Smart Energy Monitoring

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Contiki

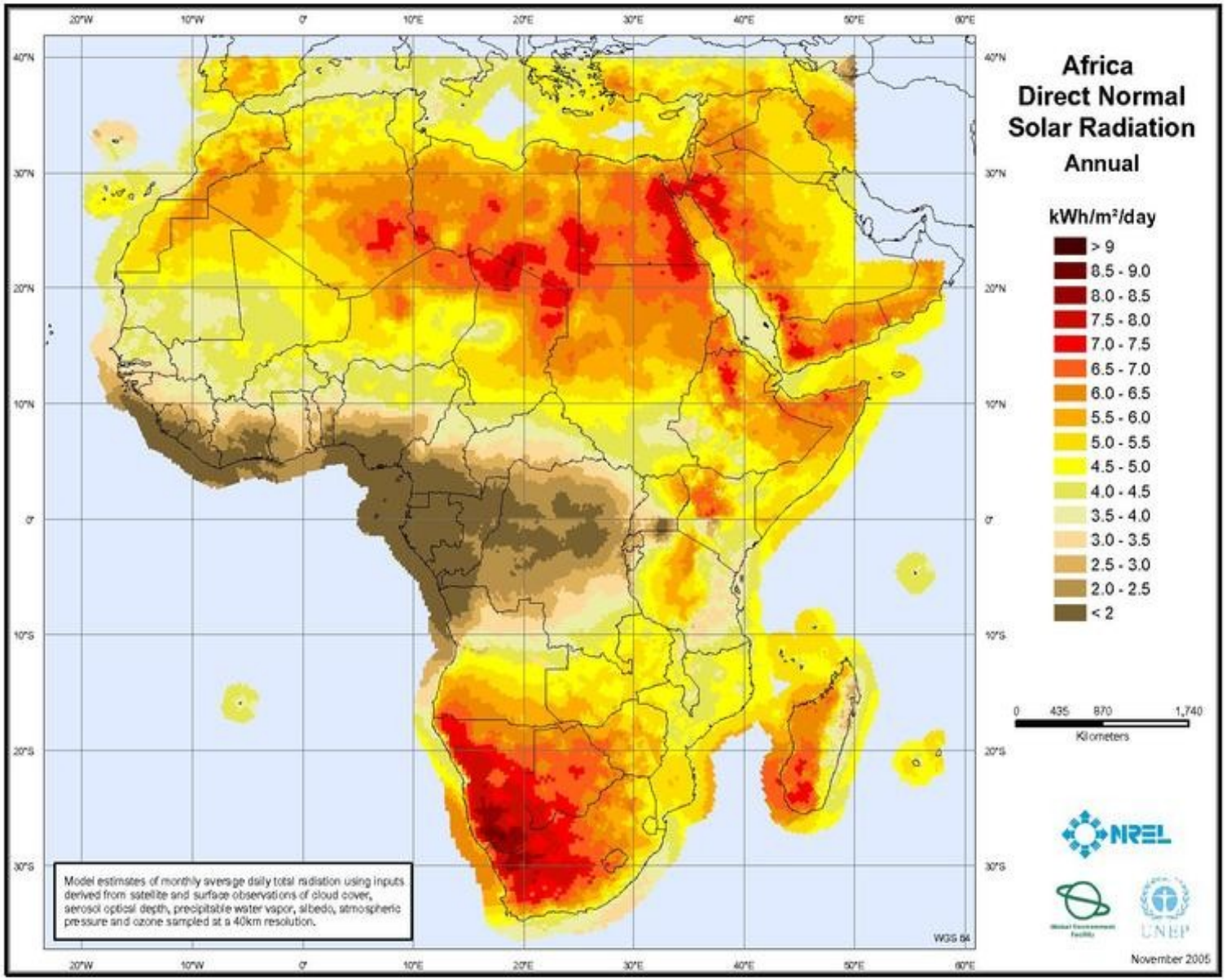
The Open Source OS for the Internet of Things

UNIVERSITY of the
WESTERN CAPE

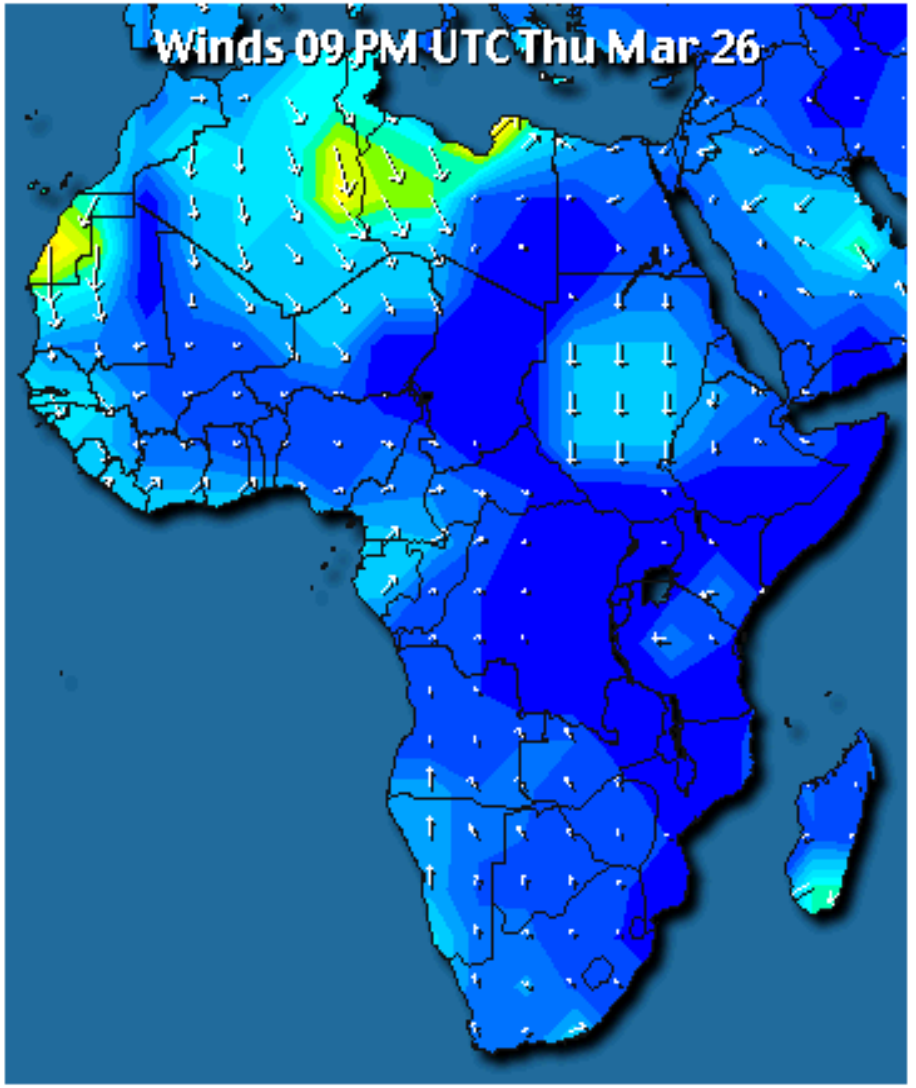
Areas of Interest

- Solar farms
- Wind farms
- Energy harvesting
- Green buildings/homes
- Architectures
- Cloud
- Security & Confidentiality

Africa & Middle East



Africa Hourly Wind Map



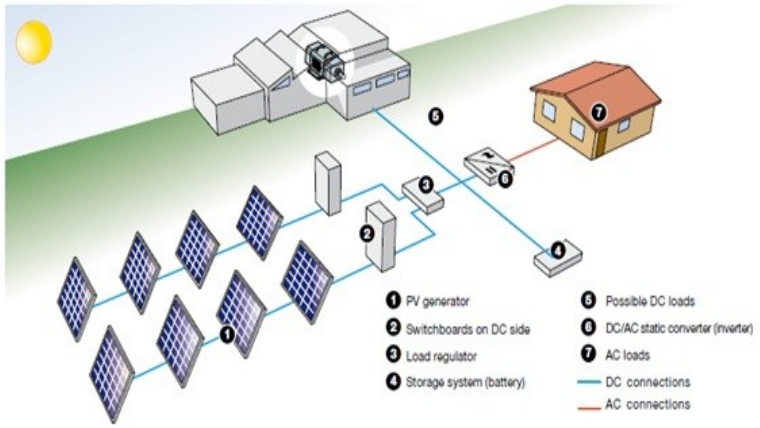
0 2 4 6 8 10 12 14 16 18 20 m/s

0 5 10 15 20 25 30 35 40 45 mph

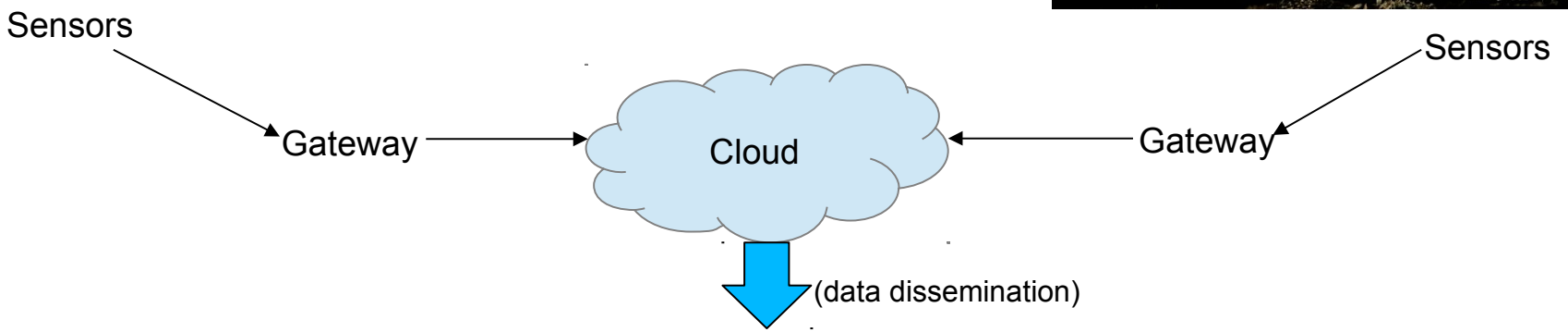
Green farms

- Use of sensors to take system readings and communicate those readings over a network (**different architectures**)
- Cut out the need for an engineer to visit a site (**remote monitoring**)
- How much do you think companies could save on traveling costs?

Solar farm



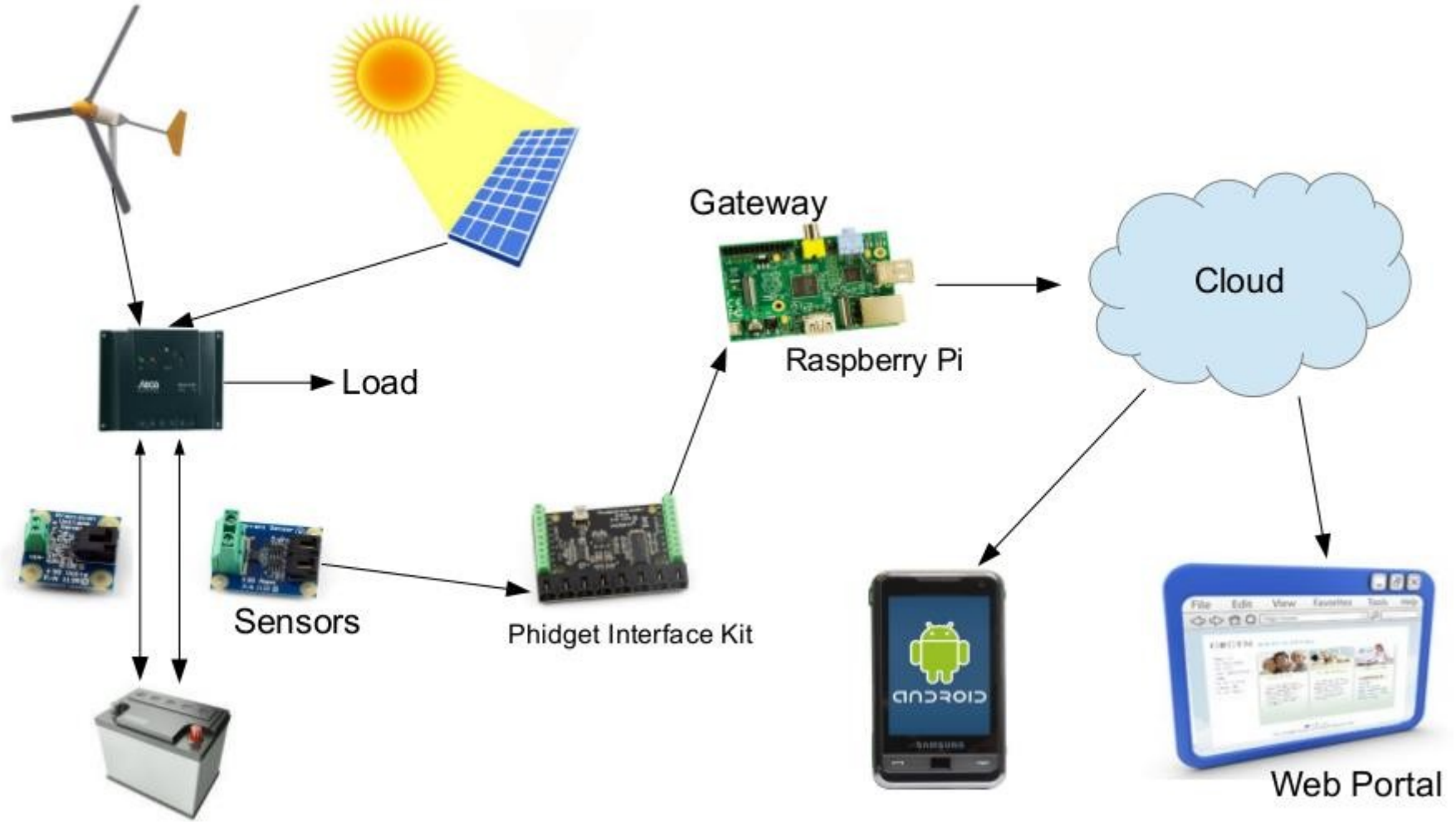
Wind farm



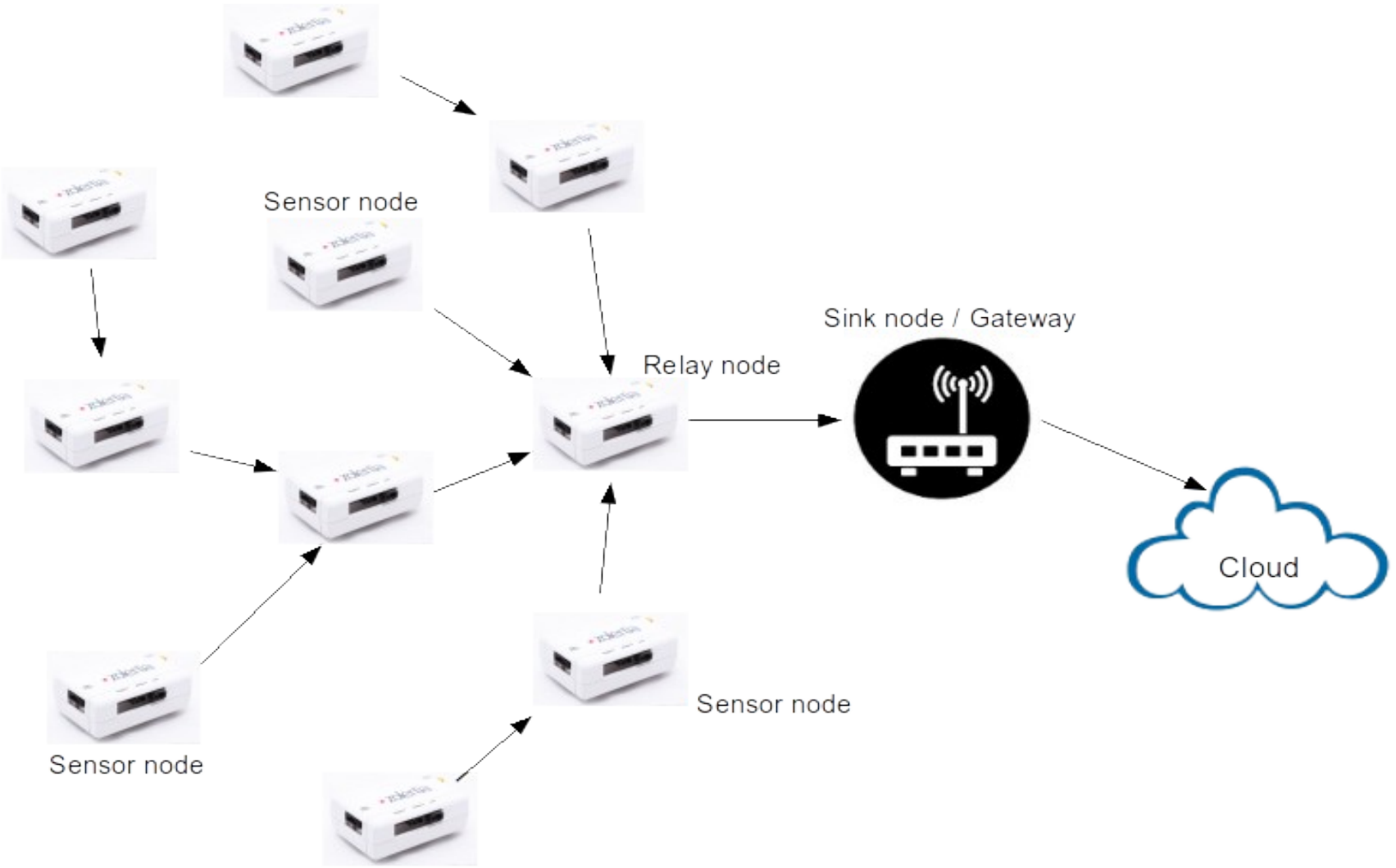
Customer groups

- Eskom (public sector) – load shedding
- Private energy sector
- Remote areas
- Insurance companies
- Reduction of travelling costs by engineers and researchers

Standalone System/Network

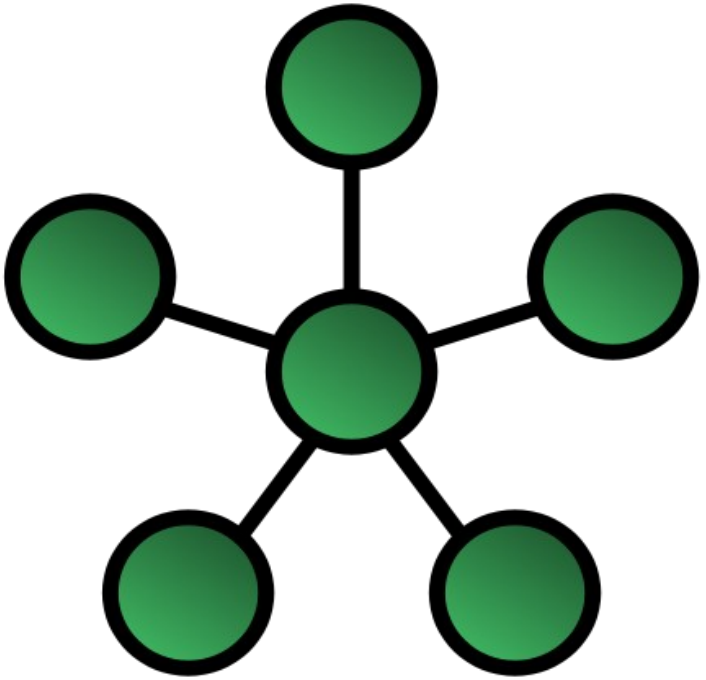


Mesh network

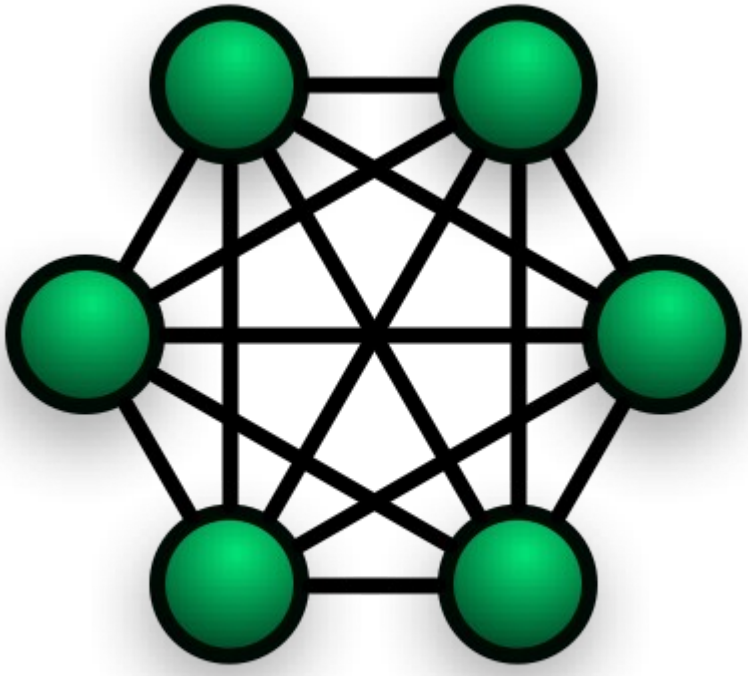


Architectures

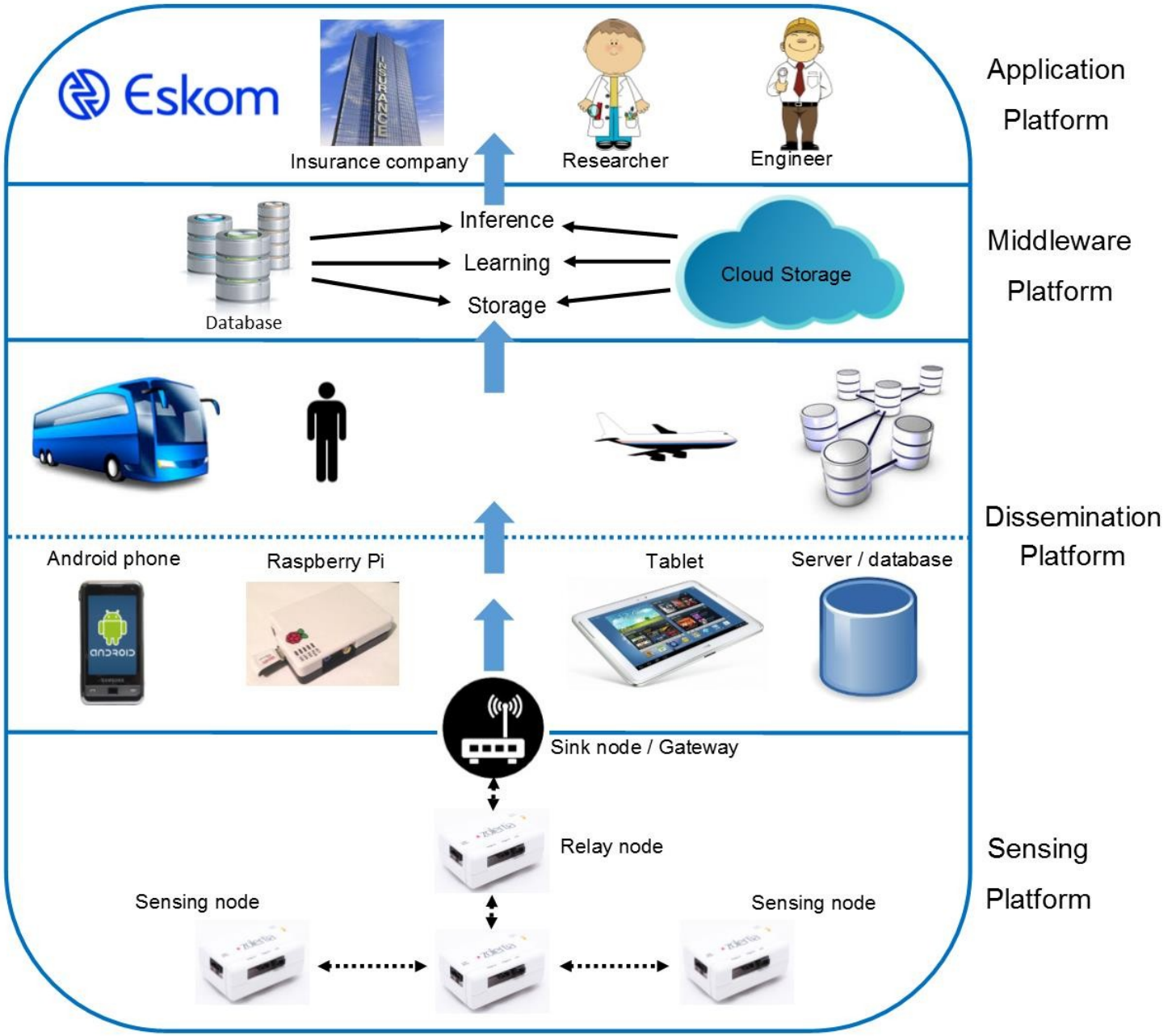
Star network topology



Mesh network topology

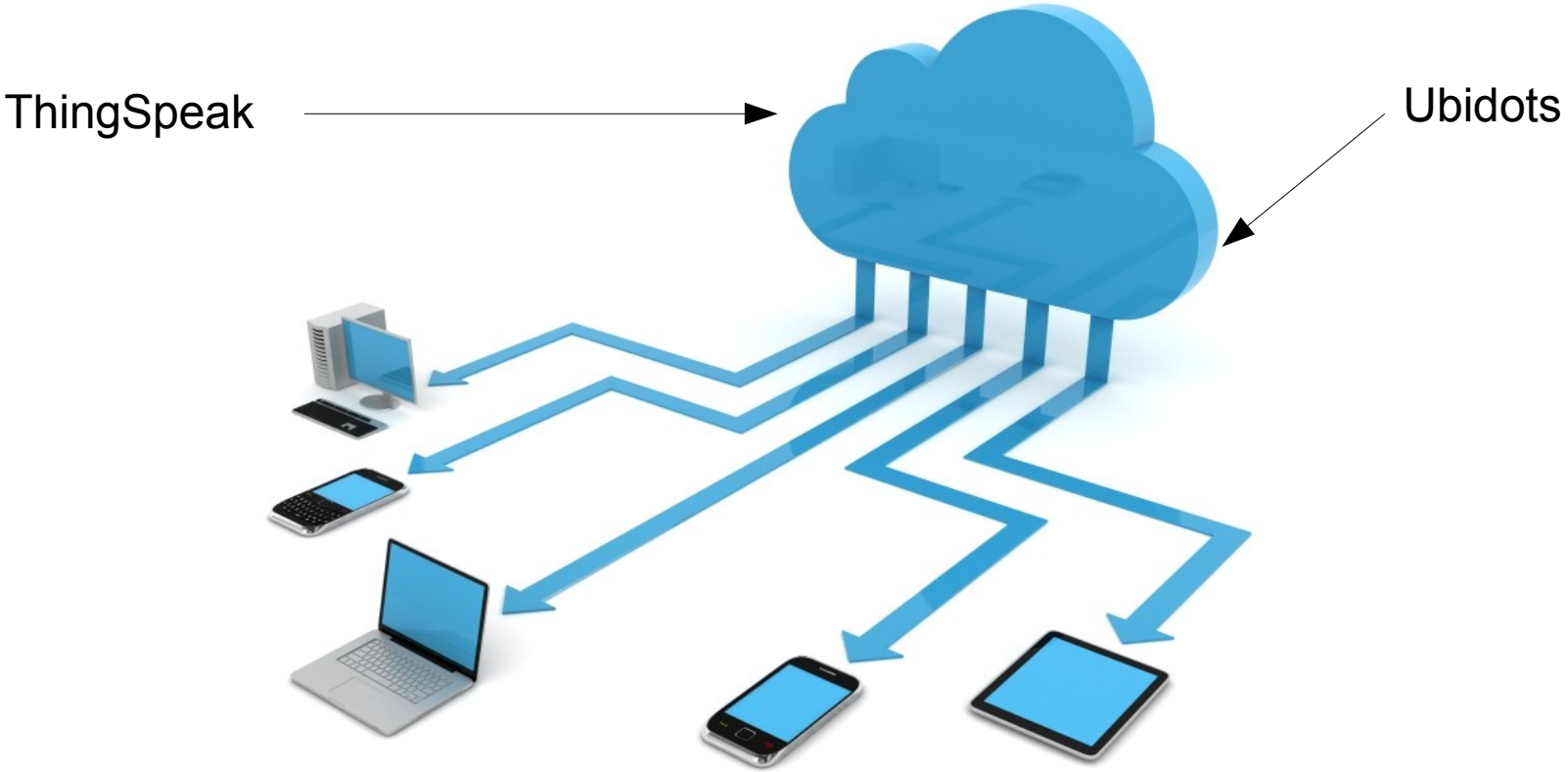


Framework Implementation



Cloud

- How do we share this information?



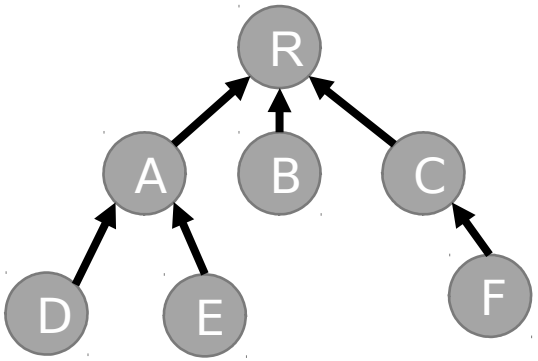
Security & Confidentiality

- Encryption
  - low overhead / light weight
- Anomally detection
  - Sinkhole attack

Example - No Sinkhole

Advertised Link Metrics

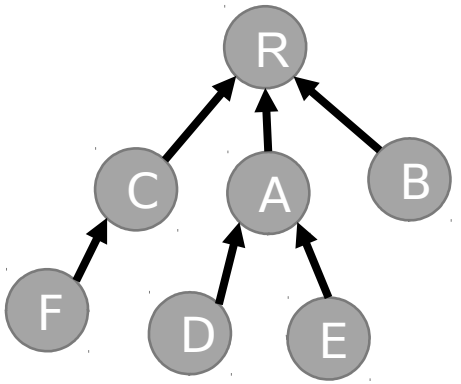
R	A	B	C	D	E	F
X	2	0	1	0	0	0



In-Memory Network Model

Calculated Link Metrics

R	A	B	C	D	E	F
X	2	0	1	0	0	0

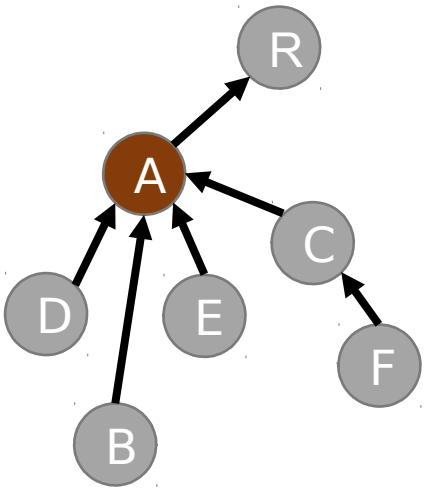


Live Network Topology

Example - Possible Sinkhole

Advertised Link Metrics

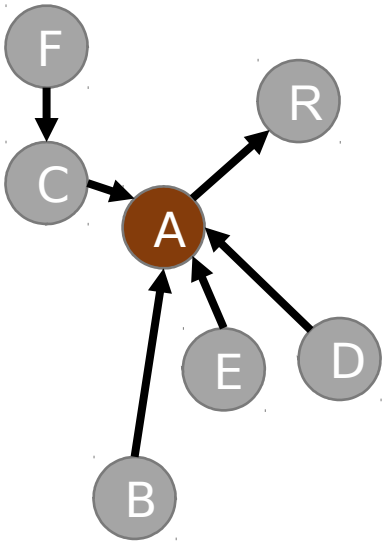
R	A	B	C	D	E	F
X	0	0	1	0	0	0



In-Memory Network Model

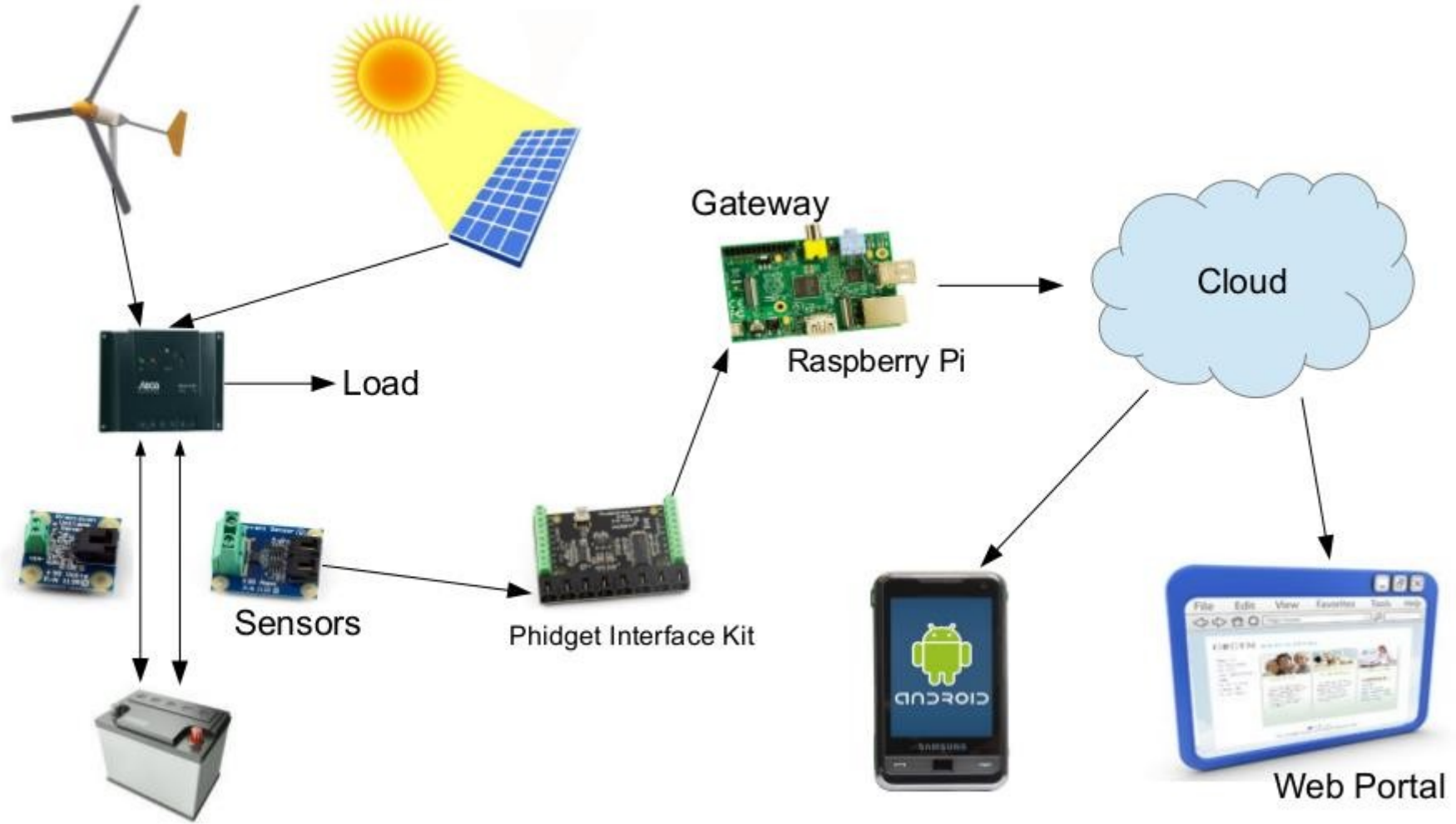
Calculated Link Metrics

R	A	B	C	D	E	F
X	4	0	1	0	0	0

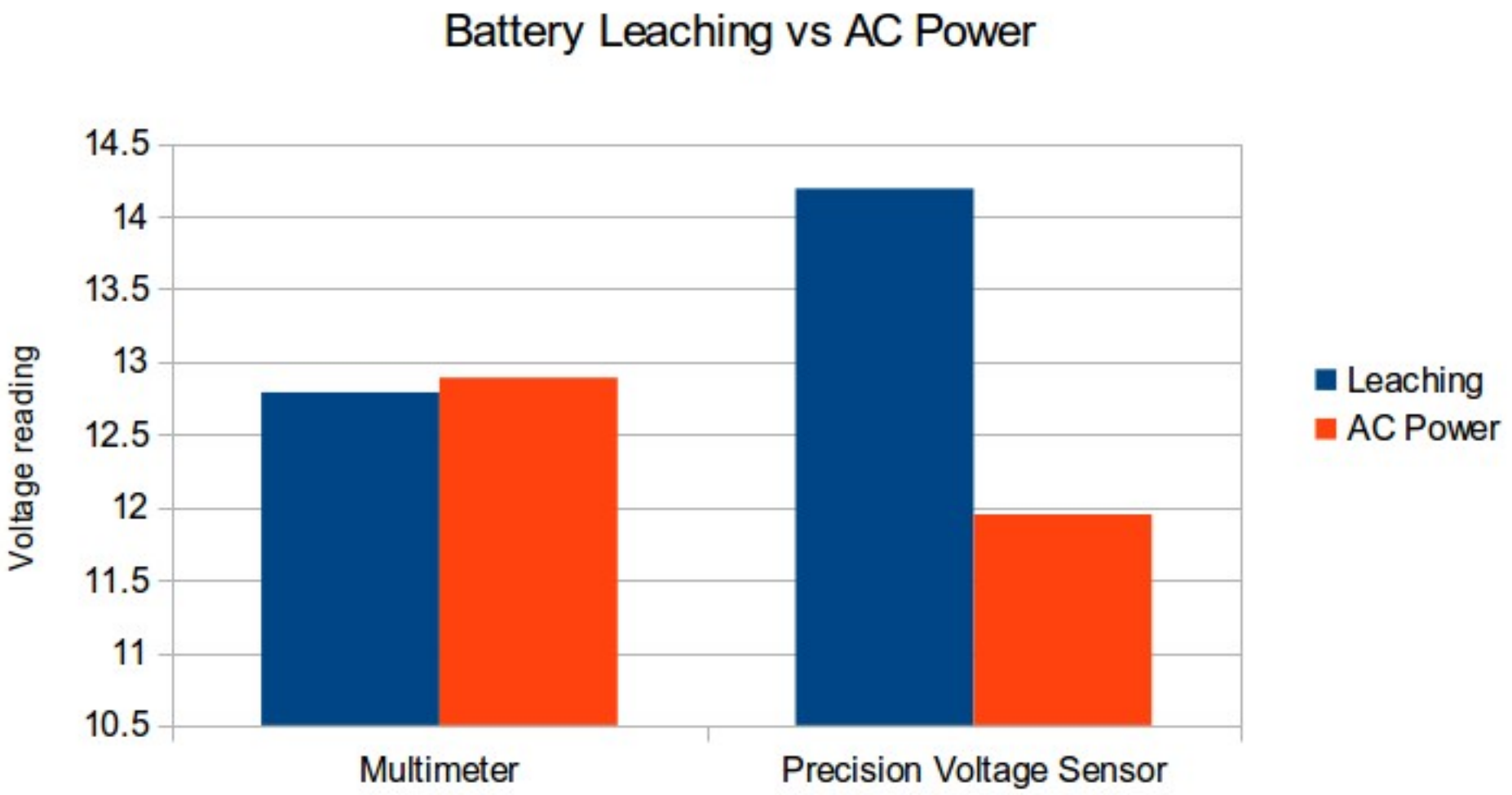


Live Network Topology

Standalone System (Testing)



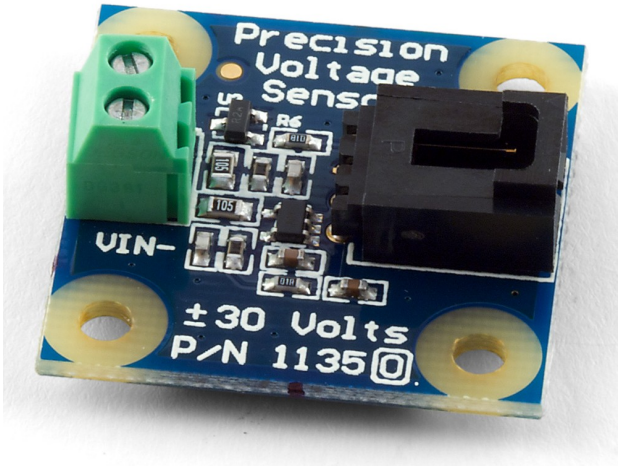
DC / AC



A voltage leakage exists that effects the Precision Voltage Sensor reading when leaching.

Testing - Calibration
Phidget Sensors vs Multimeter

	Phidget Sensor	Multimeter
Parameter		
DC Volt(s)	11.036	12.07
DC Current	0.152	0.440
Power	1.677472	5.3108



Testing – Calibration
Lab Temperature

Parameters	Phidget Sensor	Lab Thermometer	Aircon. Remote
Ambient Temperature (°C)	21.78	21.70	22.00

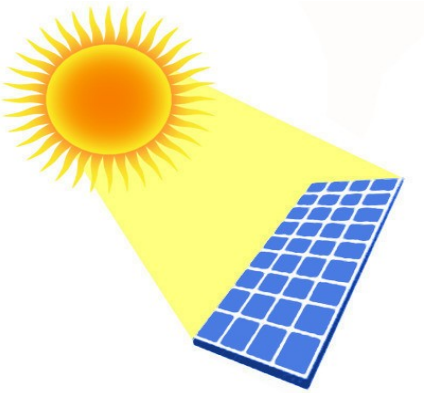
- Temperature readings were measured against twin air-conditioner temperatures set to 22 degree Celsius
- The air-conditioners were allowed to blow for 15 min. before readings were taken.

Testing – Panel Voltage

	Lab	Outside
Parameter		
Panel Voltage	12.71 - 14.67 V	20.6 – 21.1 V

Readings taken at 14:00 on 21 August 2014.

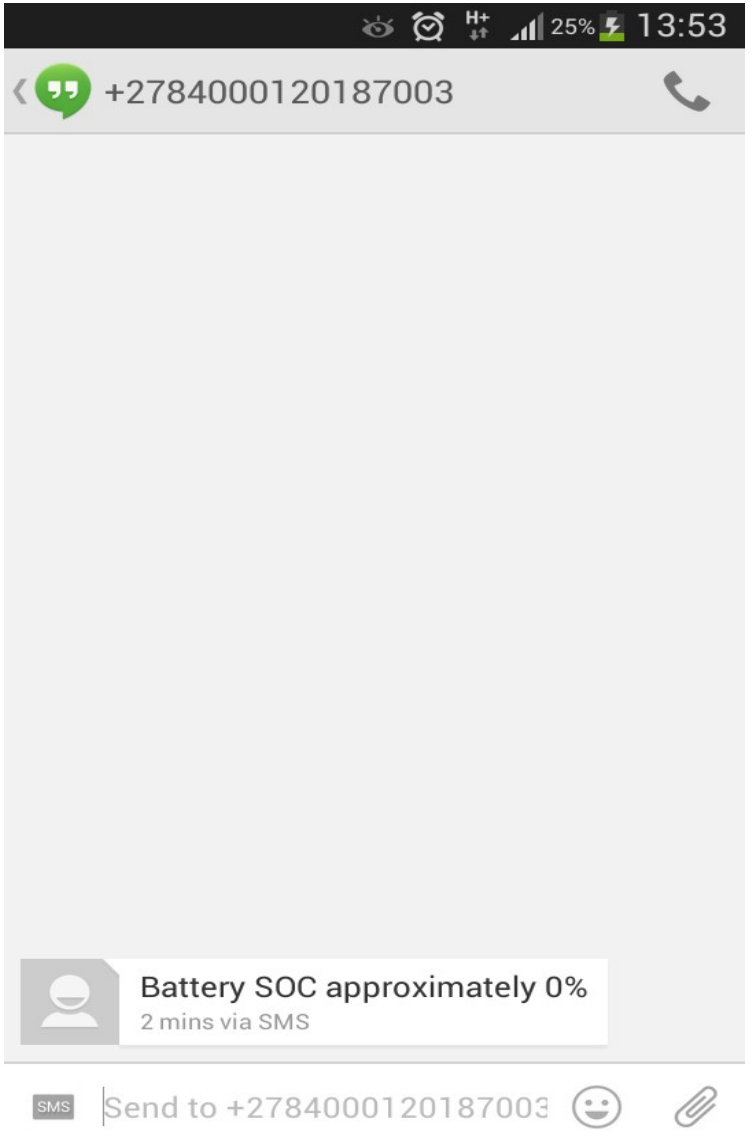
- Main emphasis is to illustrate the power generation capabilities of the panel in use
- It is able to generate a voltage indoors by scavenging from secondary power sources (lab lighting).



Testing – SMS Notification

Voltage Range	SOC (Approx.)
11.58 <= voltage < 11.75	20%
11.31 <= voltage < 11.58	10%
10.50 <= voltage < 11.31	0%

Field test - A voltage of 11.018V



Contributors

- Prof. Antoine Bagula
- Claude Kakoko Lubamba
- Lutando Ngqakaza

Thank you!