Transmission of IPv6 Packets over Short-Range Optical Wireless Communications (IPv6 over OWC)

draft-choi-6lo-owc-00

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IPv6-over-foo Technologies…

- IPv6 over **IEEE 802.15.4** (**RFC4944**, Sep. 2007)
- IPv6 over **ITU-T G.9959** (**RFC7428**, Feb. 2015)
- IPv6 over **Bluetooth LE** (**RFC7668**, Oct. 2015)
- IPv6 over **DECT ULE** (**RFC8105**, May 2017)
- IPv6 over **MS/TP** (**RFC8163**, May 2017)
- IPv6 Mesh over **Bluetooth LE** (**RFC9159**, Dec. 2021)
- IPv6 over **PLC** (**RFC9354**, Jan. 2023)
- IPv6 over **NFC** (**RFC9428**, Jul. 2023)

- **What else for IPv6 over foo**?

⇒ IPv6 over **OWC (IEEE 802.15.7)**

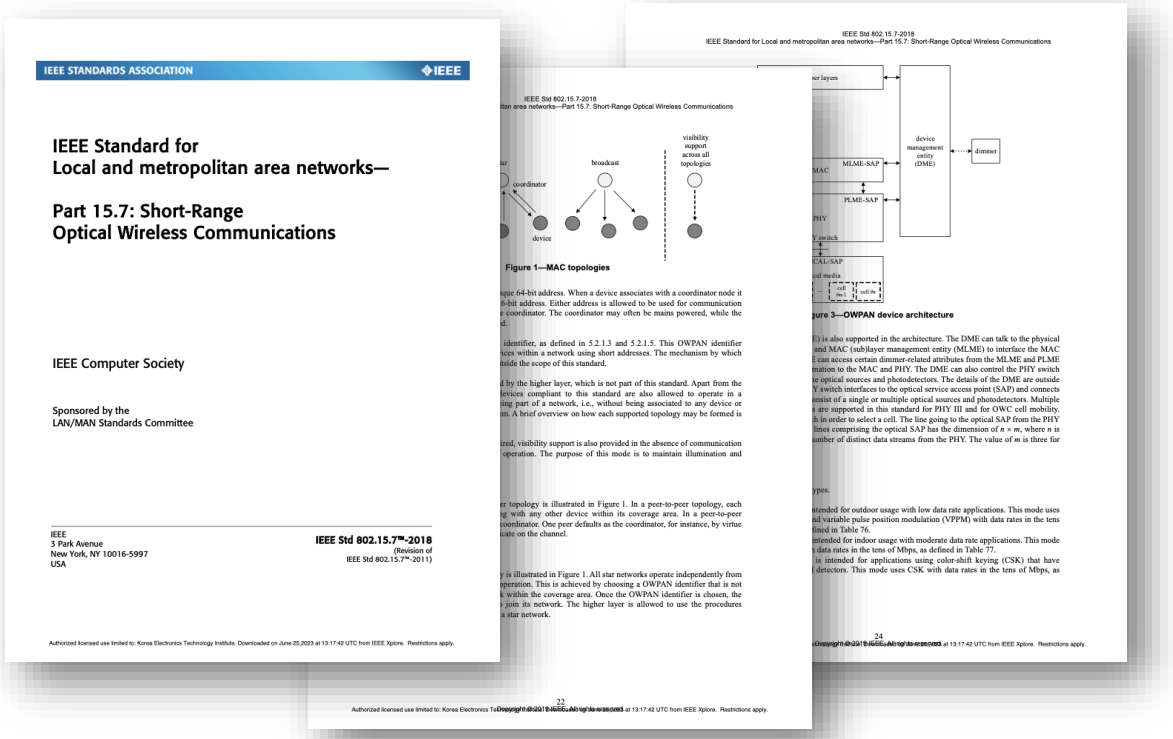
LED

Short-Range **Optical Wireless Communications (OWC)** ?

- **OWC** uses **intensity modulation of optical sources**, such as **Light Emitting Diodes (LEDs)**.
- **OWC** combines lighting and **data communications**.
- **OWC** can be finding applications in various domains including area **lighting, signboards, streetlights, vehicles, traffic signals, displays, LED panels, and digital signage, smart phones ...**
- **OWC** devices can be powered by **limited energy sources (e.g., battery or energy harvesting)** for energy-efficient services.

OWC & IEEE 802.15.7

- OWC is defined by **IEEE 802.15.7 standard**
  providing 6 characteristics, such as



Visible Light Communication (VLC),
Short-Range Communication,
Line-of-Sight (LOS) &
Non-Line-of-Sight (NLOS) Support,
High and Low Data Rates,
Energy Efficiency,
and Secure Communication.

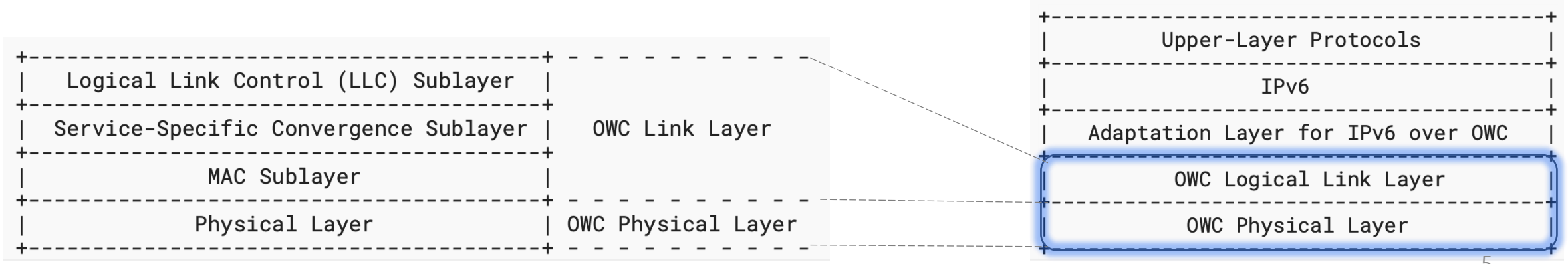
Considering on "**IPv6 over OWC**"

- **Network Topologies**
  - OWC ⇒ P2P, Star
  - IPv6 over OWC ⇒ more complicated topologies like Mesh
- **Addressing of OWC**
  - 16-bit short address or
  - Unique 64-bit address

- **MTU & Bit Rates of OWC**

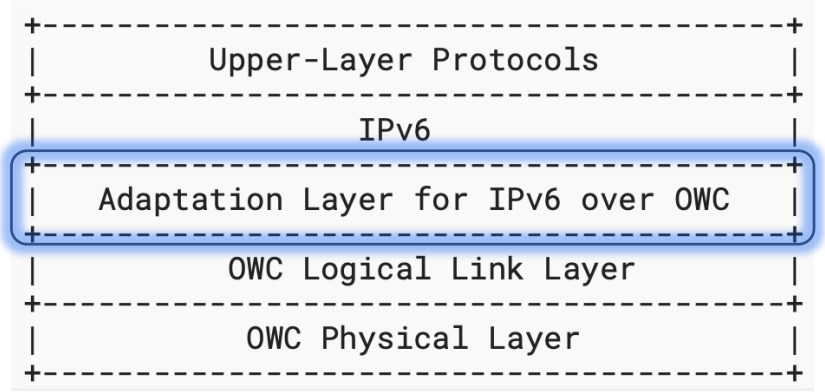
MAXIMUM PACKET SIZE AND DATA RATES IN IEEE 802.15.7 [2]

Type	Maximum packet size (*aMaxPHYFrameSize*)	Data rate
PHY 1	1,023 bytes	11.67 kbps ~ 266.6 kbps
PHY 2	65,535 bytes	1.25 Mbps ~ 96 Mbps
PHY 3	65,535 bytes	12 Mbps ~ 96 Mbps

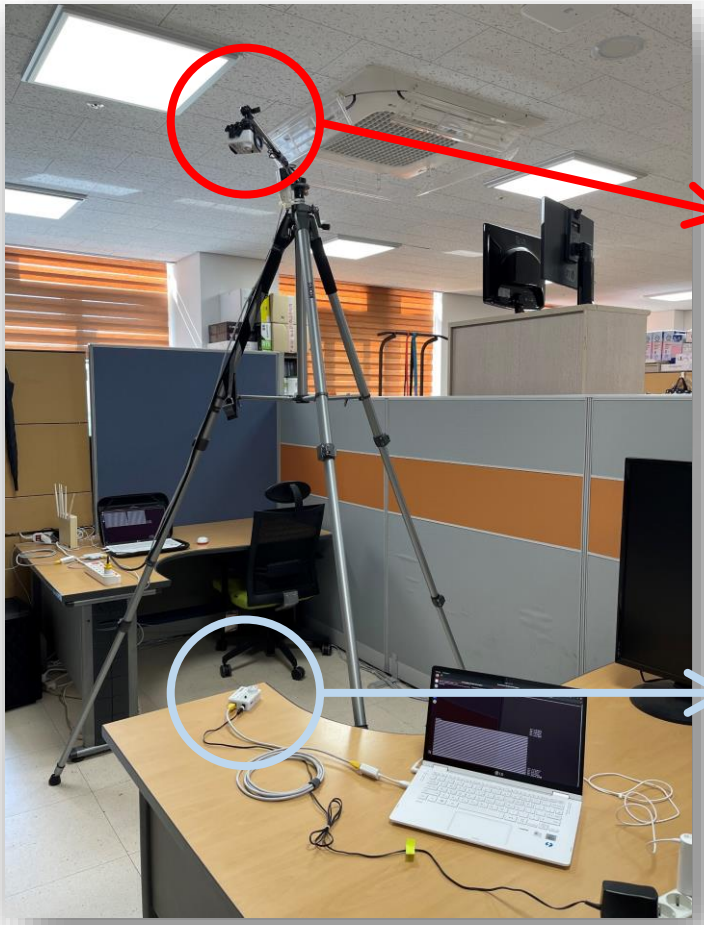


Technical Issues of "**IPv6 over OWC**"

- **Stateless Address Autoconfiguration**
- **IPv6 Link-Local Address (IID)**
- **Neighbor Discovery**
- **Header Compression**
- **Fragmentation and Reassembly**
- **Unicast/Multicast Address Mapping**
- **Internet Connectivity**



Test-bed for “IPv6 over OWC”

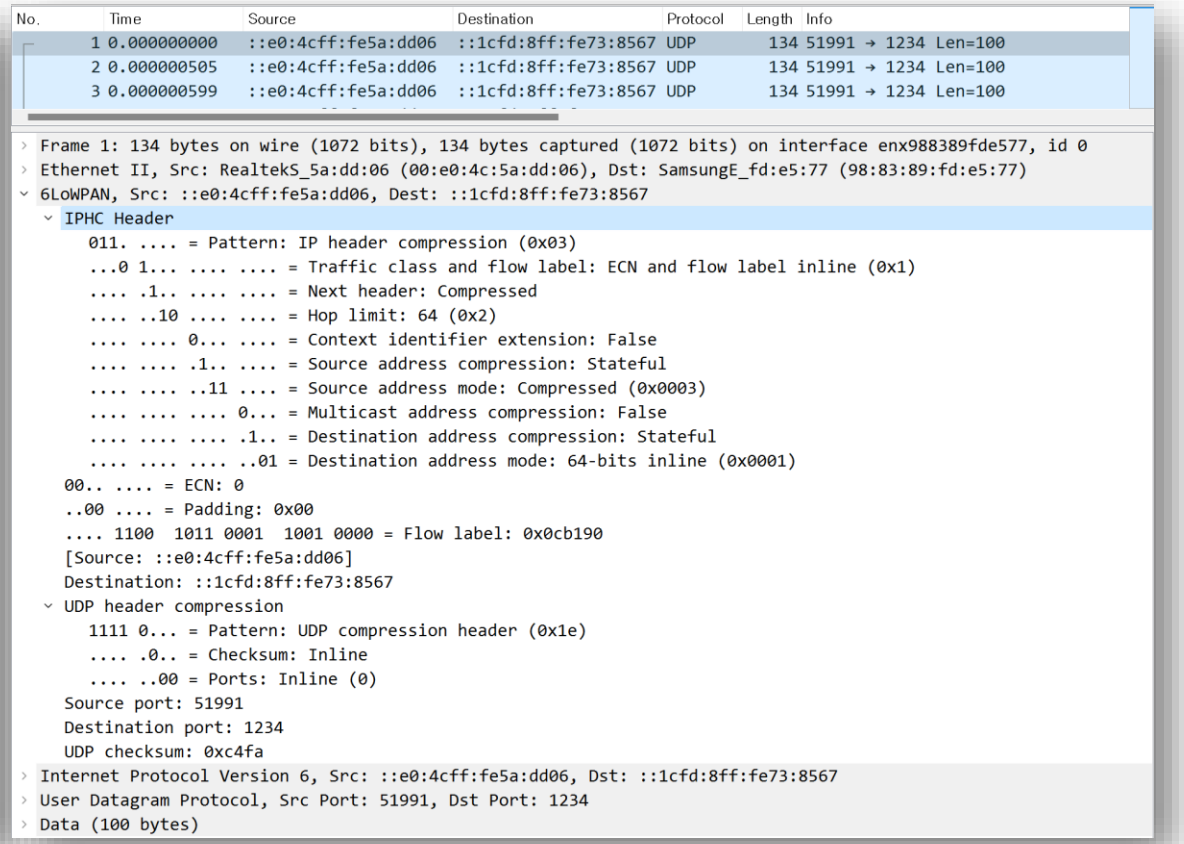


Test Results of “IPv6 over OWC”

- Ping responses

```
PING 2001:db8:aaaa::1cfd:08ff:fe73:8567(2001:db8:aaaa:0:1cfd:8ff:fe73:8567) 100 data bytes
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=1 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=2 ttl=63 time=1.68 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=3 ttl=63 time=1.68 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=4 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=5 ttl=63 time=1.67 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=6 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=7 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=8 ttl=63 time=1.67 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=9 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=10 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=11 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=12 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=13 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=14 ttl=63 time=1.63 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=15 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=16 ttl=63 time=1.62 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=17 ttl=63 time=1.67 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=18 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=19 ttl=63 time=1.62 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=20 ttl=63 time=1.62 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=21 ttl=63 time=1.68 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=22 ttl=63 time=1.62 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=23 ttl=63 time=1.64 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=24 ttl=63 time=1.65 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=25 ttl=63 time=1.67 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=26 ttl=63 time=1.62 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=27 ttl=63 time=1.66 ms
108 bytes from 2001:db8:aaaa:0:1cfd:8ff:fe73:8567: icmp_seq=28 ttl=63 time=1.64 ms
```

- Wireshark captured



Ref. IEEE WCL about “IPv6 over OWC”

Cheol-min Kim, Sang-Kyu Lim, Jin-Doo Jeong, **Younghwan Choi**, Seok-Joo Koh, "**6LoWPAN Over Optical Wireless Communications for IPv6 Transport in Internet of Things Networks**” **IEEE Wireless Communications Letters**, Vol. 11, Issue 6, June 2022.

Concluding remarks

- **The 1st Individual I.D., "draft-choi-6lo-owc-00" for IPv6 over OWC**; get started & published
- LEDs; **being widely used anywhere for lightening** (& nature-friendly)
- **OWC; data transmission** by using LEDs **based on the std. IEEE 802.15.7**
- **"IPv6 over OWC" has shown promising results as one of the IPv6-over-foo technologies based on the test-bed experimental outcomes.**