

IETF and Energy Overview

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NMRG / OPSAWG
draft-eckert-ietf-and-energy-overview-04

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<https://github.com/toerless/energy/draft-eckert-ietf-and-energy-overview>

Overview

- First presented at IETF114 with target individual submission
 - Feedback AD/other was to go ask OPSAWG if there is interest to adopt as WG item
 - Or any other options ?
 - Else authors will be happy to go back to individual submission track
 - Also presented at IAB workshop end last year on sustainability
- Goal: provide background / reference of the different items related to energy IETF has worked on
 - To help anyone who want to learn
 - To help anyone who is interested in new work (see e.g.: summary of IAB workshop) to get IETF background
 - Saving, Sustainability, ... (waste ?!)
 - Target audience ideally not only classical IETF audience (IAB workshop also had reach beyond IETF community)
- Varied set of areas
 - Best with support / input from wide set of expert holders for different subjects / topics (IMHO)
 - “Ok” if this looks like a book with chapters from different authors (not a single story to tell!)
 - Main challenge: what degree of detail for each topic
- *Following slides for reference/reading – not going to present them all.*

What has the IETF ever done for Energy ?

Well, obviously, *“the IETF has never done anything for energy”*

Oh wait !

There are all these “IoT” groups, that where driven by limited energy as much as limited compute and limited bitrates/radio (often driven by limited energy)

And was there not also....

And ...

And ...

“Monty Python’s Life of Brian”

What have the Romans ever done for us...



**ALL RIGHT, BUT
APART FROM**

**THE SANITATION,
THE MEDICINE,
EDUCATION, WINE,
PUBLIC ORDER,
IRRIGATION,
ROADS,
THE FRESH WATER
SYSTEM
AND PUBLIC
HEALTH.**

**WHAT HAVE
THE ROMANS
EVER DONE**

IETF and Energy Overview

Draft goes from very high level energy impacting results of Internet architecture to several (in authors opinion) significant technical areas of work
Finished (RFC) or attempted/abandoned (drafts)

Digitization of non-digital / pre-network workf lows

- Packet multiplexing principle
- e.g.: evolution from ftp, mail (SMTP), group-communications (NNTP), HTTP/HTML
- Both often reducing instance energy consumption but increasing overall consumption by exploding number of instances

Energy Savings Through Scale

Joule/Bit going down with each faster network generation

The Internet as Network of Networks drives large amounts of this scale

The more smaller network we would have in its absence the more energy waste we would have ?!

Datagramm + End-to-end transport as lowest cost network, most easily scaleable technology (TCP/IP)

Convergence => Converged Networks via TCP/IP

DiffServ, IntServ, DetNet (probably more)

Example: Voice / SIP -> background noise/energy utilization now in networks

Energy Savings Through Scale (continued) ... And Waste

Often complex comparisons of total energy consumption:

Many network based work flows show easily calculated energy saving (Streaming,..)

... Extreme opposite, e.g.: “Proof of Work” crypto mining (easily calculated extreme bad)

Network itself only “enabler” (both when the net result is good or bad)

Common case: network is better per transaction, but network enables fast growth of transactions

Energy saving vs Sustainability – what is the difference ?

A) Different metric re. “Good” (renewable) vs. “Bad” energy

“Follow the (green) energy” cloud scheduling (“Proof of Work” in underutilized hot climate solar park” ?!)

“Minimize Heat generation” / energy waste through cooling (“Data center in cold climates”)

“Heat recovery” (Mini-DC doubling as heater in single family homes with fiber Internet)

Example ? Long history application area: Telecollaboration

Long history: email, nntp, Mbone, SIP, “telepresence” RTCweb, ...

Difficult comparison of sustainability of travel (found example paper attempting to do this):

Planes, Trains, Automobiles and bicycles...

Global Warming impact of energy burned in planes 3x worse then when burned at sea level

The lower cost network traffic is, the more saving/sustainability opportunity it opens

But also the more waste as an enabler (at application level)

Net beneficial ?! (I think so).

Low Power and Lossy Networks

Low-bitrate radio /low performance compute driven by low power consumption needs

Some other factors too (radio regulation, chip cost,...), but energy IMHO prime.

ENERGY HARVESTING / Maximize battery lifetime

[RFC8352] overview, 802.15.4, Bluetooth LE, WiFi, DEC ULE,...

Summarizing key points of WGs 6LOPAN, LPWAN, 6TISCH, 6LO, ROLL

Few explicit energy related drafts too, not adopted (RPL routing metrics, path selection)

Low Power IETF technology proliferates into other IETF areas... Does that save energy ?

Constrained Nodes and Networks

Used by ‘higher than network” groups in IETF

LWIG (low-power guidance), CoRE (CoAP), ACE (constrained security) (Elyptic Curve lower compute/power cost), Satellite network initiatives (heavily power constrained)

Devices with Batteries

Minimize periodic network traffic vs. Hard-state protocols examples

Sample Technology Enabler

IP Multicast – meant as a bandwidth saver. Should also save Energy

Lots of application of multicast (“discovery”) that waste Energy

Often simply not well applied

Multicast problems on wireless [RFC9119]– L2 optimization (buffer and send periodic)

MiMo makes multicast less attractive (“unicast like antenna focussing”).

Sleepy Nodes

Energy consumption reduced when compute/network transmission happens in short bursts rather than spread out – loss of energy on up/down high/low switching, minimize it

Variety of protocols partially considering the problem. Little adopted ?! (CoRE, DNS,...)

(Lack of) Energy Benchmarking

Energy Production/Consumption Management networks

Smart Grid – intelligent management primarily energy consumption, also some production (spec unclear)

Smart Metering, smart timing of consumers, LLN infrastructures to connect them etc. pp

Synchro Phasor Network

Synchronize wide-area interconnected power connectors (same phase, appropriate power levels)

Often initiated (15 years ago ?) to avoid spreading brownouts, more reliable country wide power generation

Msec accurate latency measurement of packet propagation along powerlines to measure power propagation times.

Energy Management: EMAN & Metrics / Benchmarking

Few Energy Metrics proposed for benchmarking (but now new work..)

Even Energy Pricing by time metrics proposed for managing time-shifting consumption

EMAN – Energy Management Working Group

2010 - 2015. 7 RFC: MIB based measurement of (primarily) current equipment power consumption

PoE port support. Aka: (i think) also power/on off of powers possible to signal.

Battery powered network support specifics

Power-awareness in Forwarding and Routing Protocols

Power Aware Networks (PANET)

Ideas for minimizing networks power consumption by low-power/switching off components dynamically when not needed for current performance requirements of network

Not progressed (2013/2014) – due to concerns of reduced resilience in network switching off redundancy,..

Also driven by rolling blackouts in India – reduce power consumption ONLY during critical energy supply times

SDN based forwarding semantics

Optimization of energy often NP complete problem, central entity often easiest way to manage. SDN semantic common way to think about this, variety of protocol/mechanisms from IETF to support building this, recent work on looking at this type of use-case

Gaps

Before 2022, few attempts to find/document gaps (for energy efficient networks).

Opinions / Feedback

Please review

Github: <https://github.com/toerless/energy>

Feel free to open issues

Discuss on opsawg@ietf.org

If no interest here, we will move back to e-impact@ietf.org

Thank you!