

سایت اختصاصی  
مهندسی کنترل



Controlengineers.ir

# ***Building Management Systems (BMS)***

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## How can I save energy with an EMS?

### Relay driven EMS

- Options are limited to basic scheduling and equipment control

### Pneumatic EMS

- Scheduling
- Instrument feed back
- Utilizing basic Proportional Integral Derivative (PID) loops



## How do EMS/BMS systems work?

Energy Monitoring and Management systems are integral to Building Management Systems (BMS) and Building Automation Controls (BAC) , and use a networked system of sensors, software, and building controls.



## Building Automation Systems and the Environment – Profits for Stakeholders

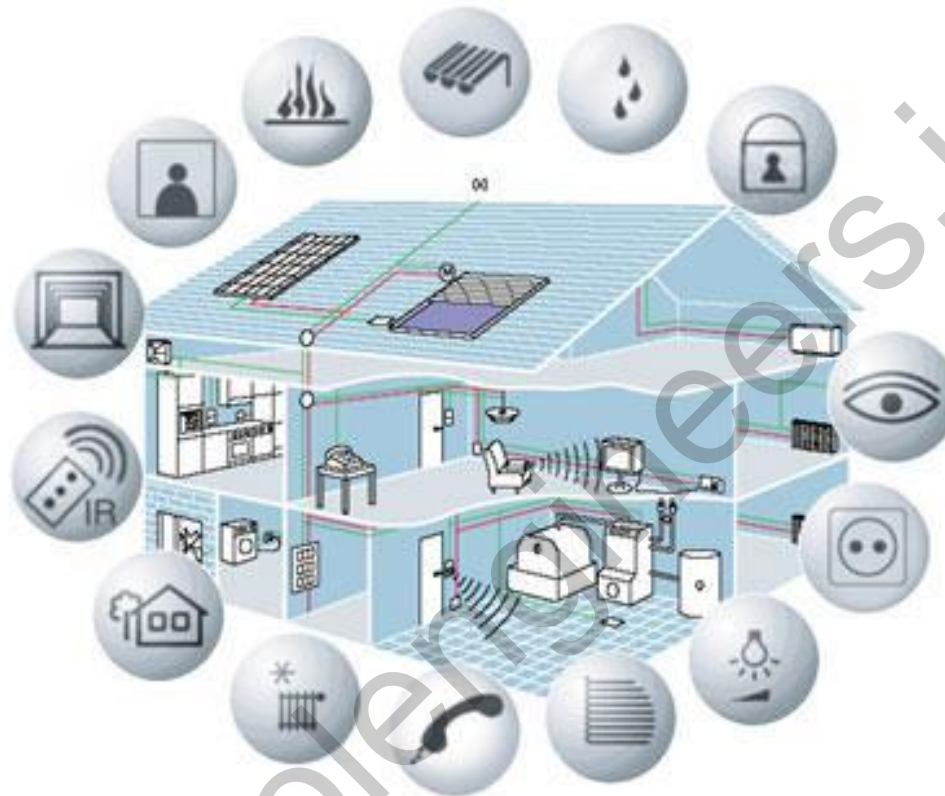
The combination of energy management and building controls provides owners and occupants with benefits beyond economic savings, reductions in energy as a resource as well as emissions as a consequence

# ***What is BMS?***

A **Building Management System (BMS)** is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems.







## Building Management Communication Protocols

A Building Management System (BMS) is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems. A BMS consists of software and hardware; the software program, usually configured in a hierarchical manner, can be proprietary, using such protocols as C-bus, Profibus, and so on, recently, however, new vendors are producing BMSs that integrate using Internet protocols and open standards such as DeviceNet, SOAP, XML, BACnet, LonWorks and Modbus.

# ***BMS Characteristics***

- A BMS is most common in a large building.
- Its core function is to manage the environment within the building and may control temperature, [carbon dioxide](#) levels and humidity within a building.
- BMS systems are linked to access control (turnstiles and access doors controlling who is allowed access and egress to the building) or other security systems such as closed-circuit television (CCTV) and motion detectors.
- Fire alarm systems and elevators are also sometimes linked to a BMS



# ***Functions of Building Management Systems***

To create a central computer controlled method which has three basic functions:

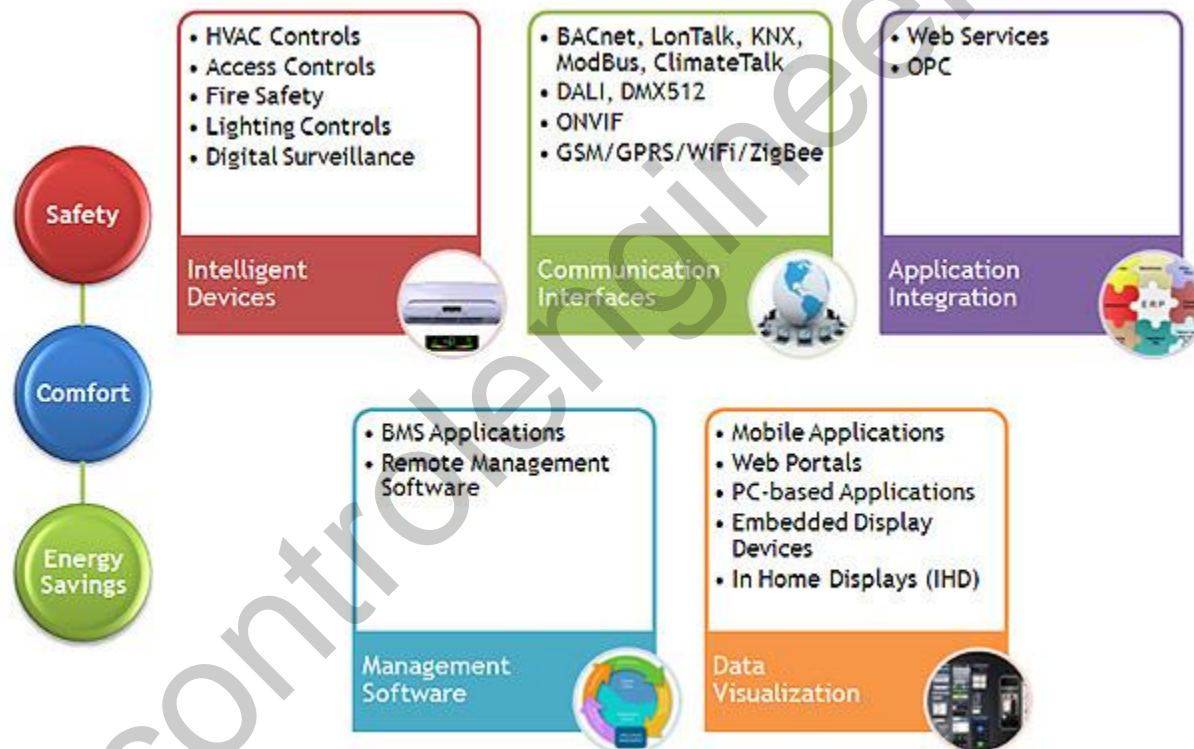
- Controlling
- Monitoring
- Optimizing

the building's facilities, mechanical and electrical equipments for comfort, safety and efficiency.

# ***A BMS system normally comprises***

- [Power systems](#)
- Illumination system
- Electric power control system
- Heating, Ventilation and Air-conditioning [HVAC](#) System
- Security and observation system
- Magnetic card and access system
- [Fire alarm system](#)
- [Lifts](#), [elevators](#) etc.
- Plumbing system
- Burglar alarms
- Other engineering systems
- Trace Heating

# Building Automation Systems





## Energy Management in Building Systems

EMS/BMS helps with central services including chillers and boilers.

# Building Automation Vendors





# Building Automation Vendors



**Johnson Controls - <http://www.johnsoncontrols.com>**



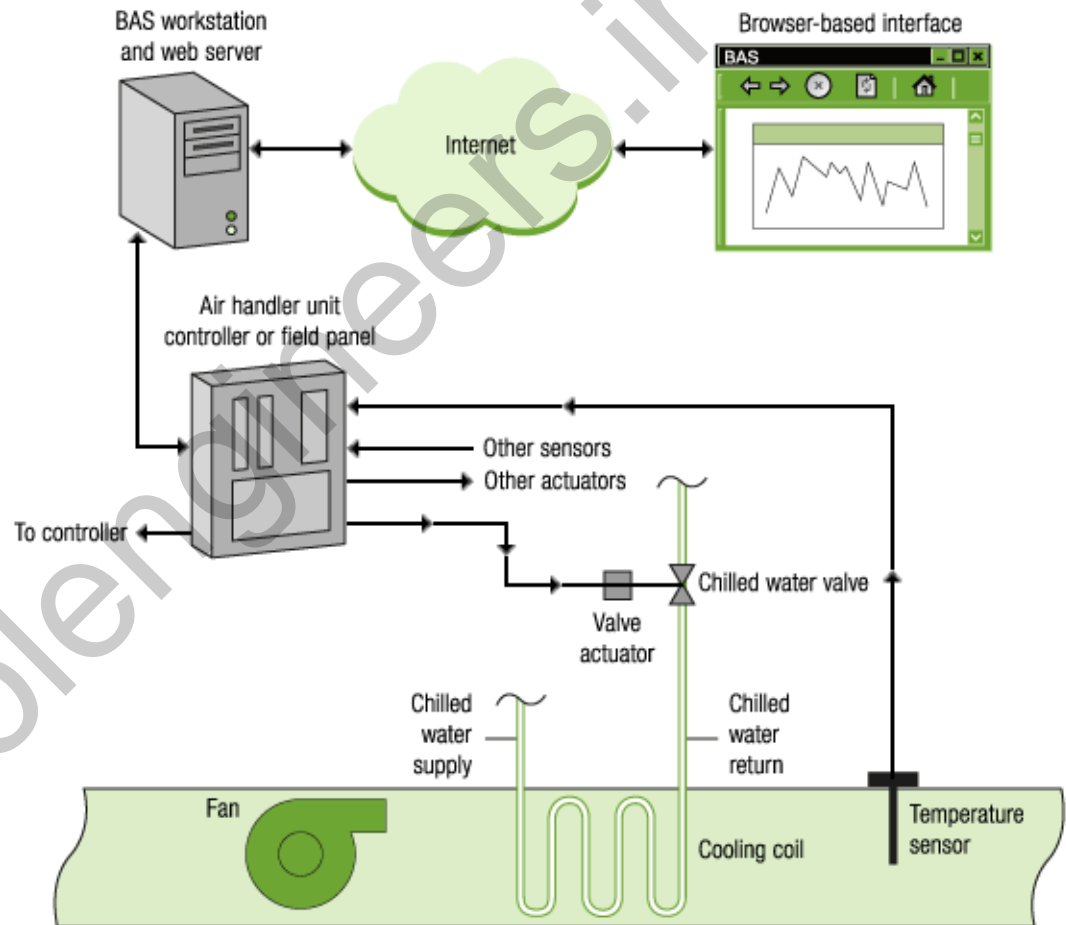


## Building Management System Components

Building Management System (BMS) is a wide range of applications which covers Heating Ventilation Air Conditioning (HVAC), Environmental monitoring, Fire Protection system, Alarms & Surveillance System, Lift Management System, Smart Building Technologies and Energy Conservations.

## How Building Automation Systems fit together

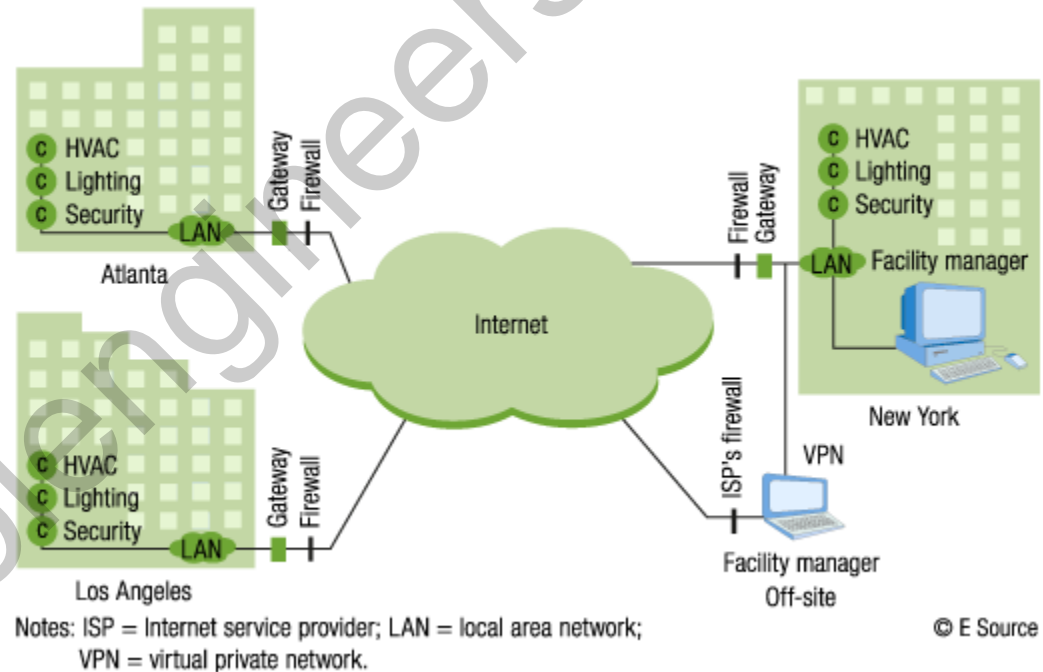
The building automation system (BAS) has become the accepted technology used in controlling HVAC and other systems in most new commercial and institutional buildings (Figure 1). Existing buildings can be retrofitted with BASs, a change that has been shown to provide economically beneficial improvements in energy efficiency and occupant comfort. Although most BASs are designed primarily for HVAC control, many incorporate additional functions, such as lighting control, computerized maintenance scheduling, life-safety functions (such as smoke control), and access (security) control. A building automation system (BAS) consists of sensors, controllers, actuators, and software. An operator interfaces with the system via a central workstation or Web browser.



© E Source; adapted from Portland Energy Conservation Inc.

## How Building Automation Systems work together

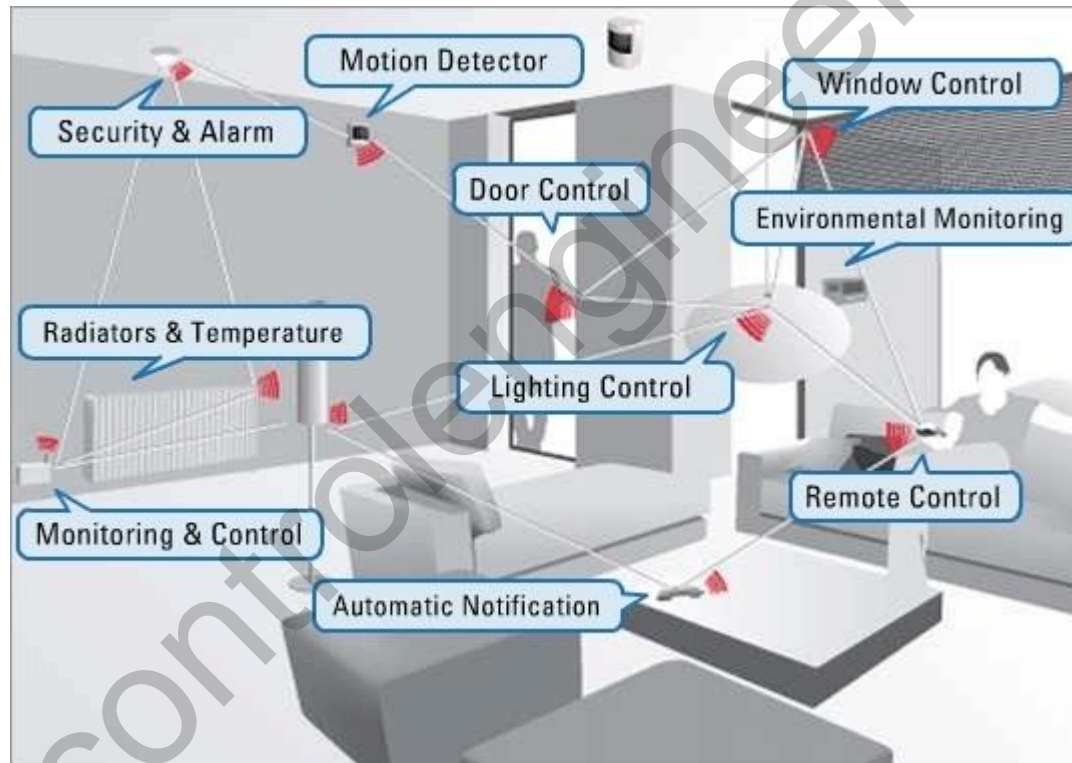
Controllers embedded in lighting, HVAC, and security equipment communicate with each other via a local area network. Each building is then connected to the Internet through a gateway that is protected by a security firewall. Because these networked building systems offer remote control capabilities, facility managers can monitor and control their buildings from any location with a Web connection. They can also manage multiple sites simultaneously or aggregate them for load control. Connecting a BAS to the Internet allows it to communicate with other computer applications such as online weather-forecasting services. The concept of enterprise-wide management for facilities throughout the world is exciting, whether it concerns the management of HVAC control for building comfort, fire and physical safety, security, or buying power.



# ***Security Systems***

- It is a multi level security system.(physical security).
- They have access control.
- All the employees are provided with access cards.
- The CCtv's are placed at all the gates and these are monitored at the reception.

# Security Systems



# ***Fire Alarm Systems***

- Each room has a fire alarm which detect the smoke. It is also provided with the sprinkler system.
- These sprinklers will not be in server room
- The fire extinguishers will be different in server room. A mock fire drill is conducted every month.
- Fire extinguishers are placed every 100m.



# ***Air Conditioning***

- The air chillers which are placed at the top of the building send cool air to the A.H.U(Air Handling Units ) which are provided at all the levels.
- There are 4 A.H.U's in each level.
- The cool air is distributed to the entire level from the A.H.U's.

# ***Server Room***

- This is the main part in an IT company in which all the data is stored.
- This room cannot be accessed by everyone. It has a passcode and access card to enter.
- 18 degrees is maintained in the rooms

# Server Room

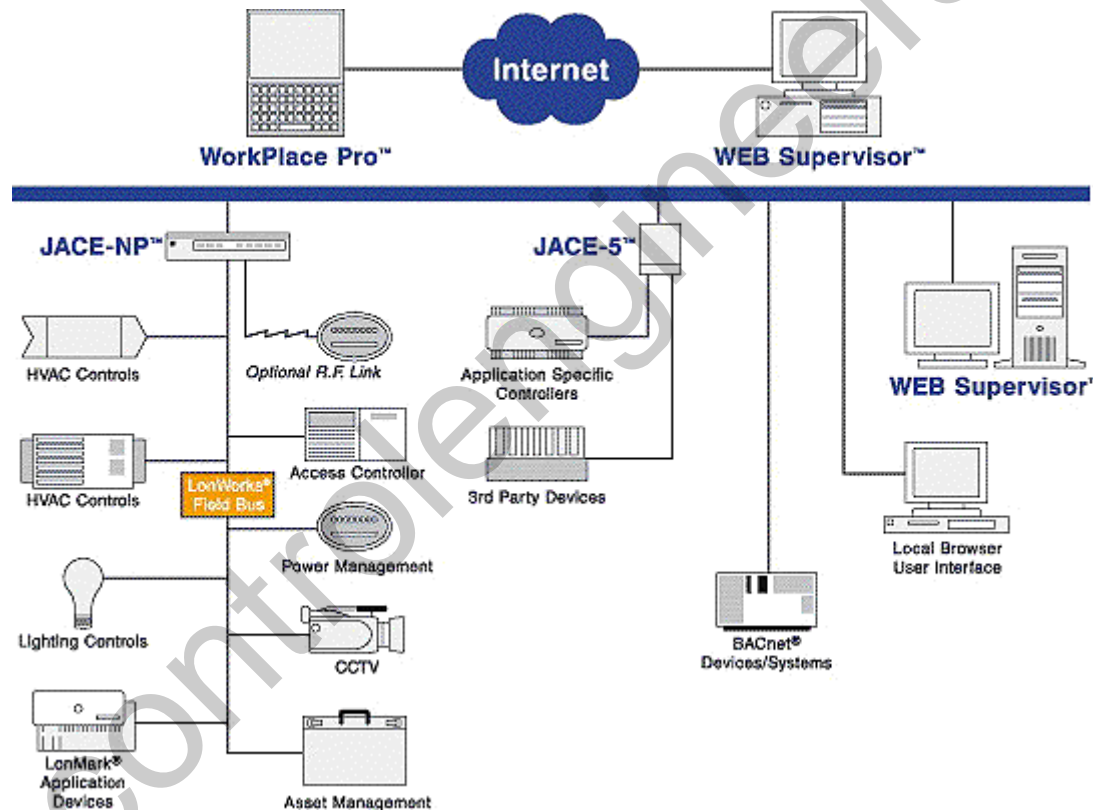


Due to the fast increasing requirement of information management in all kinds of industries, people are building more and more large data centers all around the world. Usually the large data center is bigger than 500 m<sup>2</sup> and the numbers of racks inside is a large number. The requirements for power system include high power, high reliability, easy for upgrading and etc. <http://www.invt-power.com/>

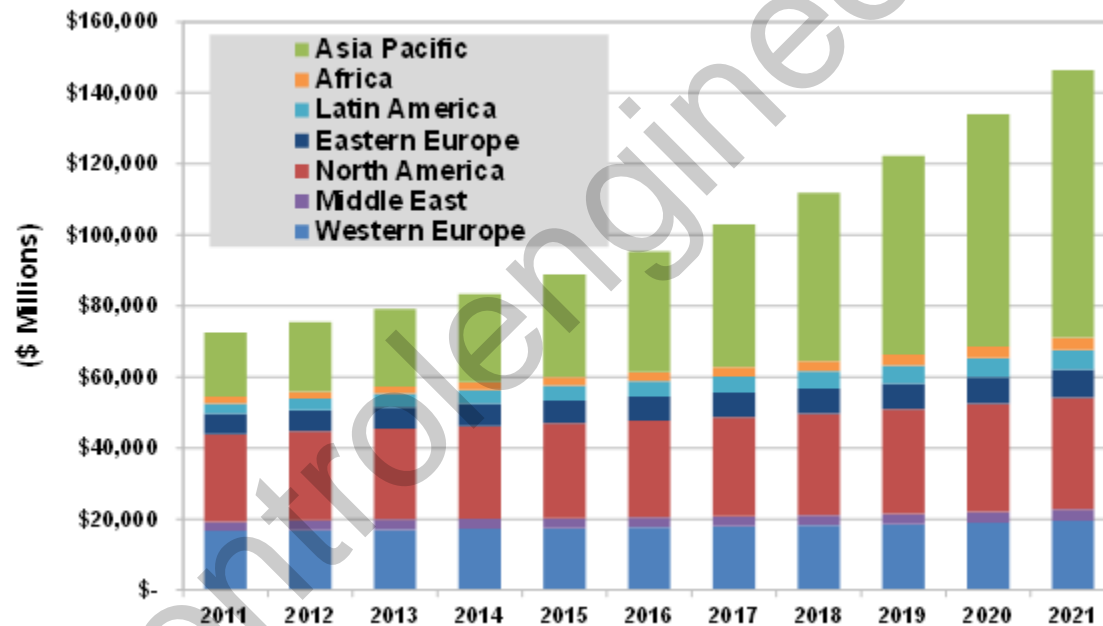
# ***Power Systems***

- The main power comes from the AP electricity board.
- Automatic switch on and off generators systems – if one failed the other works.
- The main power will be sent to UPS (which has 30min backup).
- Each cabin has 3 power sockets

# Integrated Systems



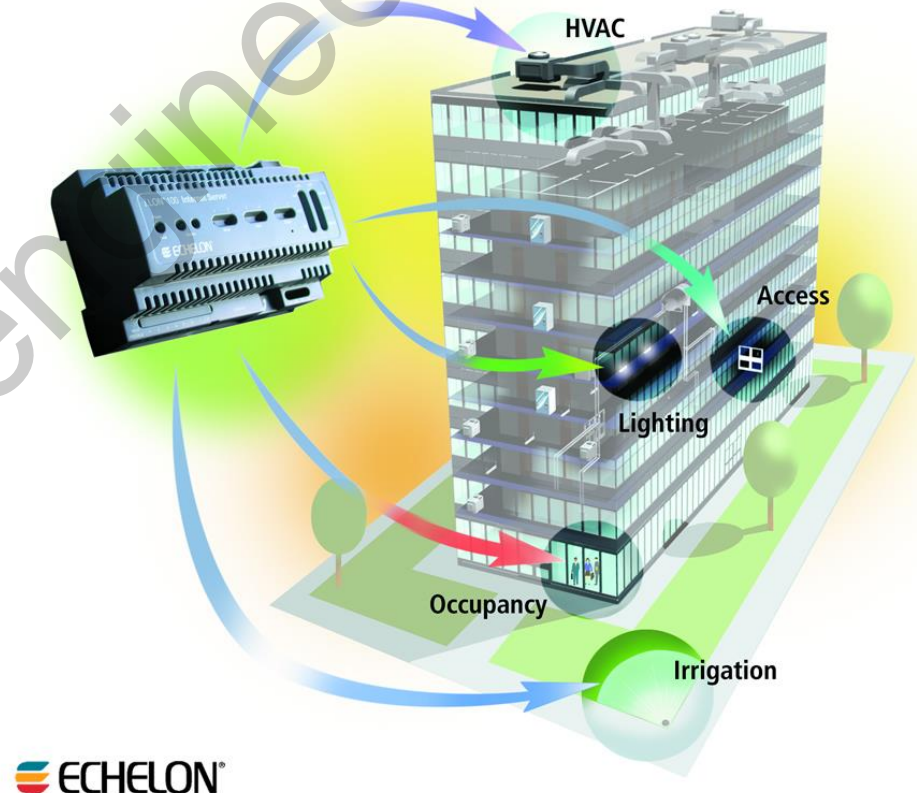
# BAC Growing Market





# Network Integration with Demand Response

Significant imbalances between electricity supply and demand can destabilize the grid or cause severe voltage fluctuations and failures. Demand response, the reduction of electric demand from the grid, can relieve system stress and help prevent blackouts and brownouts. Demand response played an active role in managing energy events in various parts of the United States during the summer of 2006. Aggregating demand response efforts across a region has historically been a time-consuming and labor-intensive process. EnerNOC uses its Network Operations Center (NOC), in Boston, MA to remotely manage electricity consumption across a network of end-use customer sites and make energy available to grid operators and utilities on demand. Echelon's i.LON® Internet Server, when installed at commercial, institutional, and industrial customer sites, can enhance EnerNOC's technology by enabling a direct wireless connection from the NOC to building and energy management systems.



 ECHELON®

# ***Internet Protocols***

- [DeviceNet](#) – Interconnect Control Devices
- [SOAP](#) – Simple Object Access Protocol
- [XML](#) – eXtensible Markup Language
- [BACnet](#) – Building Automation Controls
- [LonWorks](#) – Local Operational Networks
- [Modbus](#) – Serial Communication Protocol

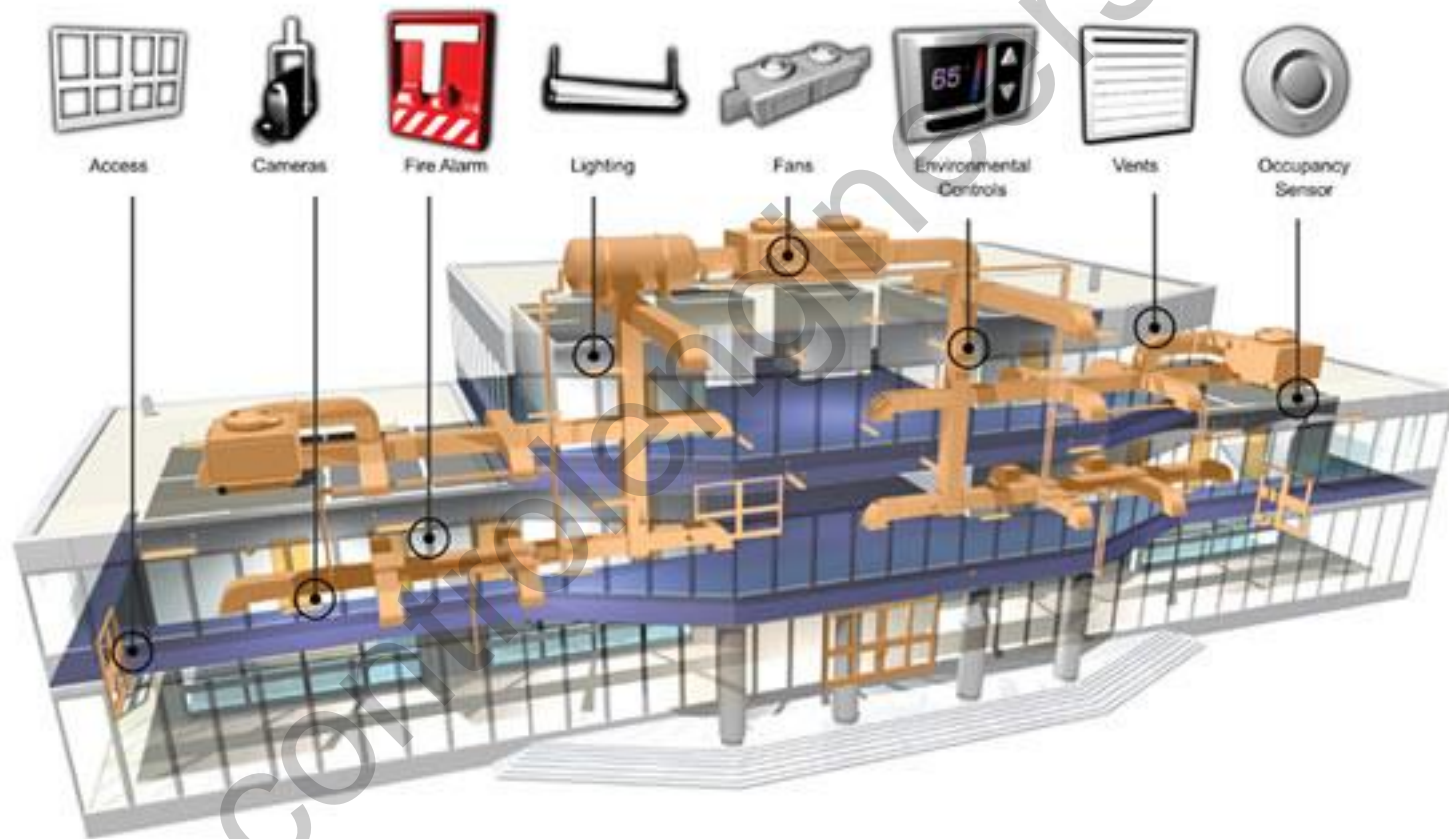
# ***LonWorks™***

**LonWorks** (local operation network) is a networking platform specifically created to address the needs of control applications. The platform is built on a protocol created by [Echelon Corporation](#) for networking devices over media such as [twisted pair](#), [powerlines](#), [fiber optics](#), and [RF](#). It is used for the automation of various functions within buildings such as [lighting](#) and [HVAC](#); see [Intelligent building](#).

# ***The LonWorks® Protocol***

- The LonWorks® protocol provides services at each layer of the OSI seven layer reference model. The protocol is open for anyone to implement, and a [reference implementation](#) in the C programming language can be obtained from CEA. Since its invention, the protocol has become an ANSI standard, an IEC standard, a Chinese national standard, and recently has achieved ISO standardization

# LONtalk Network

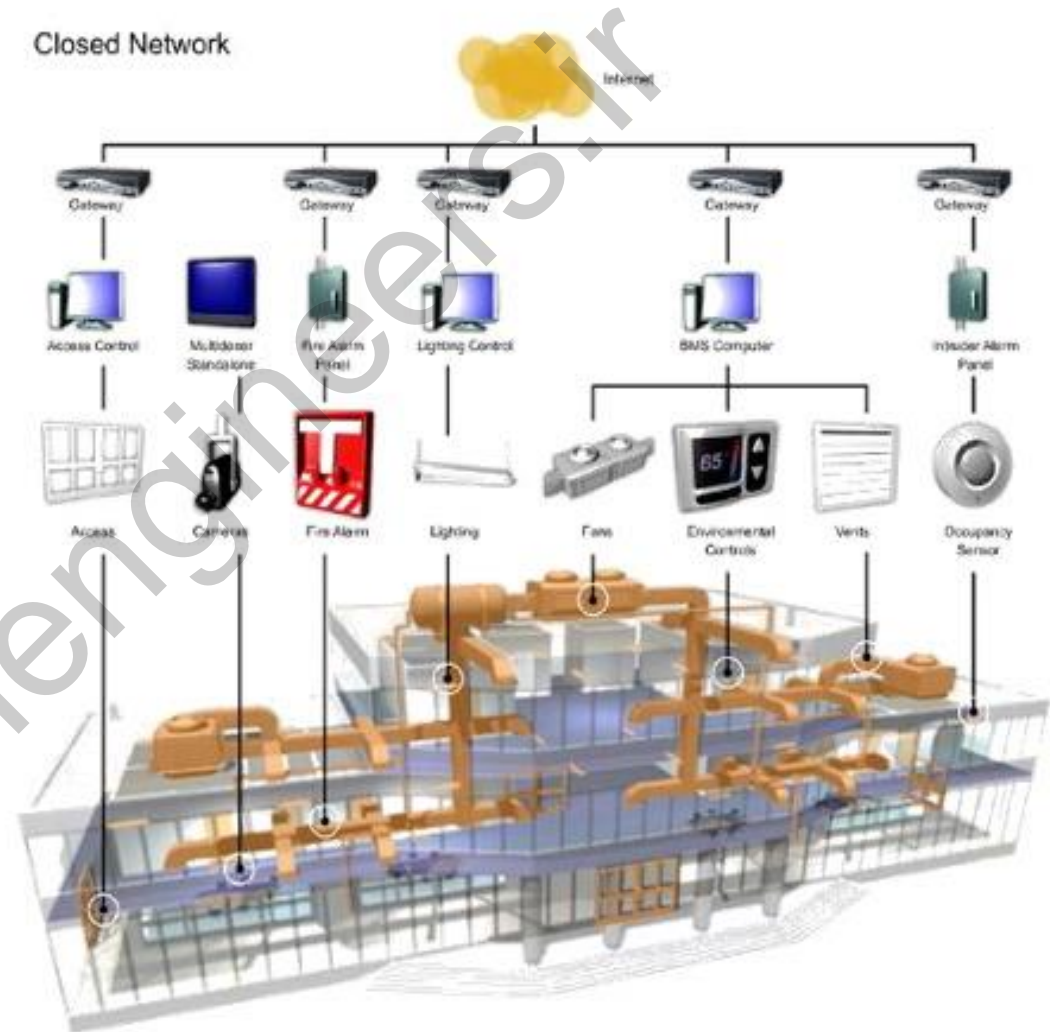




# LONtalk Network

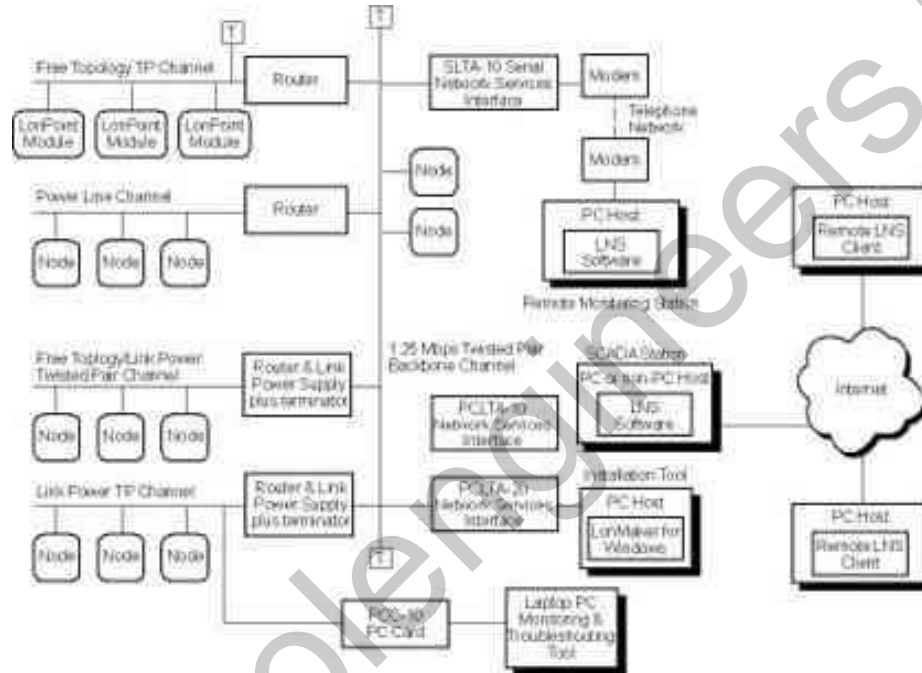
**LonTalk** is a protocol optimized for control created by [Echelon Corporation](#) for networking devices over media such as [twisted pair](#), [powerlines](#), [fiber optics](#), and [RF](#). It is popular for the automation of various functions in industrial control, [home automation](#), transportation, and buildings systems such as [lighting](#) and [HVAC](#); see [Intelligent building](#). LonTalk is defined by [ANSI](#) Standard ANSI/CEA 709.1. The LonTalk protocol has been ratified by standards setting bodies in the following industries & regions:

- ANSI 709.1 - Control networking (US)
- EN 14908 - Building controls (EU)
- GB/Z 20177.1-2006 - Control networking and building controls (China)
- [IEEE](#) 1473-L - Train controls (US)
- SEMI E54 - Semiconductor manufacturing equipment sensors & actuators (US)
- IFSF - International forecourt standard for EU petrol stations





# What's a LON Works?



## What's a LonWorks?

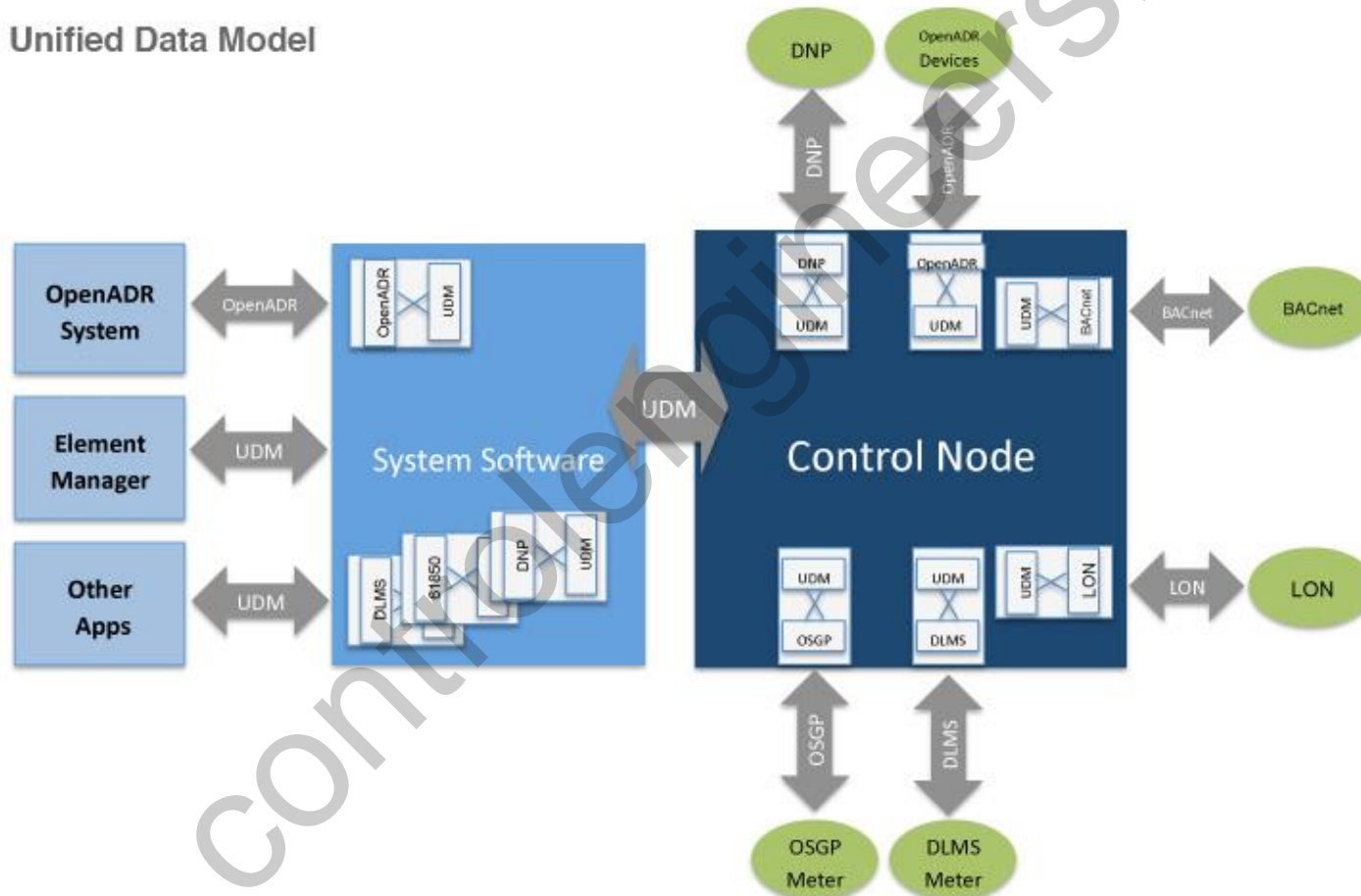
Let's take a quick look at control networks and LonWorks. A simple definition for a control network is: any group of devices working in a peer-to-peer fashion to monitor sensors, control actuators, communicate reliably, manage network operation, and provide complete access to network data. Control networks provide deterministic timing of commands, responses, events, and data transfers. LonWorks is based upon the LonWorks protocol, also known as the EIA 709.1 Control Networking Standard. Neuron chipsets are used in transceivers for communicating across LonWorks. LonWorks consist of devices such as:

- Network Interfaces => Control Modules => LonPoint Modules => Routers

- <http://www.iappliancweb.com/story/oeg20010703s0016.htm>

# Control Operating System (COS)

## Unified Data Model

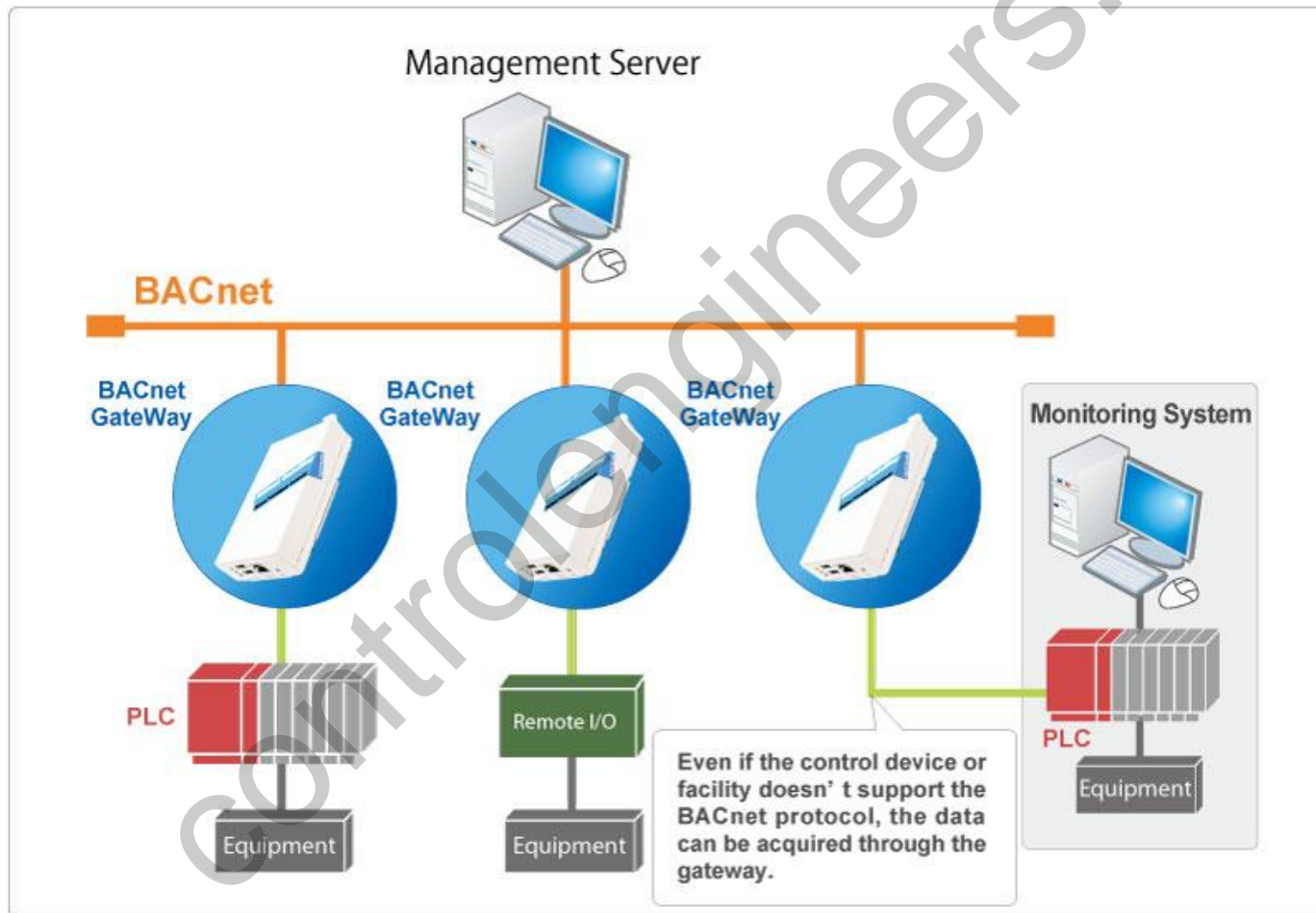


# BACnet Components



BACnet is a communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol. Facilities like electricity, air conditioning and lighting can be centrally supervised by using BACnet protocol. PLC Stands for Programmable Logic Controller. A sequence control device, used to control equipments by sequentially executing the programmed instructions planted beforehand with a computer or input device.

# BACnet Network Diagram



# Modbus

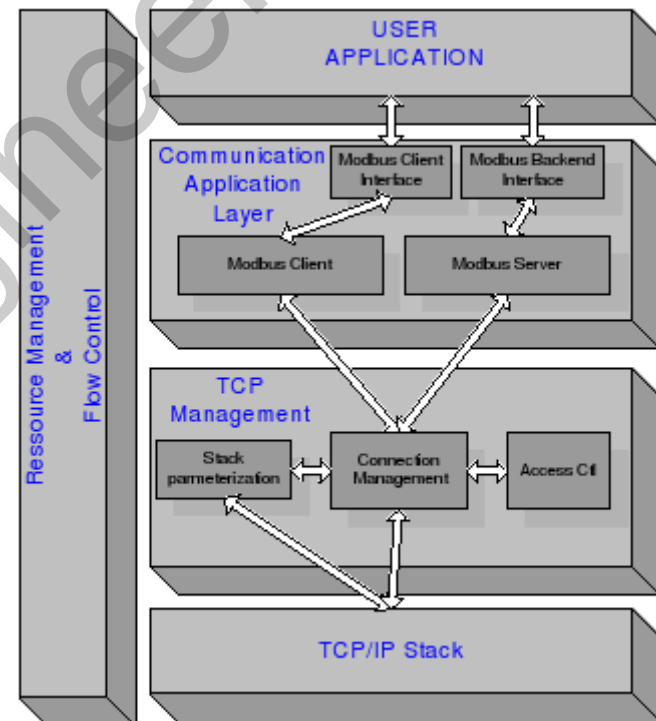
**Modbus** is a serial [communications protocol](#) published by [Modicon](#) in 1979 for use with its [programmable logic controllers](#) (PLCs). Simple and robust, it has since become a [de facto standard](#) communication protocol, and it is now amongst the most commonly available means of connecting industrial [electronic](#) devices. The main reasons for the extensive use of Modbus in the industrial environment are:

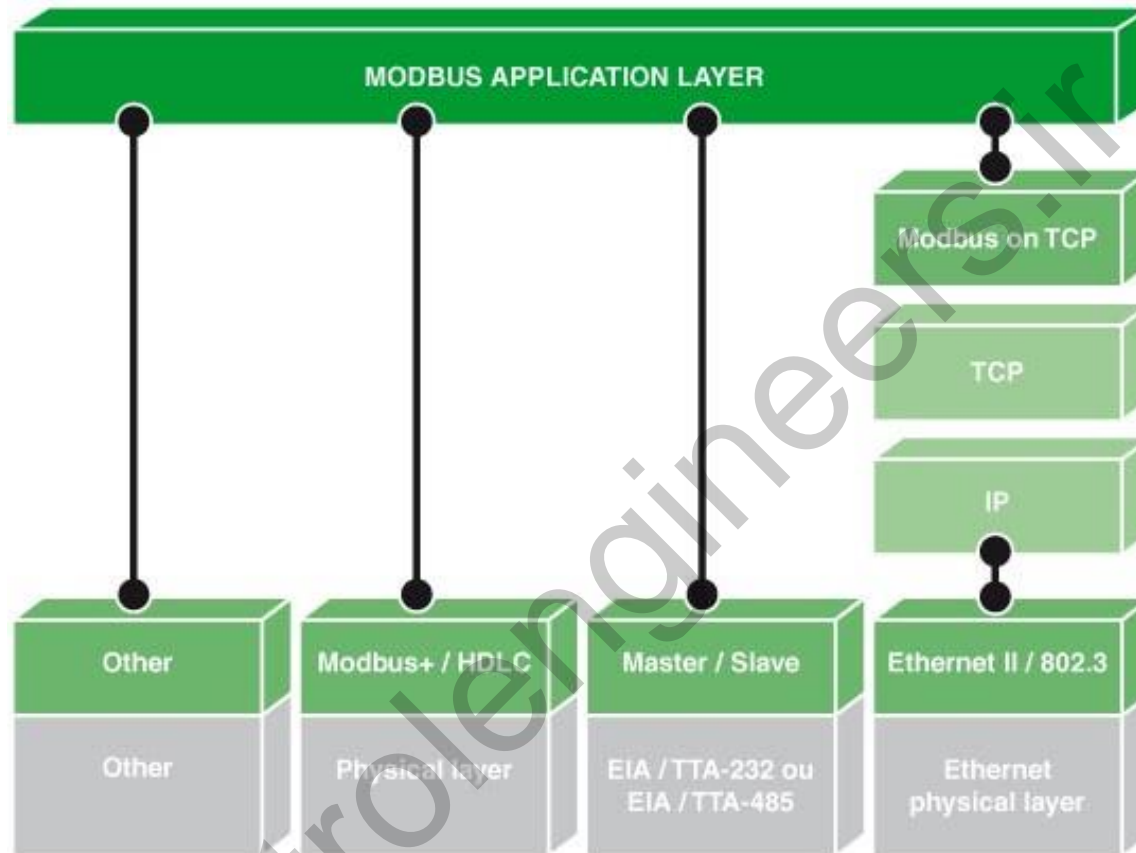
- It has been developed with industrial applications in mind
- It is openly published and royalty-free
- It is easy to deploy and maintain
- It moves raw bits or words without placing many restrictions on vendors

Modbus allows for communication between many (approximately 240) devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to a [computer](#). Modbus is often used to connect a supervisory computer with a [remote terminal unit](#) (RTU) in [supervisory control and data acquisition](#) ([SCADA](#)) systems.

# Modbus Architecture

Modbus RTU is an open, serial (RS-232 or RS-485) protocol derived from the Master/Slave architecture. It is a widely accepted protocol due to its ease of use and reliability. Modbus RTU is widely used within Building Management Systems (BMS) and Industrial Automation Systems (IAS). This wide acceptance is due in large part to MODBUS RTU's ease of use.





## Modbus Diagram

Modbus is a message handling structure introduced by Modicon in 1979. Modbus is an application level protocol based on the OSI model. It is independent of the physical layer.



# ***Summary***

- Building Automation Systems help keep buildings operating at higher efficiency
- Also provide for security and comfort
- EMS/BMS ensure that energy is not being used at the wrong time / or when not needed
- EMS/BMS can be integrated with DEMS to provide Automated Demand Response (ADR)