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HVAC Systems: Understanding The Basics

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Forecasting The Future

"... the most reliable way to anticipate the future is by understanding the present."

John Naisbitt

Megatrends

21st Century Buildings

- Purpose of a building is to provide a controlled environment for occupants.
- Building is a collection of systems that provide a controlled environment.
- Systems' integration is the key to effective and efficient building operations.
- Buildings will be optimized as a system.
- Traditional approach: optimize building subsystems leaving building suboptimal.
- Building quality will be measured by its ability to efficiency support the activity it houses - not its utility bills.

HVAC Systems Establish Environment

Sustainable Construction
LEED: Energy & Atmosphere

EA P1 Fundamental Building Commissioning

EA P2 Minimum Energy Performance

EQ P3 CFC Reduction In HVAC&R Equipment

EA C1 Optimize Energy Performance

EA C2 Renewable Energy

EA C3 Independent Commissioning

EA C4 Ozone Protection (No HCFCs)

EA C5 Ongoing Measurement & Verification

Example HVAC System Related Prerequisites & Credits

Sustainable Construction
LEED: Indoor Environ Quality

EQ P1 Minimum IAQ Performance

EQ P2 ETS Control

EQ C1 Carbon Dioxide Monitoring

EA C2 Ventilation Effectiveness

EA C3 Construction IAQ Management Plan

EA C5 Indoor Chemical & Pollutant Source Control

EA C6 System Controllability

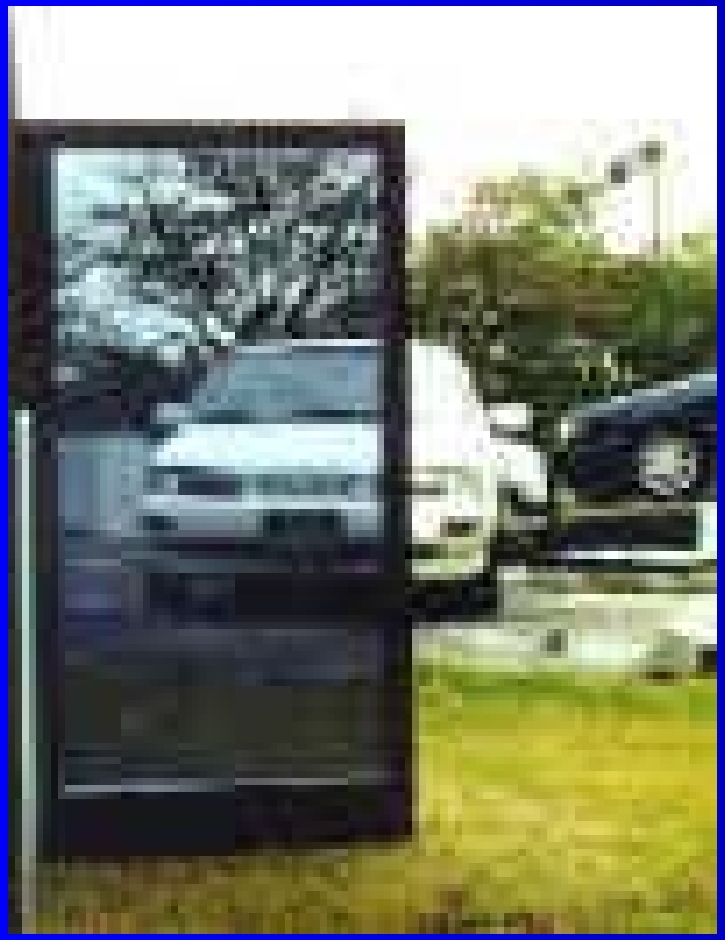
EA C7 Thermal Comfort

Example HVAC System Related Prerequisites & Credits

Building Integrated Photovoltaics

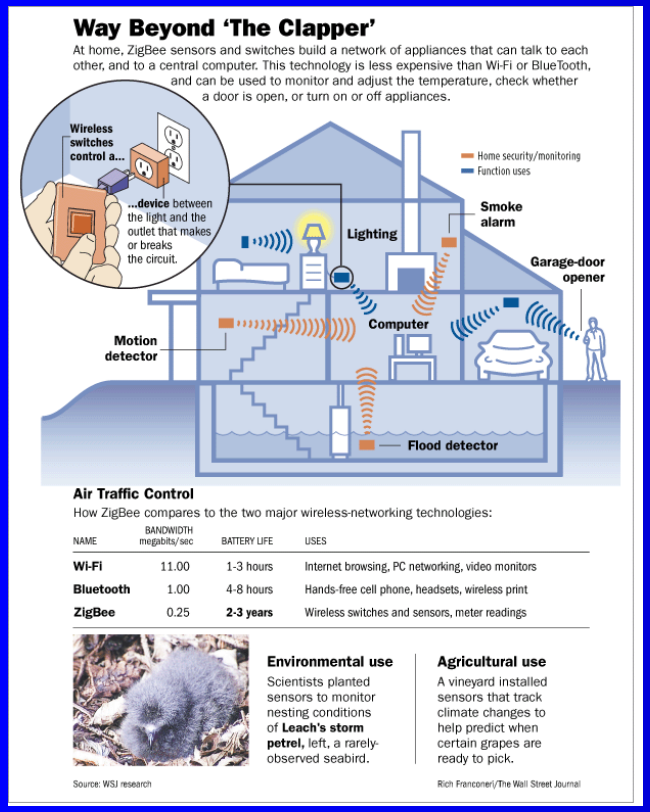
Doxford Office Park, England (*www.solarcentury.co.uk*)

Smart Vision Glass



Photos by Research Frontiers, Inc. (*www.smartglass.com*)

ZigBee (IEEE Std 802.15.4) Wireless Bldg Controls



Way Beyond 'The Clapper'

At home, ZigBee sensors and switches build a network of appliances that can talk to each other, and to a central computer. This technology is less expensive than Wi-Fi or BlueTooth, and can be used to monitor and adjust the temperature, check whether a door is open, or turn on or off appliances.

Air Traffic Control

How ZigBee compares to the two major wireless-networking technologies:

NAME	BANDWIDTH megabits/sec	BATTERY LIFE	USES
Wi-Fi	11.00	1-3 hours	Internet browsing, PC networking, video monitors
Bluetooth	1.00	4-8 hours	Hands-free cell phone, headsets, wireless print
ZigBee	0.25	**2-3 years**	Wireless switches and sensors, meter readings

Environmental use

Scientists planted sensors to monitor nesting conditions of **Leach's storm petrel,** left, a rarely-observed seabird.

Agricultural use

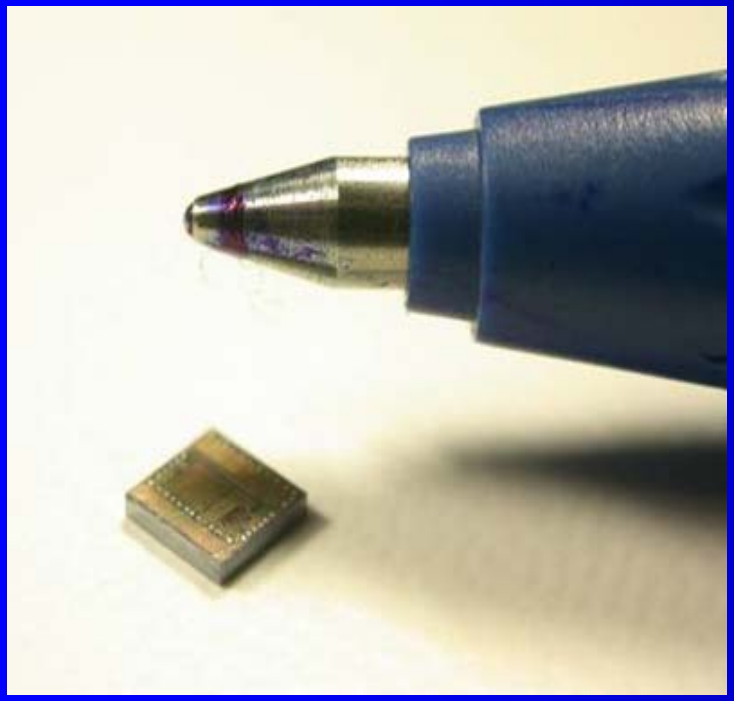
A vineyard installed sensors that track climate changes to help predict when certain grapes are ready to pick.

Source: WSJ research

Rich Francoeur/The Wall Street Journal

Self-Organizing, Self-Healing Mesh Network

"Motes" = Smart Sensors

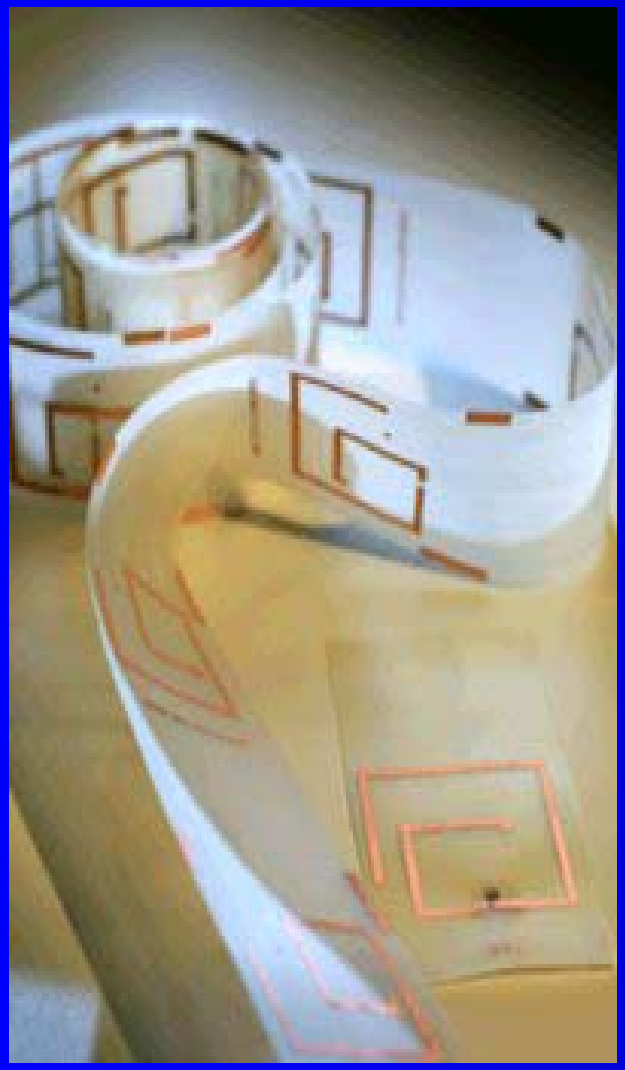


UC Berkeley "Smart Dust" Prototype

- Tiny, self-contained, battery-powered sensors and computers that use rf technology to communicate and exchange data with one another.
- Able to self-organize into ad hoc networks to form wireless sensor networks.
- Use TinyOS.
- Applications in agriculture, structure monitoring, industrial controls, military, security, etc.

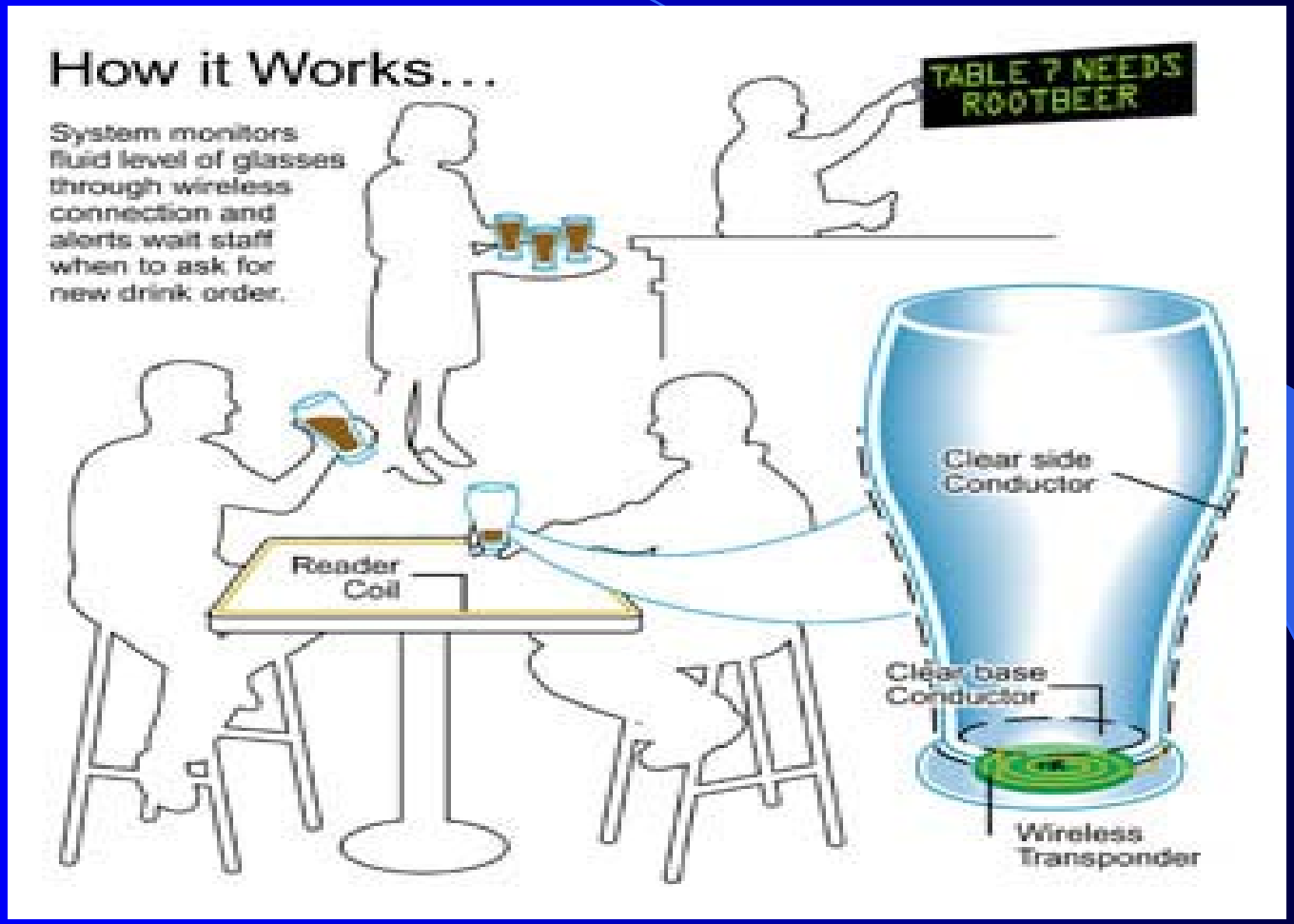
Photo from David E. Culler & Hans Mulder, "Smart Sensors to Network the World," *Scientific American*, June 2004.

Smart (RFID) Tags



- Passive
- Active

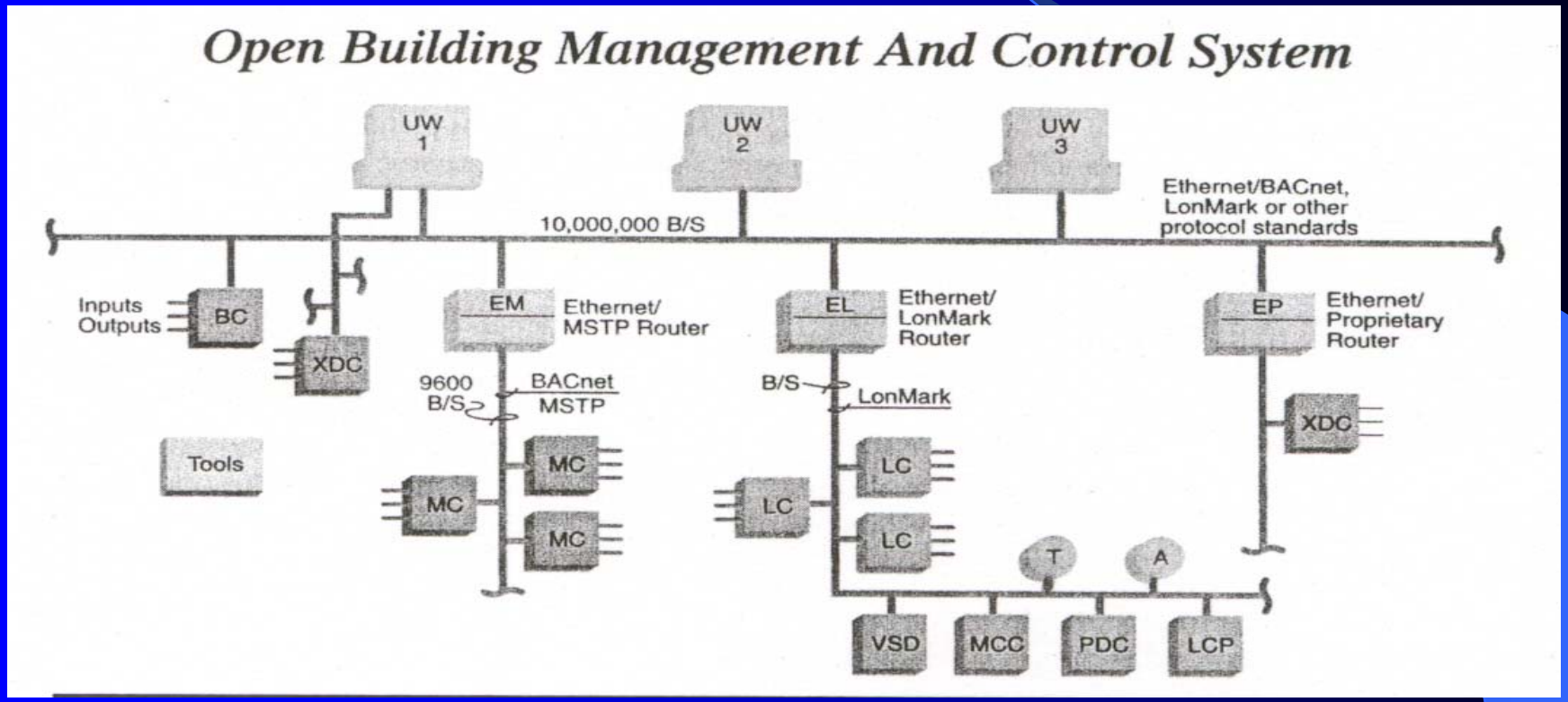
Mitsubishi "iGlassware"



Mitsubishi Electric Research Laboratories (MERL)

http://www.merl.com/projects/iGlassware/

Integrated Automation
Open Architecture Control Systems: LonMark & BACnet



Benjamin Stein & John S. Reynolds, *Mechanical and Electrical Equipment for Buildings*, John Wiley & Sons, 2000, p. 484

Security & Life Safety

- Available Today:
  - Surveillance Cameras
  - Bomb Sniffers
  - Basic Biometrics
  - Chemical & Bio Detectors
- Coming Soon:
  - Millimeter Wave Cameras
  - Vein Maps
- Under Development:
  - Remote Iris Tracking
  - Ears & Gaits
  - Odor Sensors
  - Saliva Scans
  - Universal Sensors

Catherine Yang, "The State Of Surveilance, *BusinessWeek*, August 8, 2005, pp. 52-59.

Intelligent Building

Building that provides a productive and cost-effective environment through the optimization of its structure, systems, services, and management as well as the interrelationships between them.

BICSI, *Telecommunications Distribution Methods Manual*, Ninth Edition, pp. 21-1.

Words For Today ...

Convergence

&

Interoperability

SMACNA/SMWIA New Role:
System Integrator

HVAC Systems: Understanding The Basics

Manual Objective

Provide a practical guide to HVAC systems including equipment and controls that will assist project personnel in the marketing, estimating, design management, procurement, installation, commissioning, and maintenance of HVAC systems.

Systems Approach To HVAC

HVAC Systems: Understanding The Basics

Target Audiences

- HVAC Contracting Firms:
  - Project Managers
  - Project Engineers
  - Estimators
  - Superintendents & Forepersons
  - Others
- Construction Programs – Colleges & Universities:
  - Engineering (Construction Emphasis)
  - Construction Science, Management, & Technology
  - Other Related Academic Programs
- General Contractors & Construction Managers

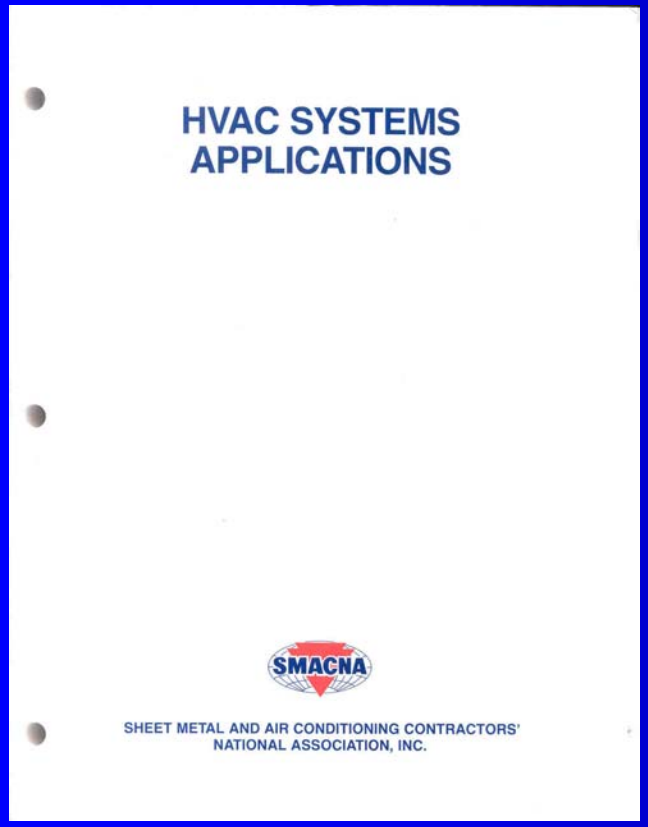
This Is Not A Design Manual

How Will This Manual Be Used?

- Chapter Education Program
- Self Study
- Reference
- College Text
- Combination

HVAC Systems: Understanding The Basics

HVAC Systems Applications



I	Introduction
II	Basic HVAC Systems
III	HVAC Control Systems
IV	Multizone Systems
V	Dual-Duct Systems
VI	Terminal Reheat Systems
VII	Variable Air Volume Systems
VIII	Induction & Induction Reheat Systems
IX	Special Applications
X	Hydronic Systems
XI	Unitary & Heat Pump Systems
XII	Cooling/Refrigerant Systems
XIII	Hydronic Heat Recovery Systems
XIV	Engineering Data, Tables & Charts

HVAC Systems: Understanding The Basics' **objective is to complement existing** ***HVAC Systems Applications.***

HVAC Systems: Understanding The Basics

Issues Addressed In Manual

- HVAC System Operation:
  - System
  - Equipment
  - Controls
  - Relative System Cost & Life-Cycle Economics
- Fabrication & Installation Issues:
  - Cost Estimating
  - Procurement
  - Scheduling
  - Sequencing (Fragnets)
  - Productivity
  - Other
- Commissioning & Closeout (TAB, LEED, Etc.)

HVAC Systems – Understanding The Basics

Table Of Contents

HVAC Systems – Understanding The Basics

Manual Format

- Conventional Paper-Based
- SMACNA Publication References
- Problems
- Case Studies
- PowerPoint Slides

Possible Electronic Format With Hyper-Linked Topics

Questions?