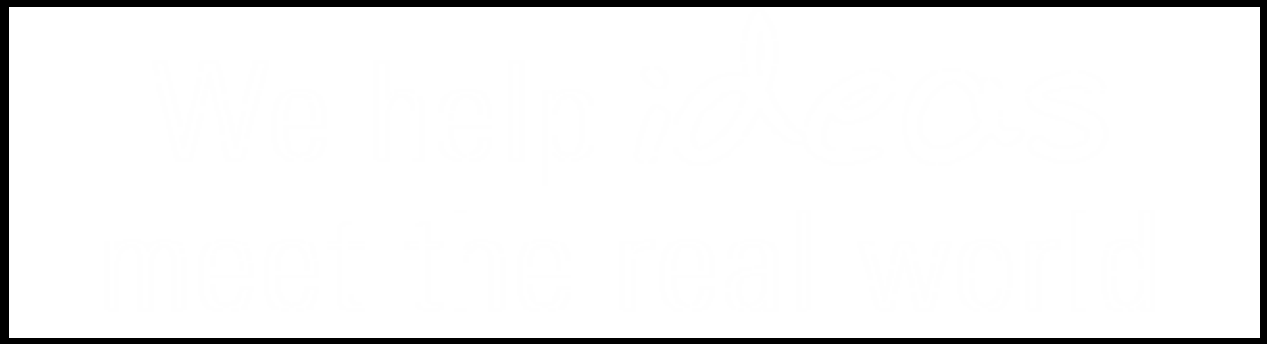
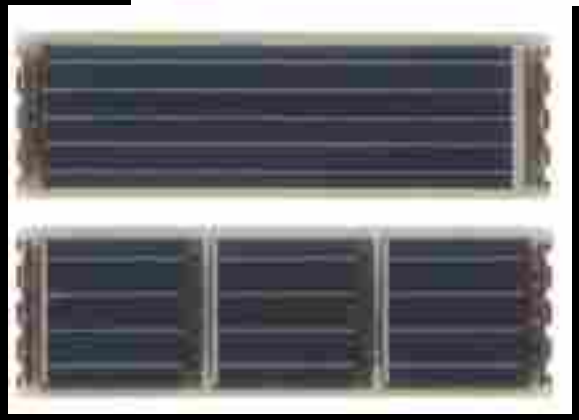


Working without Energy

If wireless systems can work without addition of energy after installation

a whole new world of +10 years applications become possible

Waste Energy can be collected and re-used



How are systems perceived today

- Always ready
- Up-time / Down-time
- Latency
- Boot time

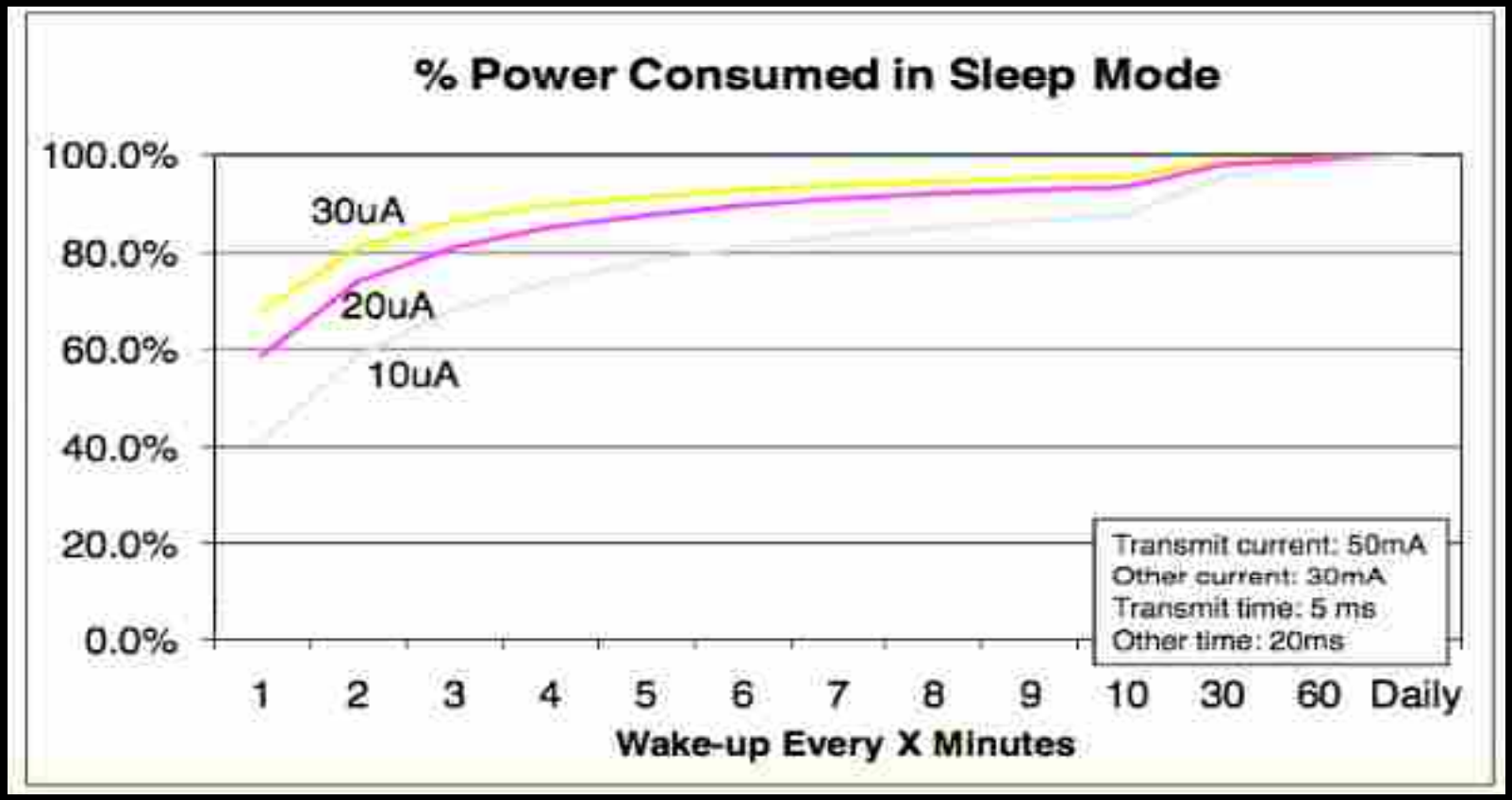
Types of Applications

- Periodic
  - Autonomous systems
- On demand
  - Most systems today
- Real time
  - Safety critical systems

- Periodic Available
  - New applications

The Idle Case

Systems at sleep consume all the power

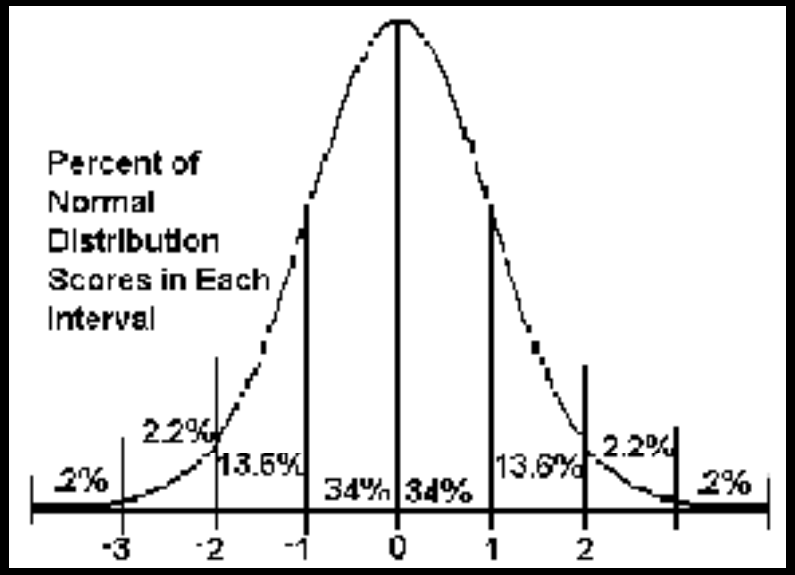


Harvest Energy for Sleep time

Source: Powercast

Case: Traffic counting

Approximations are as good as or better than real values (reduced noise)



Types of Applications

- Periodic
  - Autonomous systems
- On demand
  - Most systems today
- Real time
  - Safety critical systems

- Periodic Available
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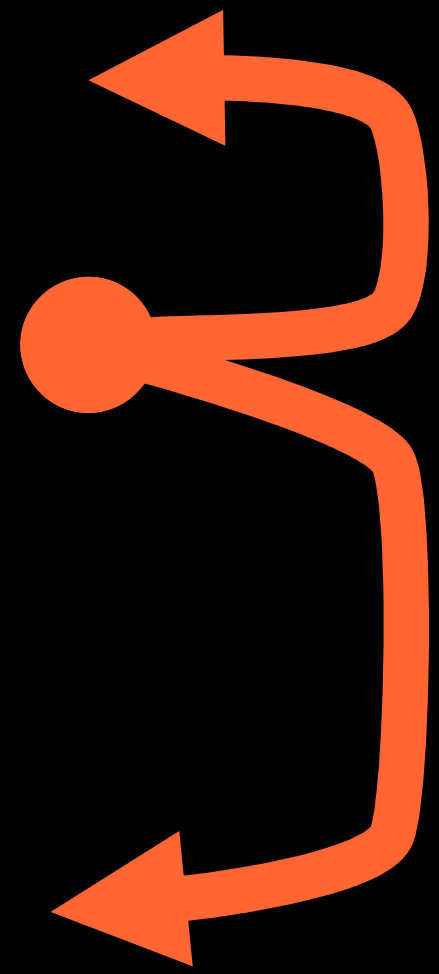

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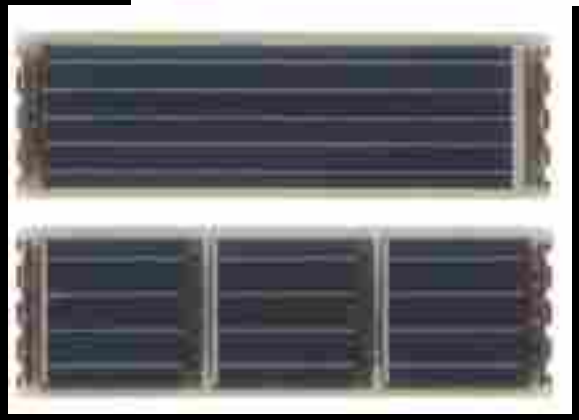
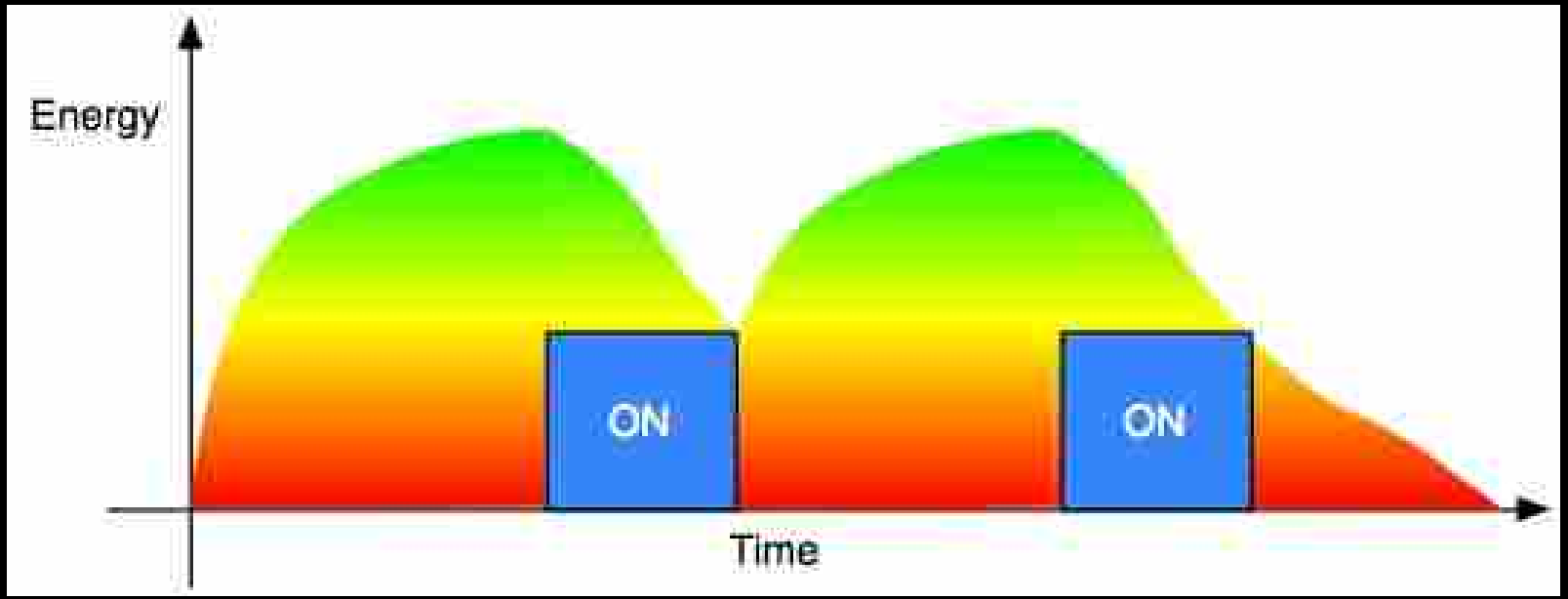


The Power Conditioner

- Harvest tiny amount's of Energy
- Build of sufficient charge
- Use the Energy in bursts



Low Energy Charge Pump

- Seiko S882Z

Almost there

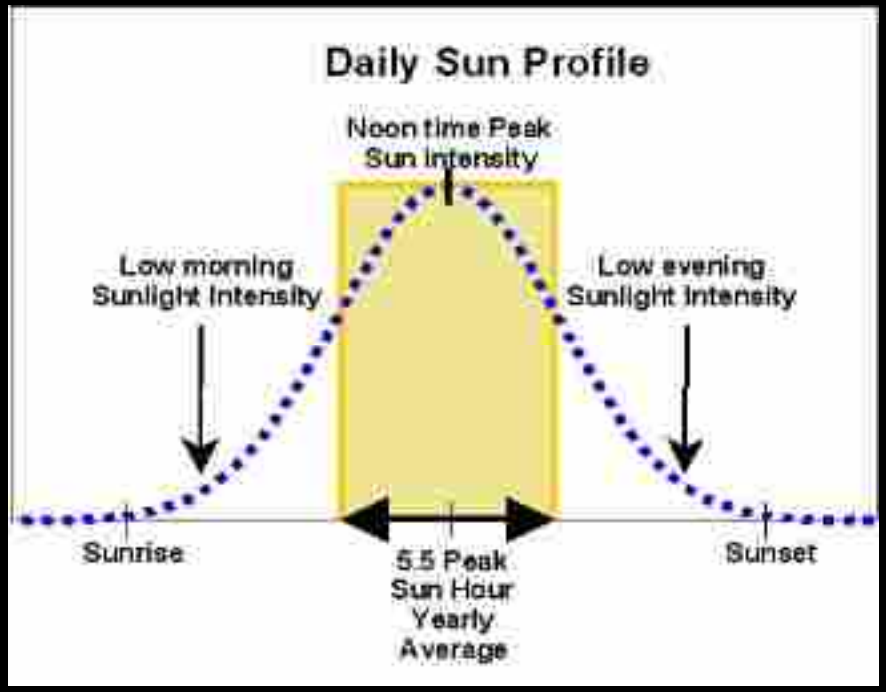
■ Features

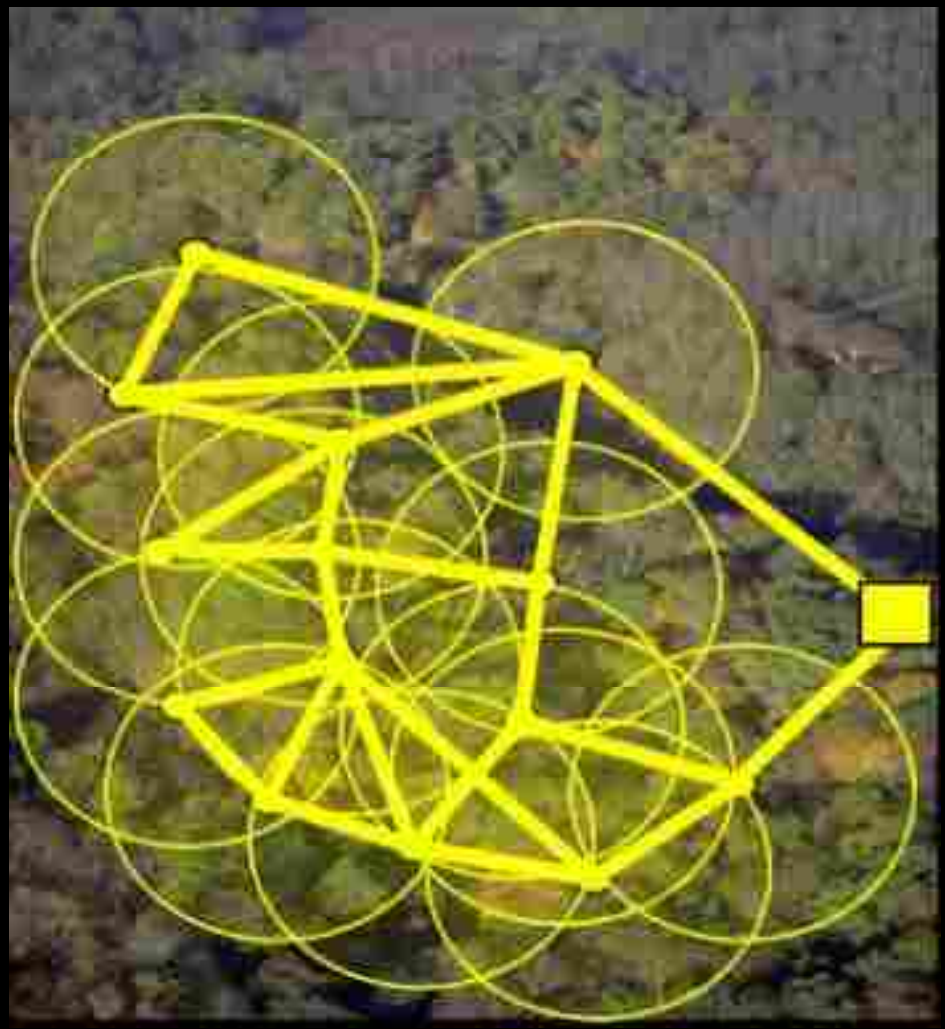
• Operating input voltage	0.3 to 3.0 V
• Current consumption	During operation : 0.5 mA max. (at V_{IN} = 0.3 V) During shutdown : 0.6 µA max. (at V_{IN} = 0.3 V)
• Discharge start voltage	1.8 to 2.4 V (selectable in 0.2 V steps)
• Shutdown voltage	Discharge start voltage + 0.1 V (fixed)
• Oscillation frequency	350 kHz typ. (at V_{IN} = 0.3 V)
• Small package	SOT-23-5 package
• External component	Startup capacitor (C_{CPOUT}), 1 unit*1
• Lead-free products	

The System View

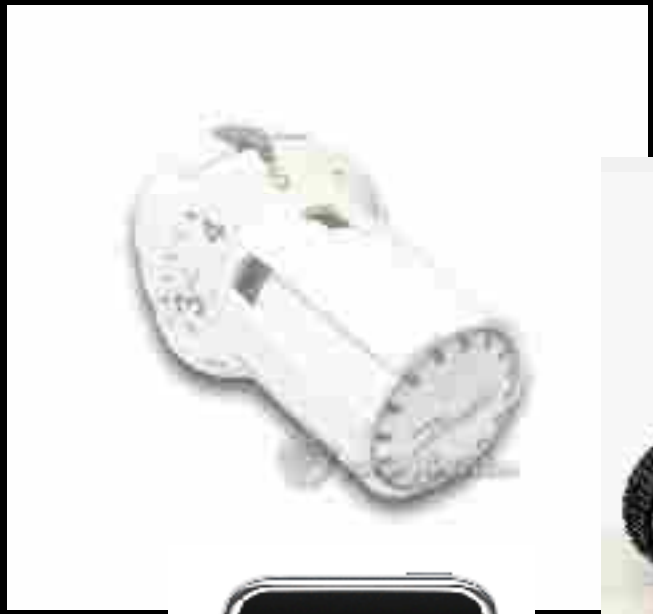
Mesh network

Optimize power in a system context





Can we turn it off



What are the real impact of lost data

Mature response ?

Bell M412 Pitch Link

The system was able to transmit realtime data about the stress on vital components

No batteries was needed

Available power exceeded need
300 uW harvested during level flight
250 uW needed for realtime operation

Source: MicroStrain

Torro Espacio Madrid

- 4200 Switches which must be rearranged on demand
- Uses en-ocean motion harvestere
- Saves 42.000 batteries in 25 years

Source: En-Ocean

Structural Health Monitoring in Los Alamos

- The bridge needs to be “cleared” after earthquaktes.
- Bridge health can be monitored by sensors (strain, ultra sound, etc.)
- Experiments shows that a 0.1F 3.3V C can be charged in 200s
- Wireless TX and RX 256 bytes (RS-232) 5.2 m

How about your product

DELTA Energy Harvesting Expertise

We have the required knowledge about:

- Mechanical Design
- Thermo dynamics
- Micro-Electronic
- Embedded Software
-

And we are used to combine the expertices

It is possible

Thomas Sørensen

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