INTRODUCTION TO BUILDING AUTOMATION SYSTEMS

National Science Foundation
Advanced Technological Education Center

Building Efficiency for a Sustainable Tomorrow
BEST Center
MODERN BUILDINGS ARE COMPLEX

Systems Commonly Found in Buildings

- HVAC Systems
- Lighting Systems
- Security Systems
- Access Control Systems
- Fire Alarm / Life Safety Systems
- Energy Monitoring Systems
- Renewable Energy Systems
BUILDINGS CONSUME ENERGY

Share of Energy Consumed by Major Sectors of the Economy, 2009

- Commercial: 19%
- Industrial: 30%
- Residential: 22%
- Transportation: 29%

HVAC-related systems consume highest %

Source: 2008 EIA Buildings Energy Data Book
BUILDING HVAC SYSTEMS

- Provide heating, cooling, ventilation, air filtration, and humidity control to building spaces
- Respond to varying ambient environmental conditions to maintain building occupant comfort
- Often have complex sequences of operation
- Typically highest energy consumer in building
- Modern building control systems had their roots in controlling HVAC systems
BUILDING CONTROL SYSTEMS

Pneumatics

- Pneumatics is the application of pressurized gases to create mechanical motion of some sort

- Prior to electrical and digital control, pneumatics were the primary means for controlling building HVAC systems

- Very reliable systems if routinely calibrated and if air supply maintained properly

- Difficult to maintain tight control

- Limited system access / Difficult to modify control sequences

- Many existing buildings still have at least some pneumatics
BUILDING CONTROL SYSTEMS

Pneumatic Control Panel
BUILDING CONTROL SYSTEMS

Electric Controls

• Electric controls utilize relays, time delays, clocks, thermostats, actuators, and various other basic electrical devices to maintain building space comfort

• Electric control systems gained popularity in the 1970s and 1980s and began replacing pneumatic control components in buildings

• Less component calibration required

• Tighter control possible

• Easier to modify control sequences
BUILDING CONTROL SYSTEMS

Electric Control Panel
Direct Digital Controls

- Direct Digital Controls is the application of microprocessor-based, networked distributed controllers to make control responses to changing systems parameters
- Less moving parts within the control system
- More accurate control
- Better access to system information / trending capabilities
- Easier to modify control sequences
- Ability to route alarm conditions to multiple locations
- Simple to make scheduling changes
BUILDING CONTROL SYSTEMS

Direct Digital Control Panels
BUILDING CONTROL SYSTEMS

Direct Digital Controls

- The first digital control systems for commercial buildings were developed in the 1960s
  - The Honeywell 16 Series was one of the first (pdf packet) [link]

- In the late 1980s, DDC systems began gaining wide acceptance in commercial buildings

- The 1990s saw the emergence of standard industry protocols for communication (BACnet / LonWorks)

- In the last 10 years, integration between various manufacturers has intensified (Tridium)
BUILDING CONTROL SYSTEMS

Modern Building Automation Systems

- HVAC / Lighting / Access / Energy Tracking Often Combined
- Integration with fire alarm, security, renewable energy systems
- Integration between equipment manufacturers
- Modern BAS systems serve as the central point of control and monitoring of the facilities’ most important and complex systems
BAS INDUSTRY

- Leading supplier to BAS industry
  http://www.kele.com/home.aspx

Industry Outlook – Green Jobs? Yes!

Internal Estimates
- U.S. Market - $5 Billion 2012
- World Market - $15 Billion 2012

Recession Resistant
- 2002 Recession – Plus 1% vs. Construction Down 15%
- 2008 Recession – Down 5% vs. Construction Down 23%
- Forward – Double-Digit Annual Growth, Starting Now
Building Automation Market Growth Versus Non-Residential Construction Growth

Growth % vs 12 Months Prior

US Non-residential Construction
North American BAS Market
BAS INDUSTRY

Drivers

- Energy Costs
- Environmental Awareness
  - LEED / Energy Star / Others
- Building Codes
  - International Energy Code
  - ASHRAE 90.1-2010 / ASHRAE 189.1-2011
BAS INDUSTRY EMPLOYMENT

Employment

- Demand Matches Industry
- Specialized Construction
- No Labor Economies of Scale
- Too Few Trained People to Hire...