# IPv6 over Constrained Node e Networks(6lo) Applicability & Use cases

*draft-ietf-6lo-use-cases-04*

Y-G. Hong (ETRI), C. Gomez (UPC),
Y-H. Choi (ETRI), D-Y. Ko (SKTelecom),
AR. Sangi(Huaiyin Institute of Technology),
T. Aanstoot (Modio AB), S. Chakrabarti

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# History and status

−WG document : draft-ietf-6lo-use-cases-00 (Nov.2.2016)

−1st revision : draft-ietf-6lo-use-cases-01 (Mar.12.2017)

−2nd revision : draft-ietf-6lo-use-cases-02 (Jul.3.2017)

−3rd revision : draft-ietf-6lo-use-cases-03 (Oct.30.2017)

−4th revision : draft-ietf-6lo-use-cases-04 (Mar.5.2018)

**Goal of this document:**

*Help 6lo/6lowpan stack adaptation by a L2-constrained techno logy and help a newcomer understand how 6lowpan stack can be applicable in practice. Useful for new adopters of IOT@IETF.*

# Update after IETF100

– Add two 6lo deployment scenarios
  - G3-PLC usage of 6lo in network layer
  - Netricity usage of 6lo in network layer

– Update MS/TP parts
  - 6lo link layer technologies
  - Use cases of MS/TP

– Add I-D. ietf-6lo-blemesh

– Editorials

# 6lo Link layer technologies

−ITU-T G.9959 (Z-wave) : RFC 7428

−Bluetooth Low Energy : RFC 7668

−DECT-ULE : RFC 8105

−Master-Slave/Token-Passing : RFC 8163

−NFC : draft-ietf-6lo-nfc-09

−PLC : IEEE 1901.2, draft-hou-6lo-plc-03

−IEEE 802.15.4e : RFC 7554

−(Potential candidate) LTE MTC : 3GPP TS 36.306 V13.0.0
  => Will be removed at next revision

# Comparison across 6lo Link layer tech.

| | Z-Wave | BLE | DECT-ULE | MS/TP | NFC | PLC | TSCH |
|---|---|---|---|---|---|---|---|
| Usage | Home Automation | Interaction with Smart phone | Meter Reading | Building Automation | Health care Services | Smart Grid | Industrial Automation |
| Technology & Subnet | L2-mesh or L3-mesh | Star Mesh | Star No mesh | MS/TP No mesh | P2P L2-mesh | Star, Tree, Mesh | Mesh |
| Mobility Re-qmt | No | Low | No | No | Moderate | No | No |
| Security Reqmt | High, Privacy re-quired | Partially | High, Privacy re-quired | High, Authen. required | High | High, Encrypt. required | High, Privacy re-quired |
| Buffering Reqmt | Low | Low | Low | Low | Low | Low | Low |
| Latency, QoS Reqmt | High | Low | Low | High | High | Low | High |
| Date Rate | Infrequent | Infrequent | Infrequent | Frequent | Small | Infrequent | Infrequent |
| RFC # or Draft | RFC 7428 | RFC 7668 | RFC 8105 | RFC 8163 | draft-6lo-nfc | draft-hou-6lo-plc | RFC 7554 |

# Guidelines for adopting IPv6 stack (6lo/6LoWPAN)

- It targets candidates for new constrained L2 technologies that consider running modified 6LoWPAN stack

- The modification of 6LoWPAN stack should be based on the following:

  - Addressing Model

  - MTU Considerations

  - Mesh or L3-Routing

  - Address Assignment

  - Header Compression

  - Security and Encryption

  - Additional processing

# 6lo Deployment Scenarios

–jupitermesh in Smart Grid using 6lo in network layer

–Wi-SUN usage of 6lo stacks

–G3-PLC usage of 6lo in network layer

–Netricity usage of 6lo in network layer

# 6lo Deployment Scenarios : Wi-SUN

−Wi-SUN technology
  • Based on the IEEE 802.15.4g standard
  • Wi-SUN networks support star and mesh topologies, as well as hybrid star/ mesh deployments
  • Wi-SUN networks are deployed on both powered and battery-operated dev ices

−Wi-SUN Field Area Network (FAN) technology
  • Cover primarily outdoor networks, and its specification is oriented towards meeting the more rigorous challenges of these environments
  • Adaptation layer based on 6lo and IPv6 network layer are described

−Wi-SUN usage of 6lo stacks
  • Advanced Metering Infrastructure (AMI)
  • Distribution Automation (DA)

[*. On behalf of Wi-SUN Alliance, Paul Duffy helped to prepare text]

# 6lo Deployment Scenarios : jupiterMesh

–jupiterMesh specification is based on
  - PHY layer : IEEE 802.15.4 SUN specification [IEEE 802.15.4-2015]
  - MAC layer : IEEE 802.15.4 TSCH specification
  - Network layer : DHCPv6 [RFC3315], 6lo/6LoPWAN header compression [RFC6282], RPL [RFC6550]

–jupiterMesh in Smart Grid using 6lo in network layer
  - Multi-hop wireless mesh network specification designed mainly for deployment in large geographical areas
  - Each subnet in jupiterMesh is able to cover an entire neighborhood with thousands of nodes consisting of IPv6-enabled routers and end-points

[*. On behalf of jupiterMesh WG, Michel Veillette and Das Subir provided related text]

# 6lo Deployment Scenarios : G3-PLC

−G3-PLC technology
- Narrow-band PLC technology that is based on ITU-T G.9903
- Support multi-hop mesh network, and facilitates highly-reliable, long-range communication
- Support IPv6

−Application domains of G3-PLC : Smart Grid and Smart Cities
- Smart Metering, Vehicle-to-Grid Communication, Demand Response (DR), Distribution Automation, Home/Building Energy Management Systems,  Smart Street Lighting, Advanced Metering Infrastructure (AMI) backbone network, Wind/Solar Farm Monitoring

−6lo adaptation layer
- Utilize the 6LoWPAN functions (e.g. header compression, fragmentation and reassembly)

*. Jianqiang Hou (Huawei) helped to prepare text

# 6lo Deployment Scenarios : Netricity

−Netricity program in HomePlug Powerline Alliance
  • Based on the PHY and MAC layers of IEEE 1901.2 PLC standard
  • Promote the adoption of products built on the IEEE 1901.2
  • Address requirements that assure communication privacy and secure netwo rks.

−Application domains of Netricity : Smart Grid and Smart Cities
  • Utility grid modernization, Distribution automation, Meter-to-Grid connecti vity, Micro-grids, Grid sensor communications, Load control, Demand respo nse, Net metering, Street Lighting control, Photovoltaic panel monitoring

−Netricity usage of 6lo stacks
  • Utilize IPv6 protocol suite including 6lo/6LoWPAN header compression, DH CPv6 for IP address management, RPL routing protocol, ICMPv6, and unica st/multicast forwarding.

*. Jianqiang Hou (Huawei) helped to prepare text

# Design space dimensions for 6lo use cases

- Deployment/Bootstrapping

- Topology

- L2-Mesh or L3-Mesh

- Multi-link subnet

- Data rate

- Buffering requirements

- Security Requirements

- Mobility across 6lo networks and subnets

- Time synchronization require-ments

- Reliability and QoS

- Traffic patterns

- Security Bootstrapping

- Power use strategy

- Update firmware requirements

- Wired vs. Wireless

# 6lo use cases (1/2)

–Use case of ITU-T G.9959: Smart Home
 • Example: Use of ITU-T G.9959 for Home Automation


–Use case of Bluetooth LE: Smartphone-Based Interaction with Constrained Devices
 • Example: Use of Bluetooth LE-based Body Area Network for fitness


–Use case of DECT-ULE: Smart Home
 • Example: use of DECT-ULE for Smart Metering


–Use case of MS/TP: Building Automation Networks
 • Example: Use of 6LoBAC in Building Automation Networks
 *. Thanks to Kerry Lynn and Dave Robin to update MS/TP

# 6lo use cases (2/2)

- Use case of NFC: Alternative Secure Transfer
  - Example: Use of NFC for Secure Transfer in Healthcare Services with
  - Tele-Assistance

- Use case of PLC: Smart Grid
  - Example: Use of PLC for Advanced Metering Infrastructure
  - Example: Use of PLC (IEEE1901.1) for WASA in Smart Grid

- Use case of IEEE 802.15.4e: Industrial Automation
  - Use of IEEE 802.15.4e for P2P communication in closed-loop application

# Thanks!!

# Questions & Comments