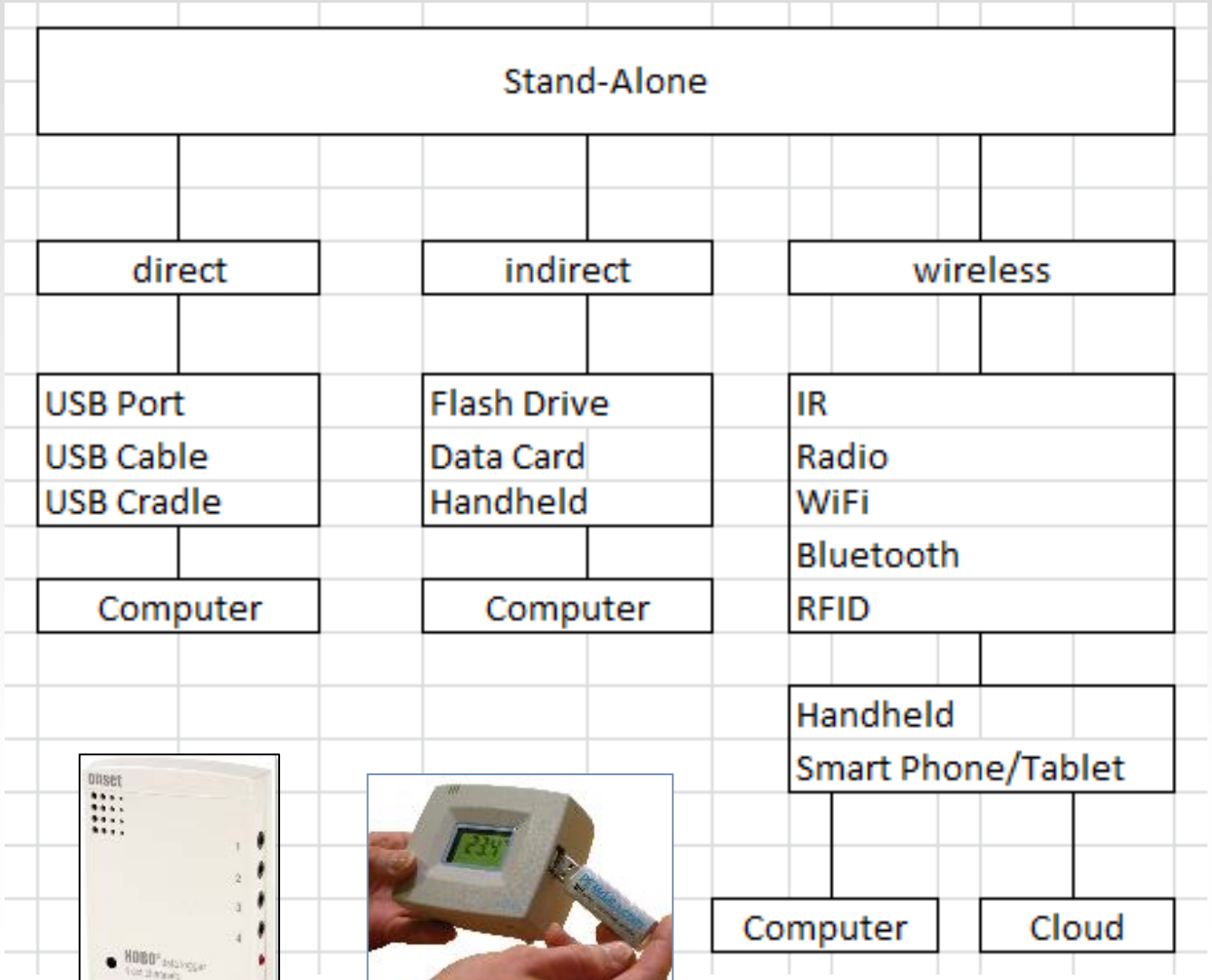
- Separate, proprietary, secure
- BMS is control, not analysis
- Requires large commitment of facilities staff time
- But, still can have its place

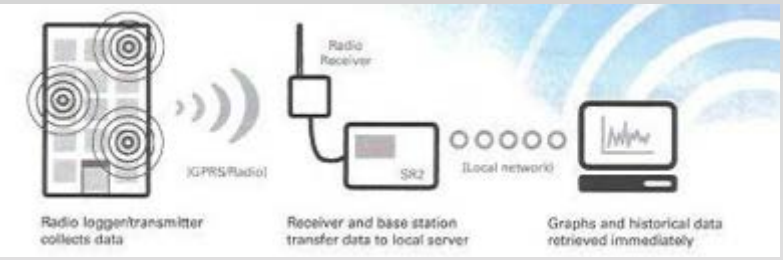


Hardware: Dataloggers

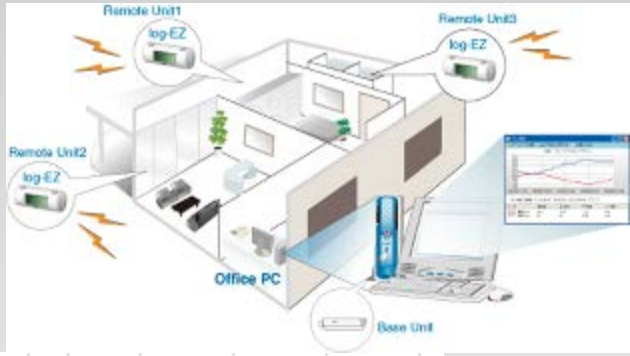
- Electronic devices that measure T & RH for graphing and analysis on computer
- Most popular and practical

Standalone loggers





Connected Systems



- Connected Systems
  - Wired (Ethernet)
    - Local Network
    - Cloud
  - Wireless
    - WiFi
      - Local Network
      - Computer
      - Cloud
    - Radio
      - RECIEVER
        - USB
          - Computer
        - Ethernet
          - Local Network
          - Cloud
        - WiFi
          - Local Network
          - Cloud
        - Cellular
    - Cellular

Costs

- Viable loggers range in cost from approx. $70 to $900.
- There is a reason why loggers are priced the way they are.
- Do not expect an inexpensive product to perform the same as a high-end product.
- There are uses for both ends of the spectrum.
- Don’t be penny wise and pound foolish.

http://www.cr.nps.gov/museum/publications/conserveogram/03-03.pdf

Hardware Specifications

Still Critical

- Operating Range
- Accuracy
- Calibration
- Power Source / Battery Life
- Sampling Rate
- Size Appearance and Construction
- Alerts / Alarms

Less Critical?

- Memory Capacity / Run Time
- Probe
- Display
- Start/Stop Options

Newly Critical

- Transmission

Software Considerations

- Data retrieval options
- Software platform compatibility
- Formats for data and graphs
- Data viewing and analysis options
- Graph modification options
- Customer Service & Technical Support

Terminology

- **Wireless** – “having no wires” but in the technology world describes any network where there is no physical connection between the sender and receiver.

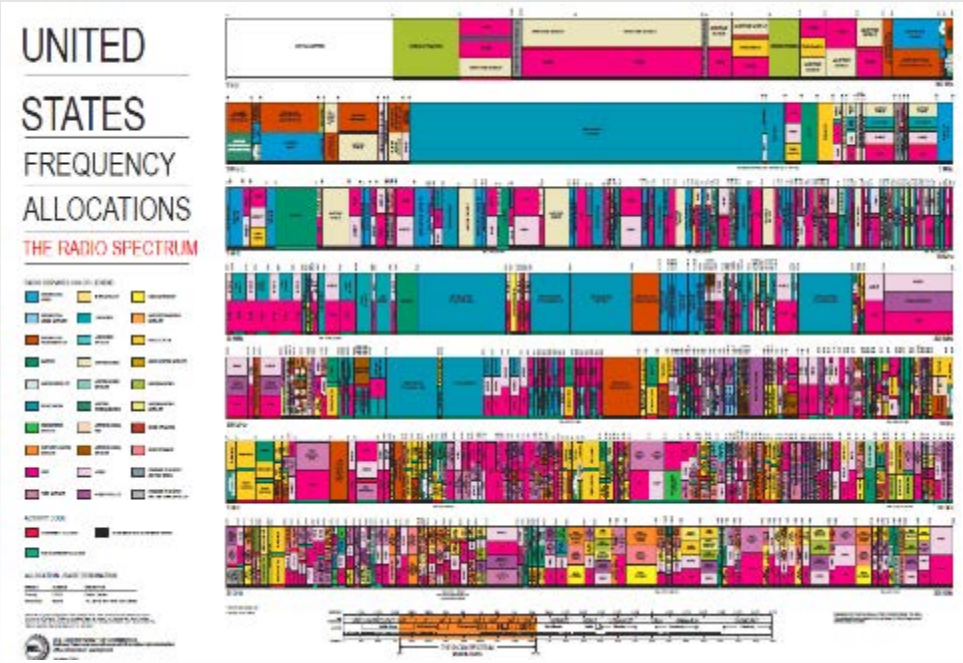
- **Cloud** – shared computing resources on demand rather than using local servers or devices to handle applications. “THE cloud” = “the Internet”

Terminology

- **Wi-Fi** – a popular networking technology that uses radio waves to provide wireless high-speed network connections.

- **Network** – computers that are linked together into a system. A LAN or ***l****ocal-****a****rea* ***n****etwork* generally describes a system in a single building using *Ethernet*.

Terminology



- **RF** – ***radio frequency***, is any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current reaches an antenna, an electromagnetic field is created that can propagate through space.

Terminology

- **Bluetooth** – a short-range radio technology aimed at simplifying communications between devices.

- **NFC** – ***N****ear* ***F****ield* ***C****ommunication* is a technology that enables convenient short-range communication between electronic devices.

Terminology

- **Cellular**
  - GSM - ***G****lobal* ***S****ystem for* ***M****obile Communications*
  - CDMA - ***Co****de-****D****ivision* ***M****ultiple* ***A****ccess*
  - GPRS - ***G****eneral* ***P****acket* ***R****adio* ***S****ervice*

- **Infrared** – also sometimes seen as "IrDA" short for *Infrared* ***D****ata* ***A****ssociation,* a group of device manufacturers that developed a standard for transmitting data via infrared light waves.

- **RFID** – ***R****adio* ***F****requency* ***Id****entification* is a short-range radio technology aimed at simplifying communications among devices.

What to Choose?


WiFi

RTR-500 Series loggers

TR-7 Series


Thermo Recorder TR-72wf
REC ENDLESS DATA
Web
72%
2
Thermo Recorder TR-71nw
REC ONETIME DATA
Web
1
71.0℃
ch.1
ch.2
DISPLAY
INTERVAL
REC/STOP

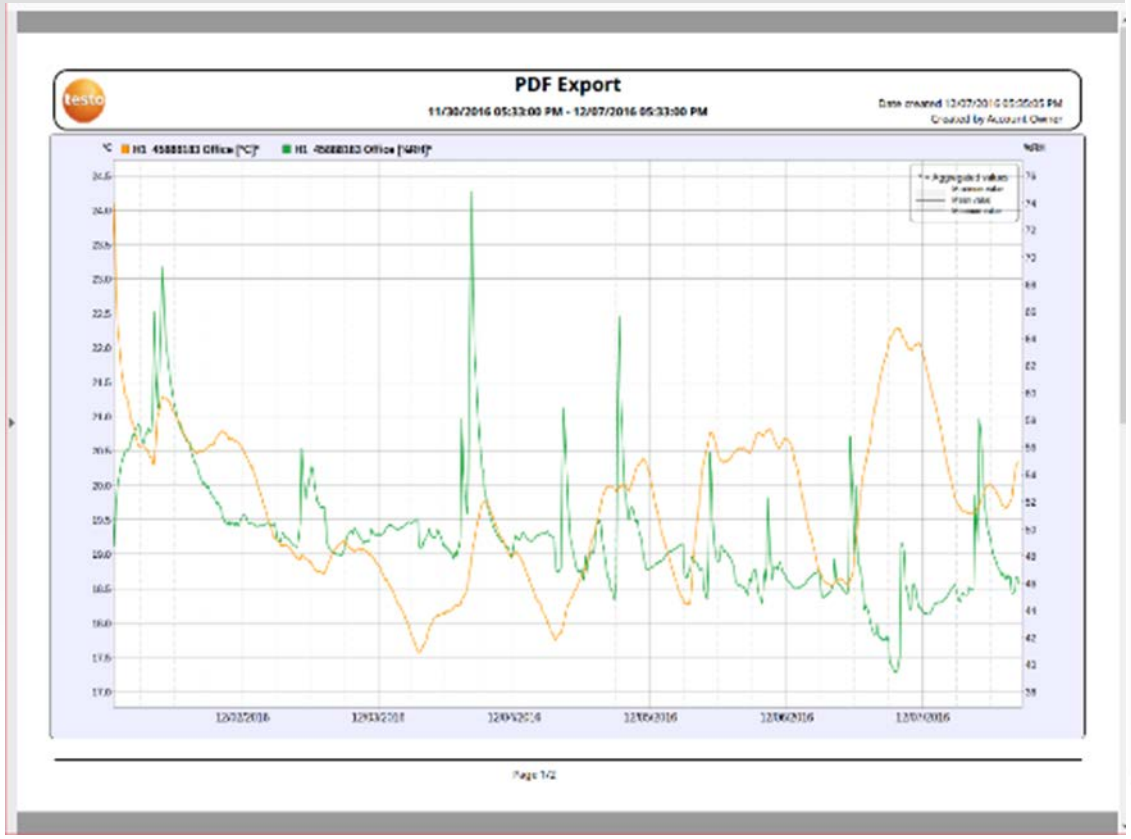

WiFi

TR-7 Series


T&D CORPORATION
WIRELESS DATA LOGGING SYSTEMS
Process and Manage Your Important Data Anytime From Anywhere
The New TR-7 Series
Warning!
25.4 °C 62 %
45

Testo Saveris2

Testo Saveris2



Saveris 2 Basic

- Measuring cycle: 15 min
- Data storage: 3 Months
- User: max. 1
- Alarm by e-mail

License details

Number of WiFi data loggers

Unlimited

Term and payment interval**

This license is free of charge

Total price: 0.0 USD **

**You will receive your invoice in your country's currency, additional local taxes may be charged extra.

Select license ›

Saveris 2 Advanced

- Measuring cycle: 1 min - 24 h
- Data storage: 12 Months
- User: max. 10
- Alarm by e-mail and SMS

License details

Number of WiFi data loggers

− 2 +

Term and payment interval**

- ◉ 12 Months 17.60 USD / Year
- ○ 24 Months 30.80 USD / Years
- ○ 36 Months 39.60 USD / Years

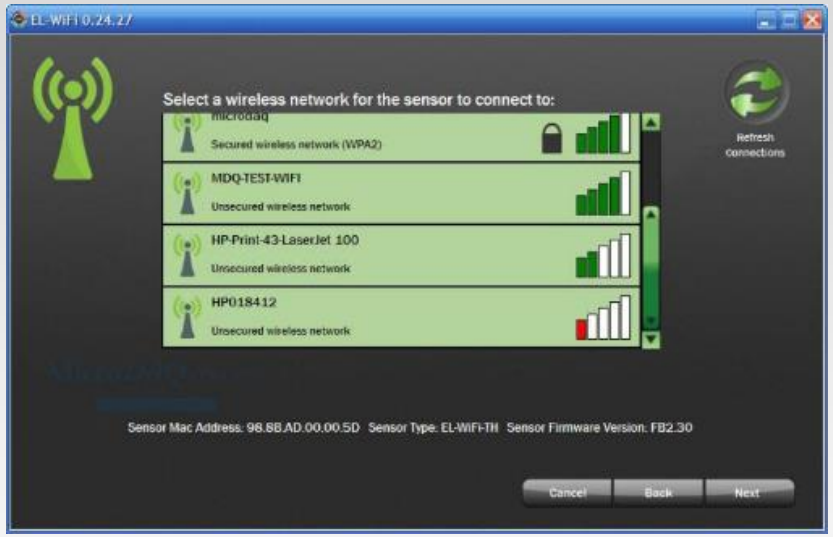
☑ Automatic license renewal *

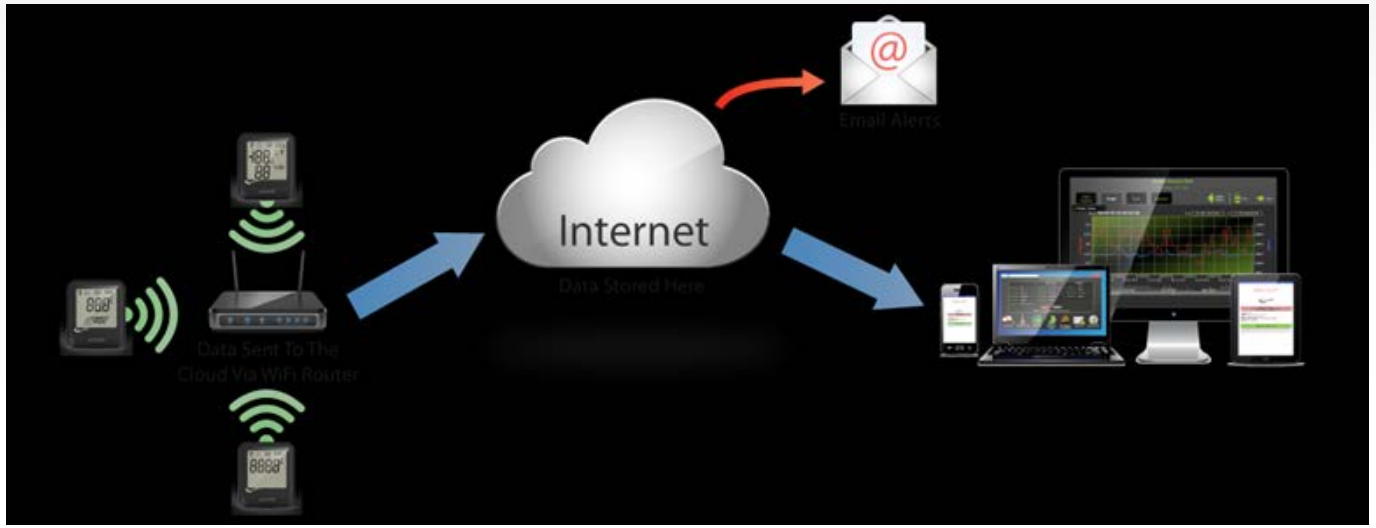
Total price: 35.20 USD **

**You will receive your invoice in your country's currency, additional local taxes may be charged extra.

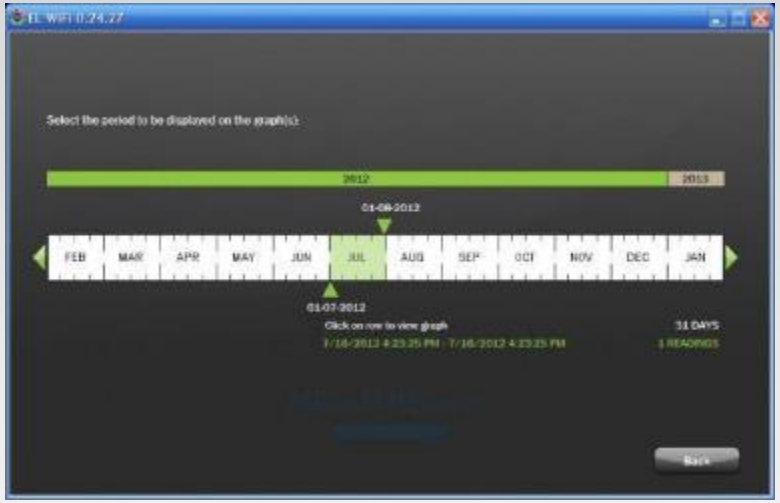
Select license ›

Lascar EL-WiFi-TH and TH+



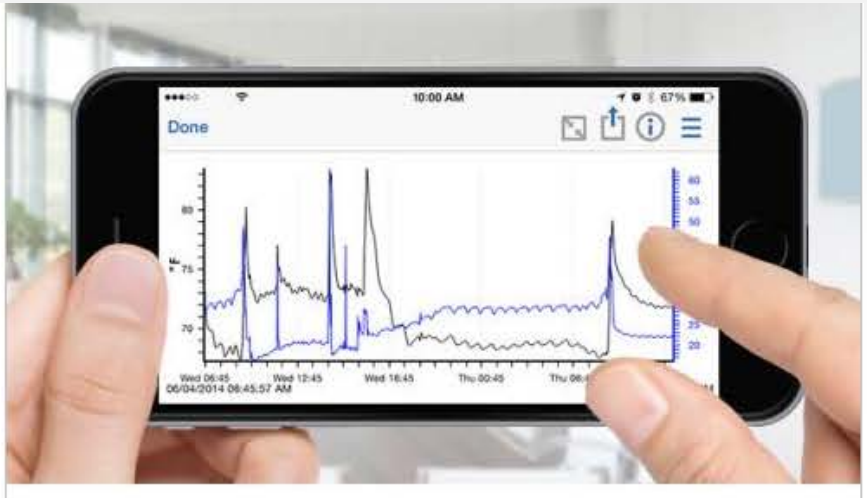


EasyLog WiFi Software

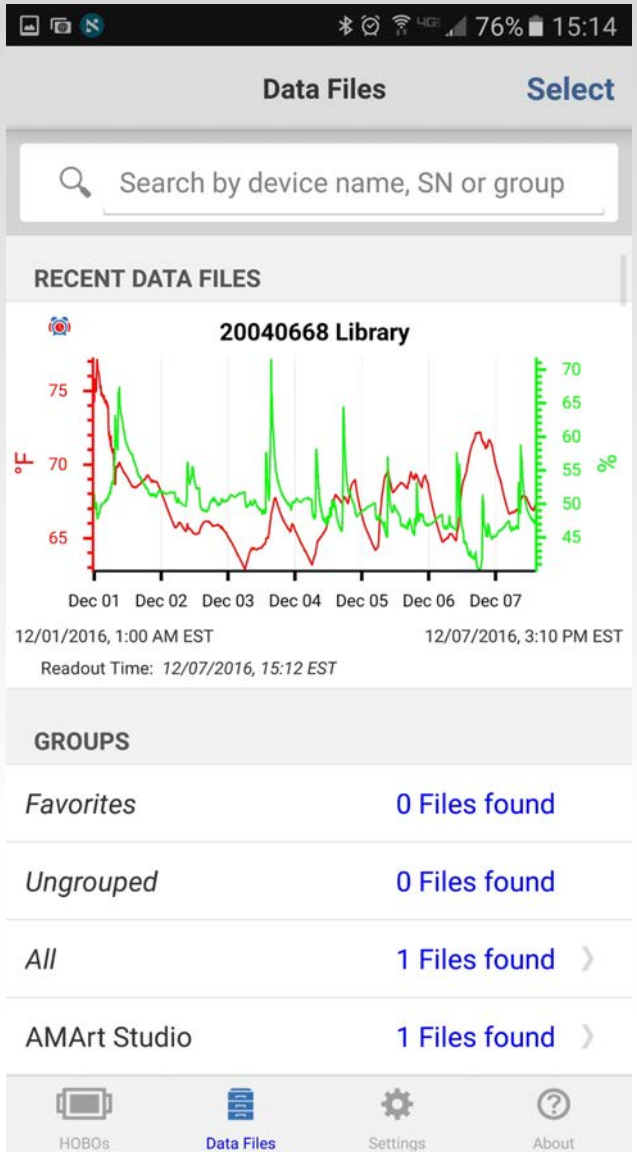


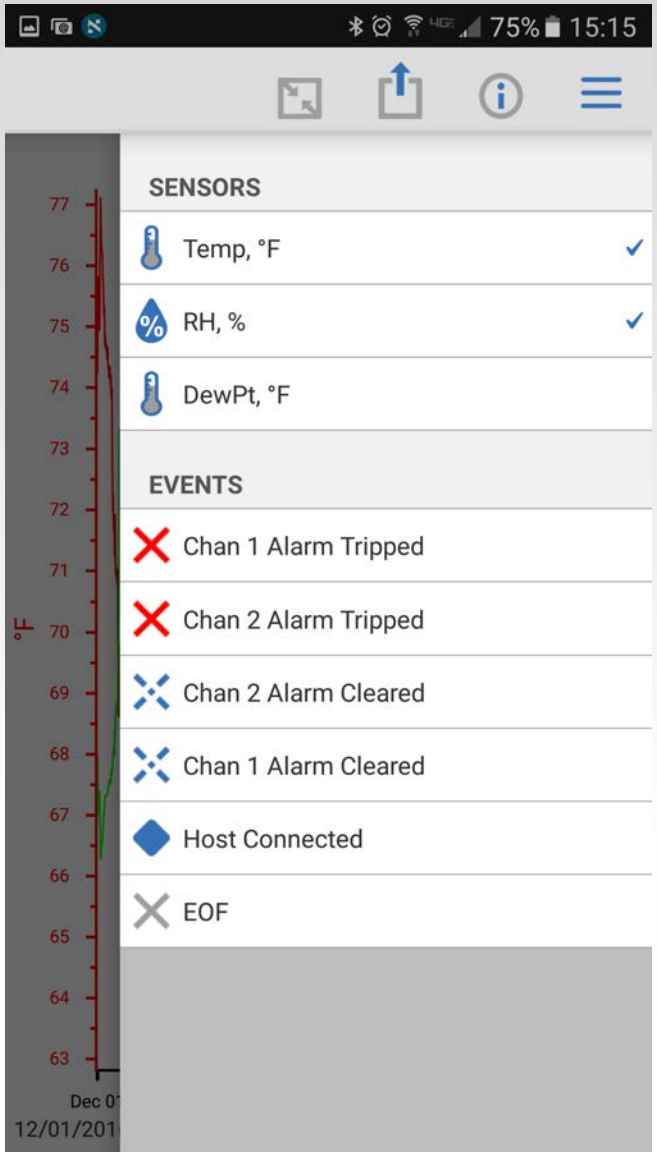

Bluetooth®

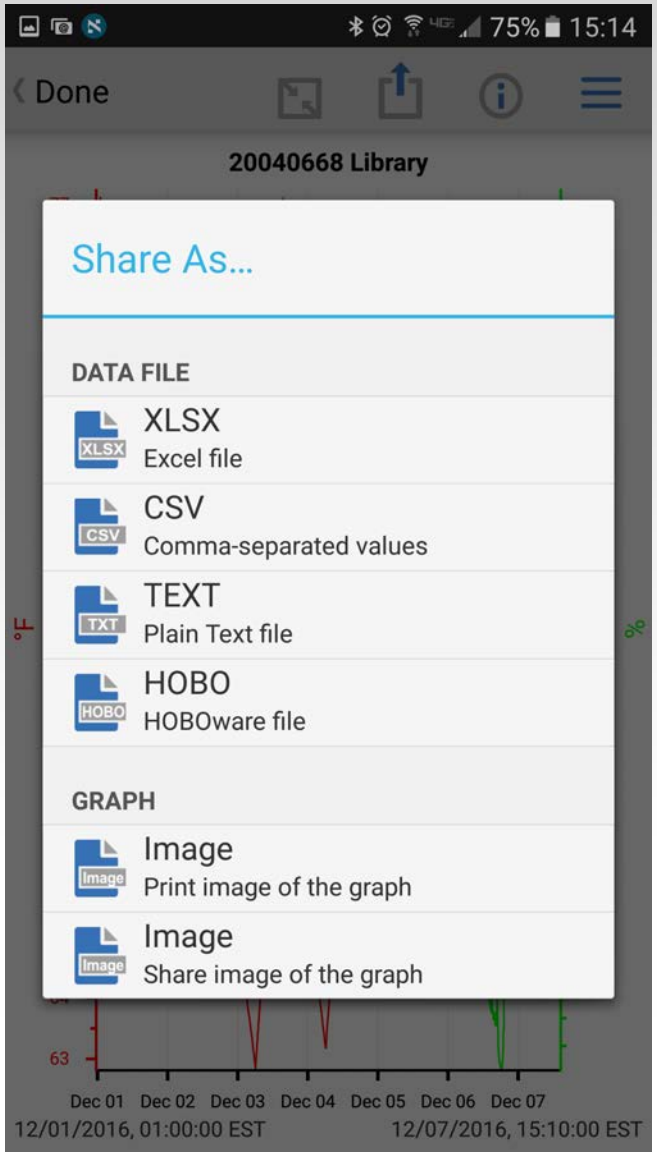
Onset Bluetooth Temp/RH MX1101



Onset Bluetooth Temp/RH MX1101







Lascar EL-BT-2 Bluetooth Wireless Temperature and Humidity Data Logger

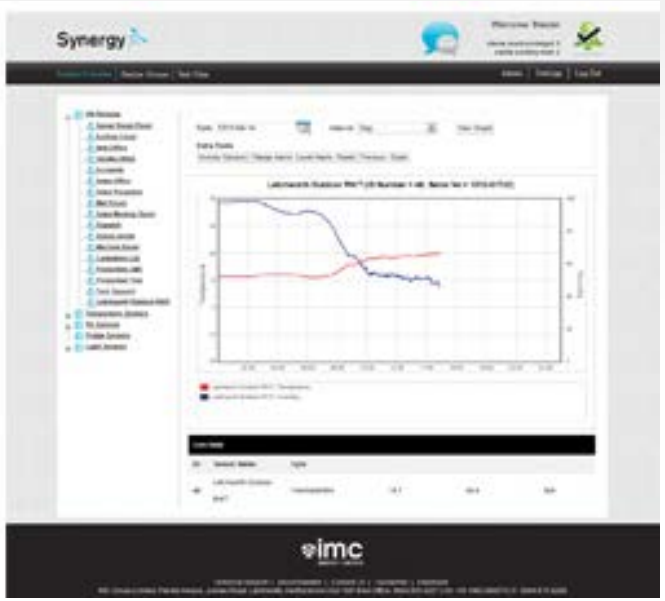
GR4 Series

- Bluetooth logger
- Phone or tablet app
- Expected early 2017

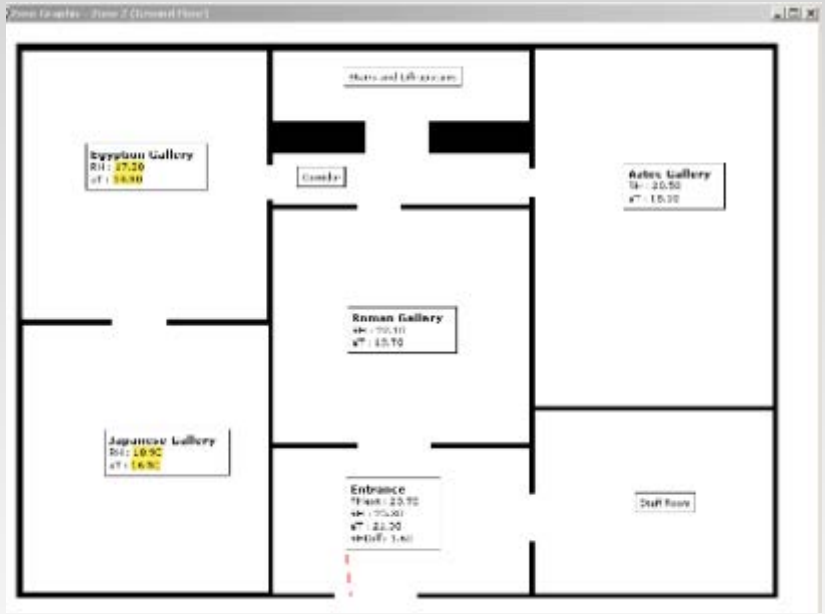
RADIO

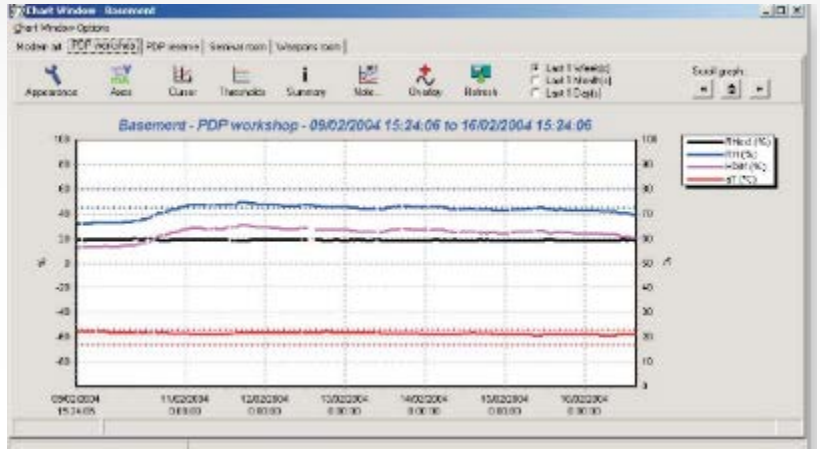
Hanwell

- Smart Receiver - SR2
- ML4000RHT Humidity series sensors
- Repeater
- Synergy Software

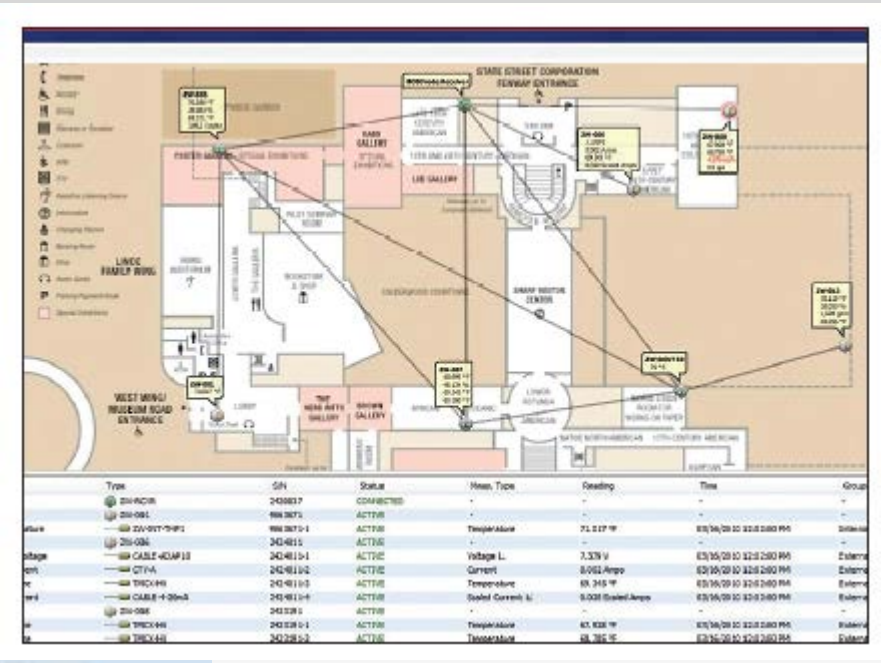


Eltek GenII Wireless Logging System

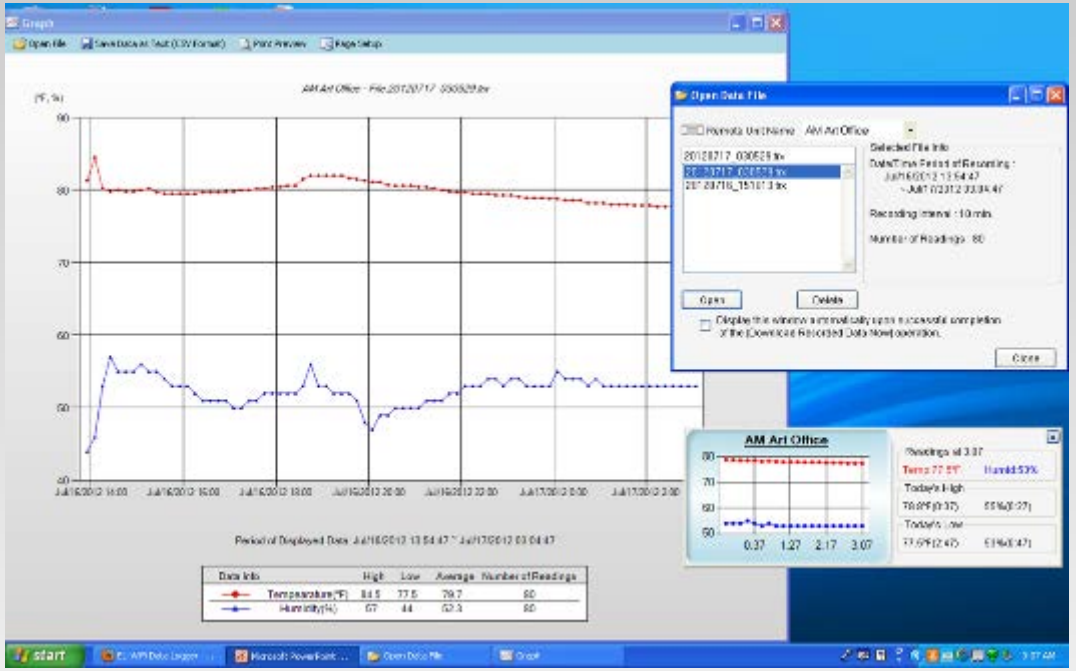


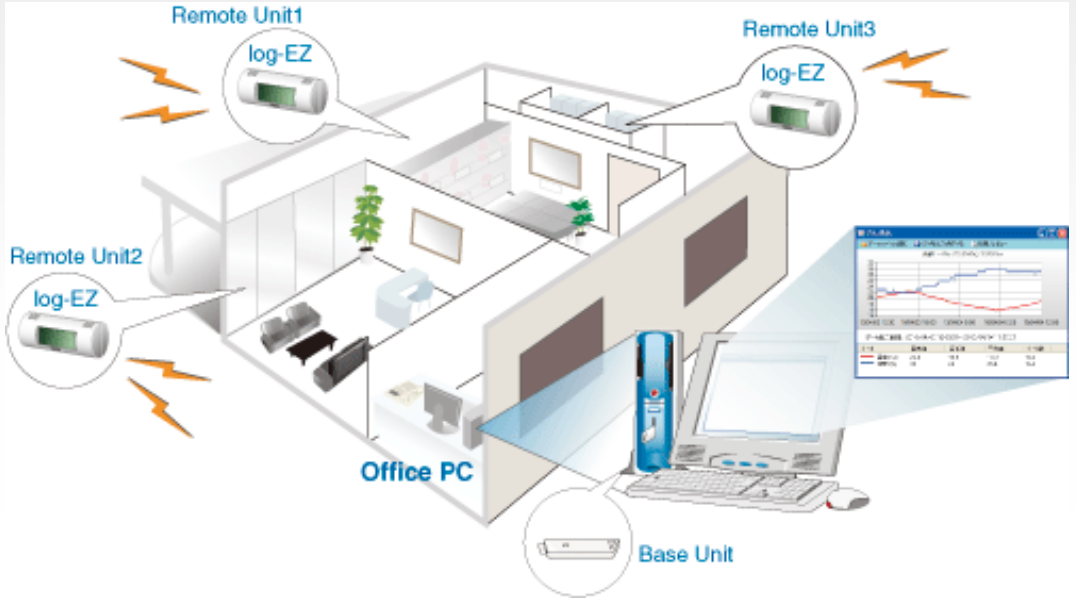


Onset Hobo ZW Data Nodes

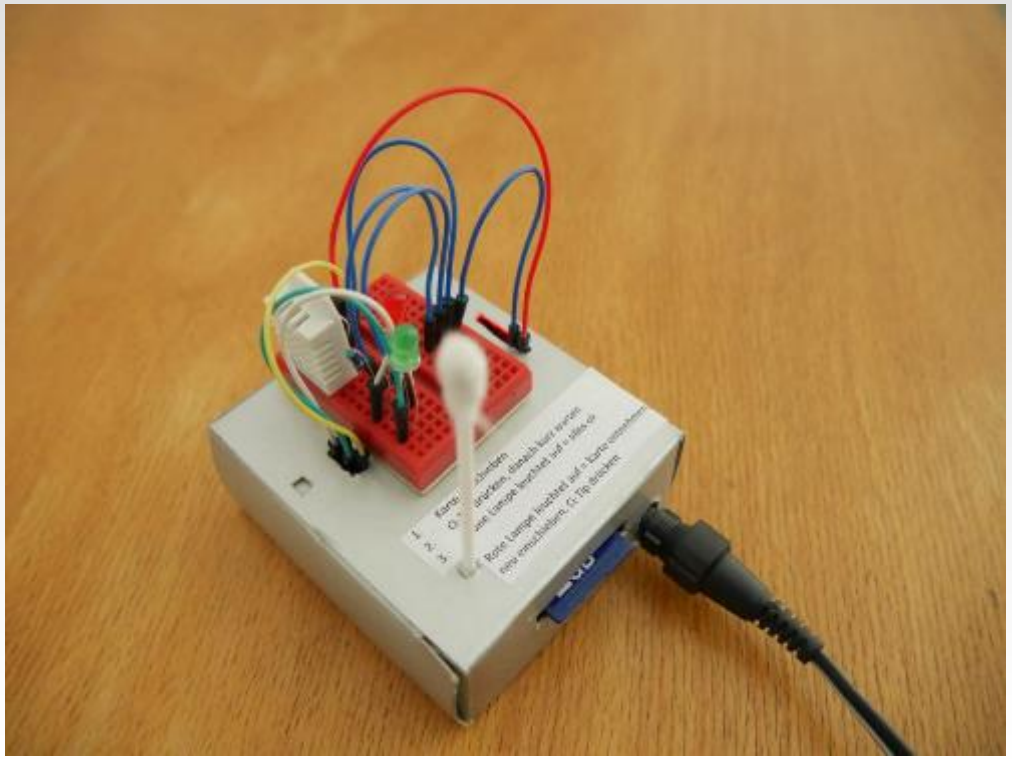


Log-EZ RTR322



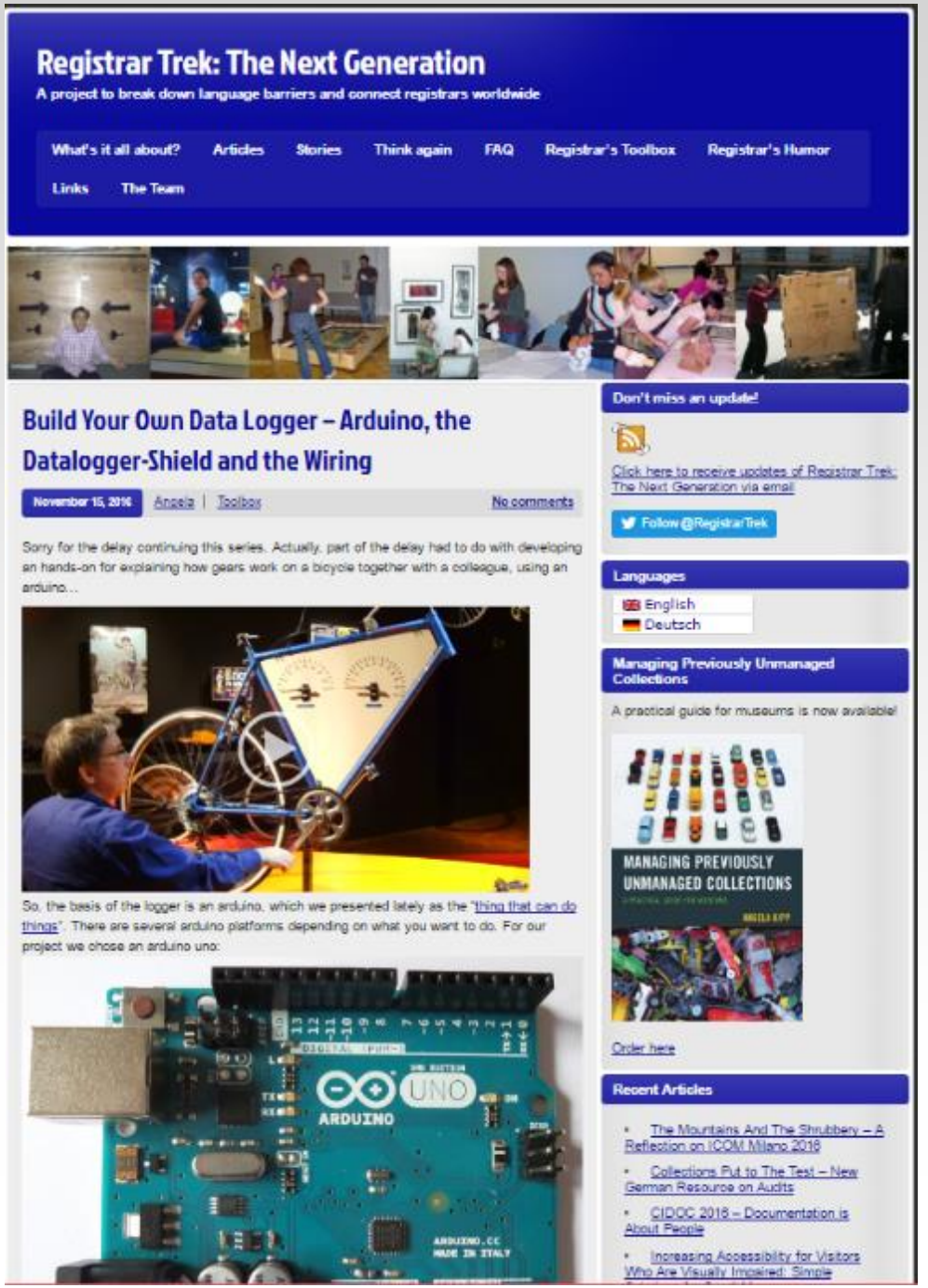


DIY Options



Registrar Trek Blog by Angela Kipp

http://world.museumsprojekte.de/



Reasons To Use Wireless Or Connected Systems

- Real-time data
- Off-site locations
- Lots of data
- Enclosed spaces

Are you ready for a connected system?

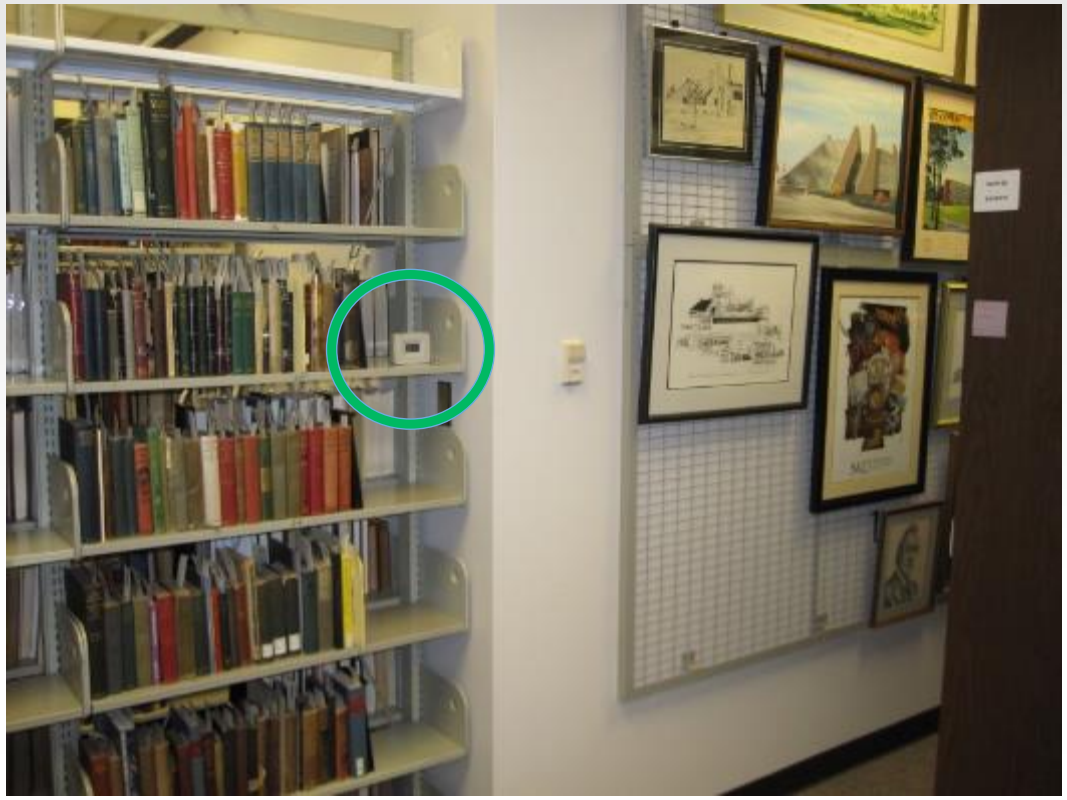
- How many spaces are you monitoring?
- Do you have the budget?
- Do you have a robust network in your institution?
- Do you have an IT person/department?
  - Are they on board?
- What is your building construction?
- Are you ready to keep up with the costs?

Troubleshooting Wireless & Connected Systems

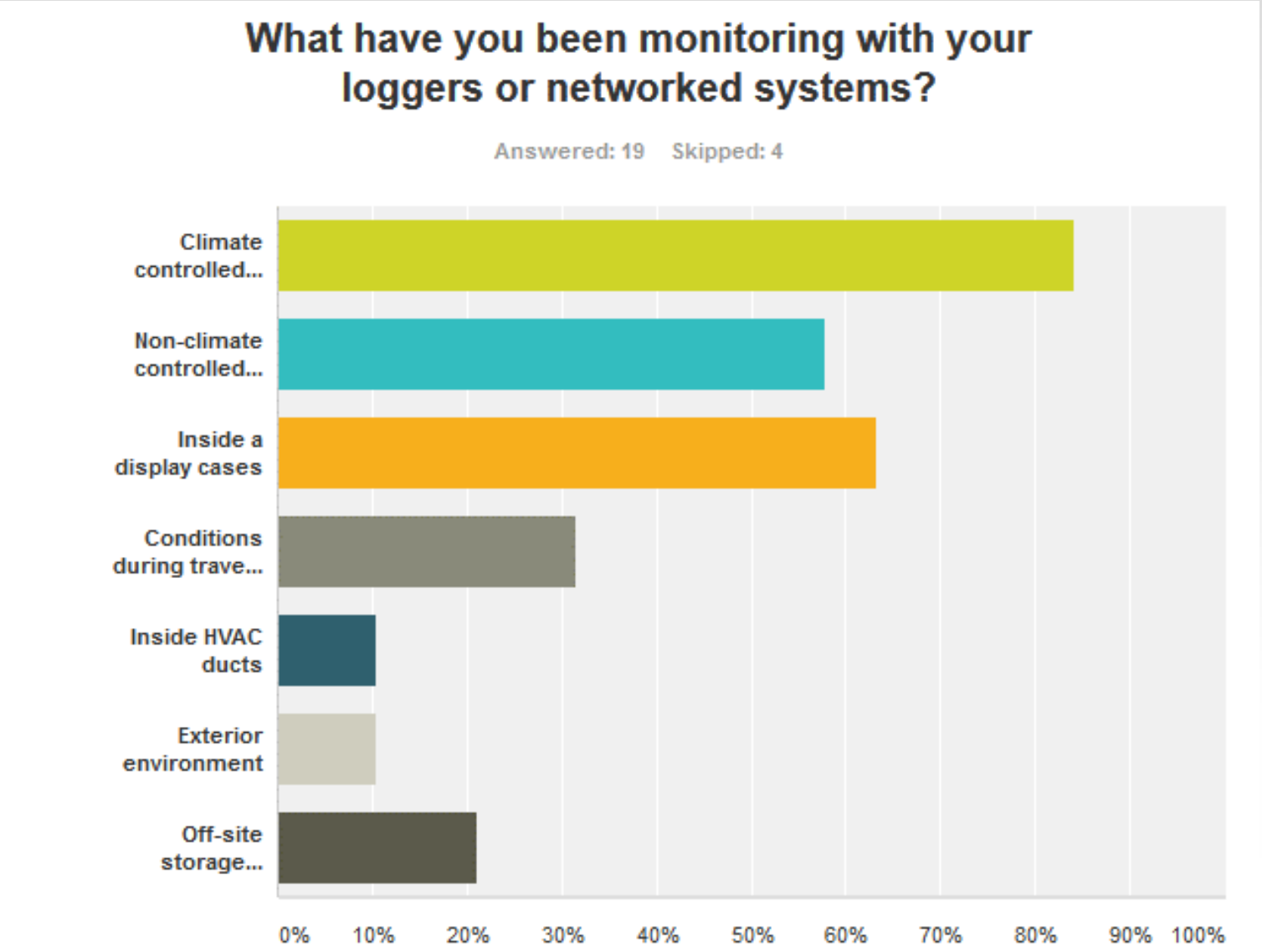
- Building construction
  - Metal
  - Concrete
  - Other wireless devices e.g. wireless phones
  - Other “noisy” devices e.g. fluorescent lights
- IT knowledge and support
- Device compatibility
- Firmware updates

Guidelines: Logger Locations & Coverage

- No magical number of monitors/locations
- Monitor what YOU need to know
- Wherever there is reason to believe conditions may differ
  - Source of heat, cold, moisture



What are you monitoring?



Guidelines: Logger Placement

- Amidst collections or in display
- 4-6 feet from floor
- Accessible for downloading
- Away from HVAC supply ducts

Guidelines: Data Management

- Data should be examined regularly
  - Monthly
  - Seasonal
  - Anomalies or emergencies
- Data should be easily accessible
  - Backup to network/dedicated folder

Acknowledgements

- Samantha Alderson, American Museum of Natural History
- Scott Ellis, Onset Computer Corp.
- Steve Knuth, TandD
- Claudio Heitkamp, Testo, Inc.
- Kelly Becker, Lascar Electronics Inc.
- Greg Basso, Cascade Systems
- Tony King, CAS systems
- Image Permanence Institute
- C2CCare Advisory Group

Rachael Perkins Arenstein

www.AMArtConservation.com

rachael@amartconservation.com