

Buildings as Networks: Guiding Principles for Energy Efficiency

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Networks are already a critical element in the performance and services provided by consumer electronics and IT equipment. When the networks are properly designed and configured, the network can act to reduce the products' electricity consumption. Many other energy-consuming products are just becoming networked. Networks controlling lights and climate control equipment are two important examples of devices connected by networks. These networks offer new services and, potentially, energy savings. In the case of lighting, sensors, combined with advanced controls, can switch off lights in unoccupied rooms, dim lights when sunlight is adequate, and even adjust exterior shades to minimize glare. Climate control systems can similarly use distributed sensors and actuators to optimize conditions and energy efficiency. Many features of these networks resemble (or are even identical to) the networks used today to link consumer electronics and IT equipment.

The design of the network will affect the energy consumption of the devices connected to it. Many network designs can promote communication among devices but networks that effectively save energy require further specifications. The following *Guiding Principles* are therefore proposed in the design and operation of networks to assure high performance and energy-efficient operation. The key in all cases is effective power management, that is, lower each device's functionality (and power use) to a level compatible with its responsibility in the network at that moment. Put another way, devices should be in a high-power "awake" mode when their contributions are required and allowed to enter a low-power ("sleep") mode whenever their contributions are not needed.

The Guiding Principles are:

- A. The existence of one device on a network should not cause another device to stay awake when it might otherwise go to sleep.
- B. The network should be designed such that a legacy or incompatible device will not prevent the rest of the network from effectively using power management.
- C. Devices should expose their own power state to the rest of the network and be able to report estimated or actual power use levels.
- D. Product interfaces — for people or other products — should follow (international) standard principles and designs.
- E. Products or devices that influence energy consumption should adhere to (international) standards for behavior and communication appropriate to their function.
- F. Products and connections should have the ability to modulate energy use in response to the amount of service required.
- G. Energy efficiency efforts should not favor any particular hardware — or even software — technology. All network technologies must be the target for efficiency efforts. Future buildings will include many different technologies; those in any particular building will be diverse, and always changing.
- H. Harmonization of basic principles underlying efficient design for networked devices should cross all end uses and be global.

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