

IEEE Smart Grid Vision Panel Session

Stephen F Bush

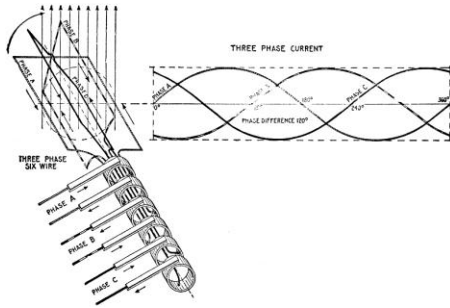
National Institute of Standards and
Technology

Tuesday, October 5, 2010 17:00 - 18:30

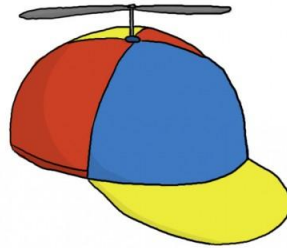
Enable active participation by consumers

Why Metrics?

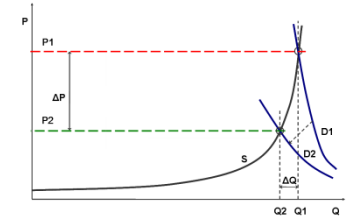
Provide power quality for the range of needs in a digital economy



Accommodate **all** generation and storage options



Enable new products, services, and markets

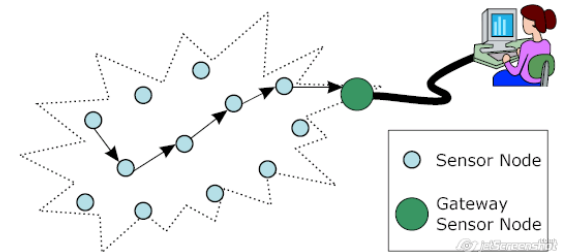


Operate resiliently against physical and cyber attack and natural disasters



Anticipate and respond to system disturbances in a self-healing manner

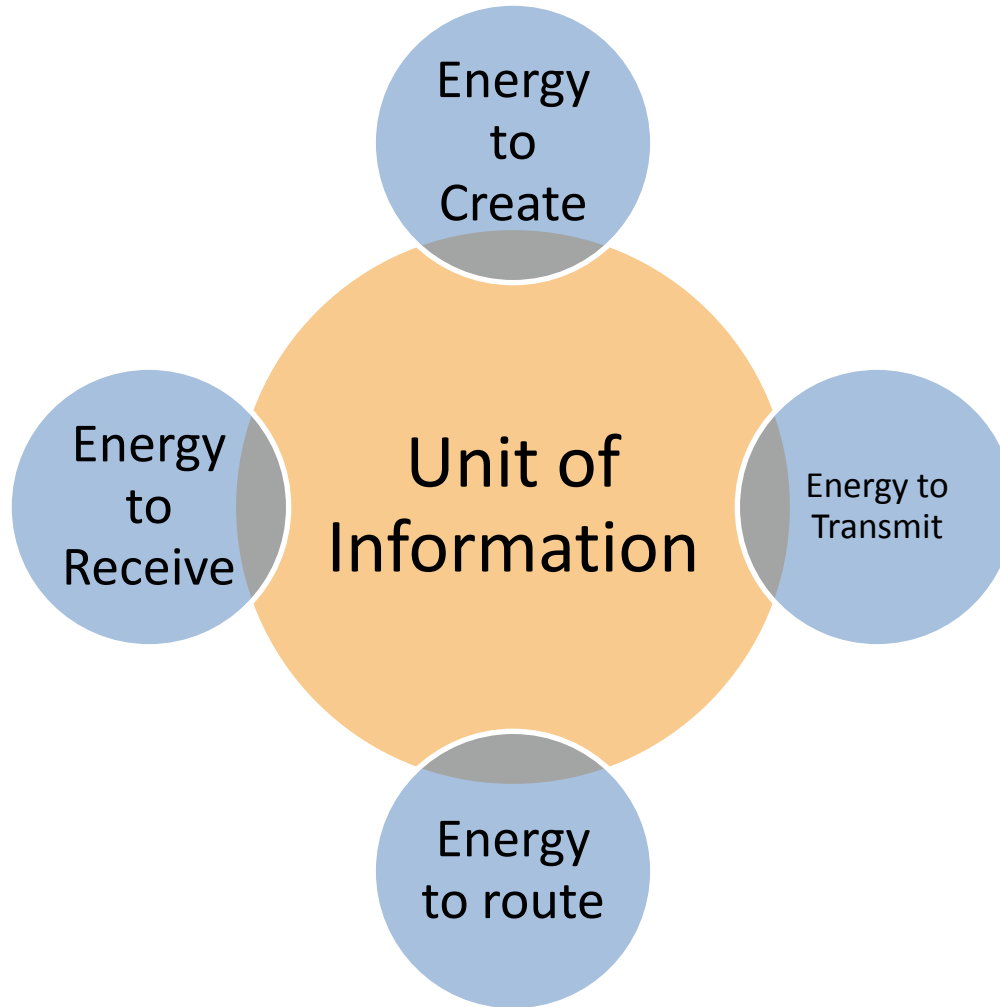
Optimize asset utilization and operating efficiency



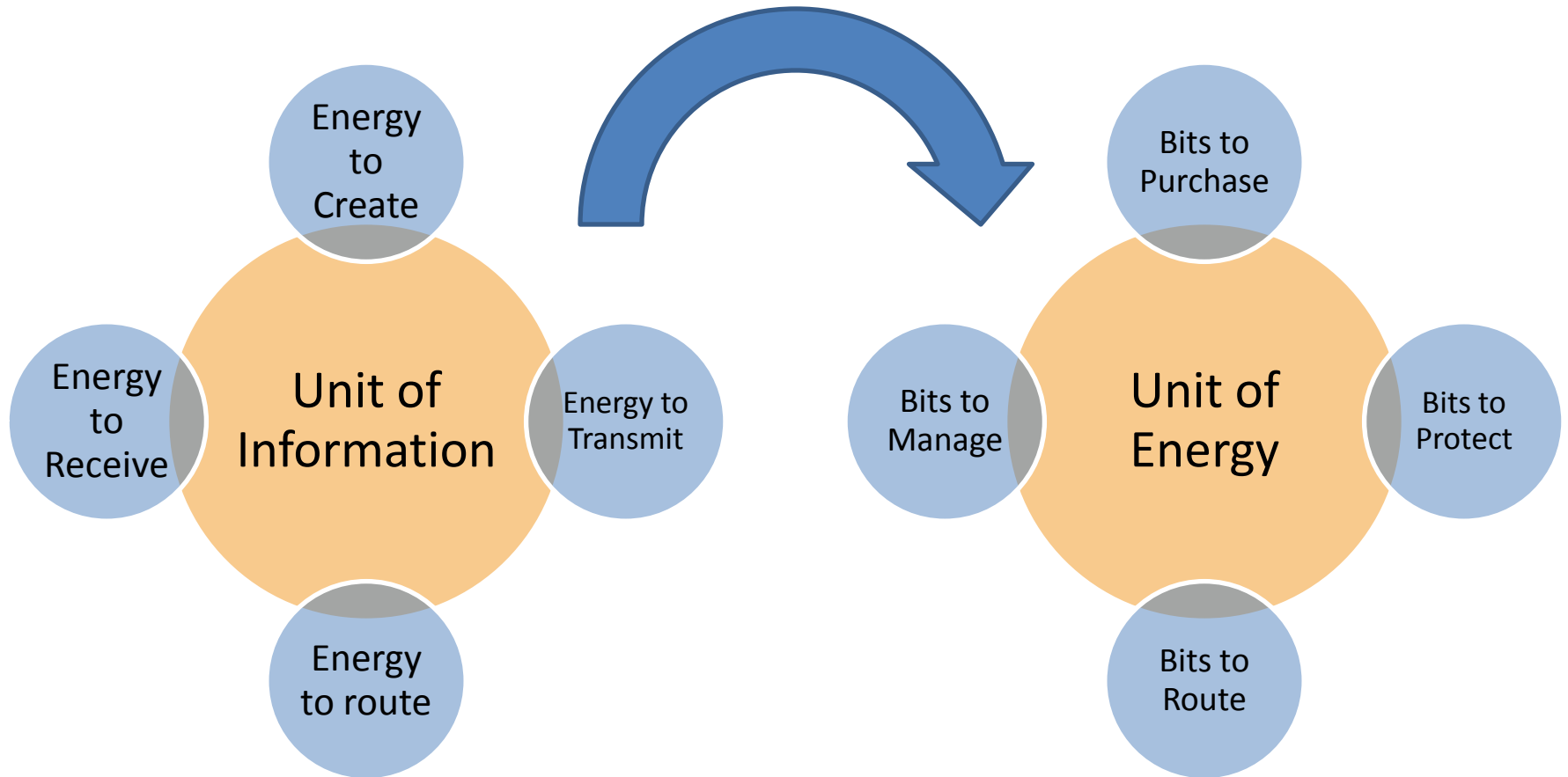
[Robert Lawton](#)

Developing correct fundamental metrics will drive success

Low Power Communication



Bits are Energy

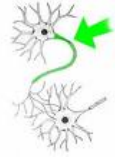


Energy and Information

Molecule-to-molecule communication



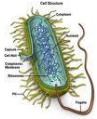
Cell 10 um



Extreme Distribution

Axon 0.5 um

Extreme Delivery

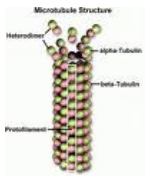


Bacteria 0.2 um

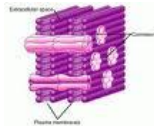


Extreme Sensing

Virus 25 nm

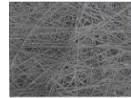


Microtubule 10 nm



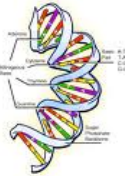
Gap junction 4 nm

Protein 1 nm



Nanowire 1 nm

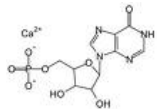
Nanotube 0.1nm



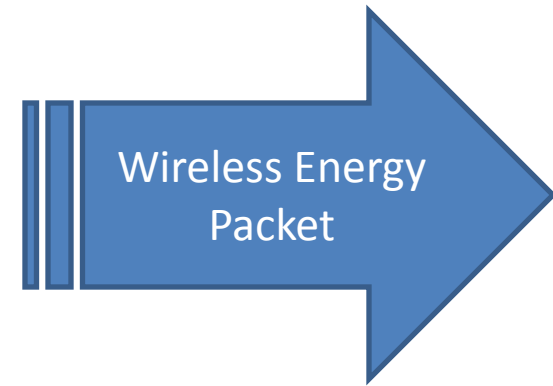
DNA 0.1 nm



Calcium ion 1 pm



Internet-like hop-by-hop transfer of power



2nd Law of Thermodynamics

Landauer's Principle

Energy and self-organization

Autopoiesis

<http://www.amazon.com/Nanoscale-Communication-Networks-Science-Engineering/dp/1608070034/>