

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

draft-ietf-6lo-owc-07

by

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Status of “IPv6 over OWC”

- draft-choi-6lo-owc-00 (IETF 117, San Francisco, July 2023)
 - The Introduction to the new I.D. IPv6 over OWC
- draft-choi-6lo-owc-01 (IETF 118, Prague, November 2023)
 - Revision addressing technical issues related to IPv6 over OWC
- draft-choi-6lo-owc-02 (IETF 119, Brisbane, March 2024)
 - Revision incorporating comments from IETF118
 - Addition of SCHC in IPv6 over OWC
- draft-ietf-6lo-owc-00 & 01 (IETF 120, Vancouver, July 2024)
 - I.D.-00 (an initial draft of draft-choi-6lo-owc-02 with typos fixed)
 - Addition of SCHC in IPv6 over OWC (new texts and figures in § 4.5.2 & § 6.)
- draft-ietf-6lo-owc-02 (IETF 121, Dublin, November 2024)
 - Revision for Fig.5, Fig.7 and Fig.8
 - IANA comment about the I.D.-01 & References
- draft-ietf-6lo-owc-03 (IETF 122, Bangkok, March 2025)
 - Comments and feedback from IEEE802.15 members and the 6lo meeting in IETF 121
 - IANA comment about the I.D.-02
- draft-ietf-6lo-owc-04 (IETF 123, Madrid, July 2025)
 - Feedback from the 6lo meeting in IETF 121
 - A New Section Added (Annex A): Hybrid compression strategy using 6LoWPAN HC + SCHC
- draft-ietf-6lo-owc-05 (IETF 124, Montreal, Nov. 2025)
 - IETF editorial conventions
 - Improved logical flow
- draft-ietf-6lo-owc-06 (IETF 125, Shenzhen, Mar. 2026)
 - Security Considerations
- **draft-ietf-6lo-owc-07 (IETF 126, Vienna, July 2026)**
 - **§ 5. Internet Connectivity Scenarios**

Summary of Revised I.D.-07

draft-ietf-6lo-owc-06.txt		draft-ietf-6lo-owc-07.txt	
6lo	Y. Choi, Ed.	6lo	Y. Choi, Ed.
Internet-Draft	ETRI	Internet-Draft	ETRI
Intended status: Standards Track	C-M. Kim	Intended status: Standards Track	C-M. Kim
Expires: 31 August 2026	KETI	Expires: 4 January 2027	KETI
	C. Gomez		C. Gomez
	Universitat Politecnica de Catalunya		Universitat Politecnica de Catalunya
	27 February 2026		3 July 2026
Transmission of IPv6 Packets over Short-Range Optical Wireless Communications		Transmission of IPv6 Packets over Short-Range Optical Wireless Communications	
draft-ietf-6lo-owc-06		draft-ietf-6lo-owc-07	

Motivations

- **No technical comments** were received during IETF125.

Unique characteristics of OWC were not fully reflected

(The previous figures in §5.1 and §5.2 were based on conventional RF networks.)

- **Mainly updated for § 5.1 & 5.2 (Internet Connectivity Scenarios)**
- No changes outside § 5

Technical Updates (1/2)

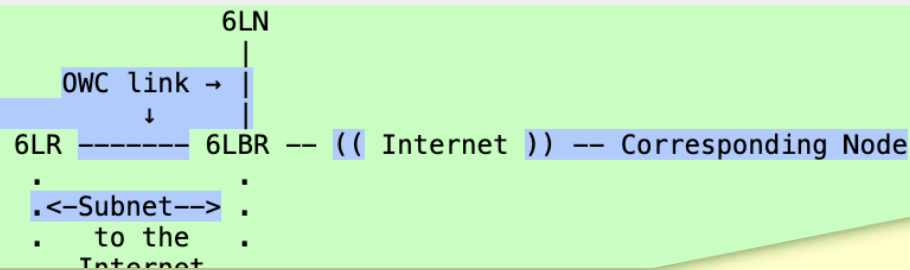
- § 5.1 OWC Device Network Connected to the Internet

- Explicitly introduced **OTR(Optical Transmission Range)**
- Clarified that communication exists within **the OTR**
- Updated Figure 7 **to visualize directional transmission**
- Added **explanations distinguishing OWC from RF**

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5.1. OWC Device Network Connected to the Internet

Figure 7 illustrates an example of an OWC device network connected to the Internet. Each OWC device, such as a 6LN, 6LR, or 6LBR, is considered an OWC device, and they communicate with one another as long as they are within each other's range.



(Why?) Unlike RF networks, OWC links are **established only within the OTR**.

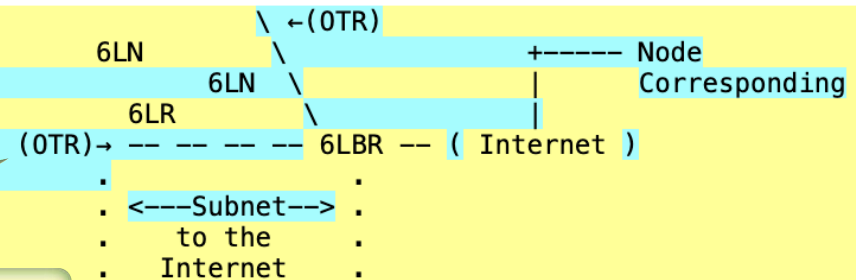
Figure 7: Example of OWC Device Network Connected to the Internet

The 6LBR is acting as a router and forwarding packets between 6LNs and the Internet. Also, the 6LBR MUST ensure address collisions do not occur because the 6LNs are connected to the 6LBR like a star topology, so the 6LBR checks whether or not IPv6 addresses are duplicates, since 6LNs need to register their addresses with the 6LBR.

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5.1. OWC Device Network Connected to the Internet

Figure 7 illustrates an example of an OWC device network connected to the Internet. Communication between neighboring nodes is established only when they are located within the optical transmission range (OTR), which reflects the directional propagation characteristics of optical wireless signals.



* (OTR): Optical Transmission Range Boundary

Figure 7: Example of OWC Device Network Connected to the Internet

The 6LBR is acting as a router and forwarding packets between 6LNs and the Internet. Also, the 6LBR MUST ensure address collisions do not occur because the 6LNs are connected to the 6LBR in a star topology, so the 6LBR checks for duplicate IPv6 addresses, since 6LNs need to register their addresses with the 6LBR. Unlike conventional RF wireless networks, communication opportunities in OWC depend on maintaining optical connectivity between neighboring nodes.

Technical Updates (2/2)

- § 5.1 OWC Device Multi-hop Network

- Each hop is **constrained by OTR**.
- Relay through 6LR extends connectivity.
- Multi-hop connectivity is **established through consecutive optical hops**.

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5.2. OWC Device Multi-hop Network

In some scenarios, the OWC device network MAY operate as a simple, isolated ad-hoc network, as illustrated in Figure 8. Two groups of 6LNs are interconnected in a star topology, with each group connected to a 6LR.

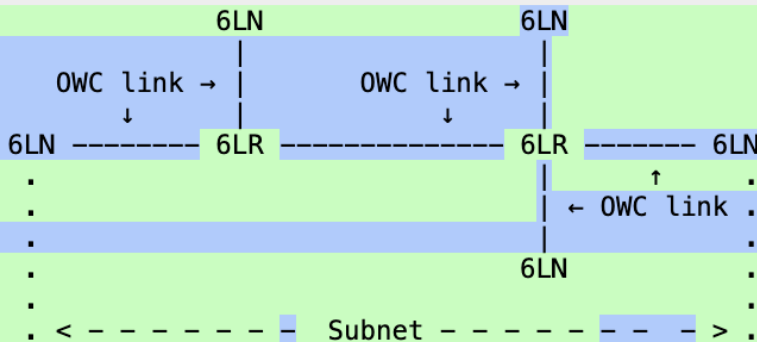


Figure 8: Example of isolated OWC Device Multi-hop Network

In multihop (i.e., more complex) topologies, DAD requires the extensions for multihop networks, such as the ones in [RFC6775].

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5.2. OWC Device Multi-hop Network

In some scenarios, the OWC device network MAY operate as a simple, isolated ad-hoc network, as illustrated in Figure 8. Two groups of 6LNs are interconnected in a star topology, with each group connected to a 6LR. Each OWC hop is formed only when neighboring nodes are within their respective optical transmission ranges (OTRs). Since each OWC hop is constrained by the optical transmission range (OTR), intermediate 6LoWPAN Routers (6LRs) relay IPv6 packets to extend end-to-end connectivity beyond a single optical hop.

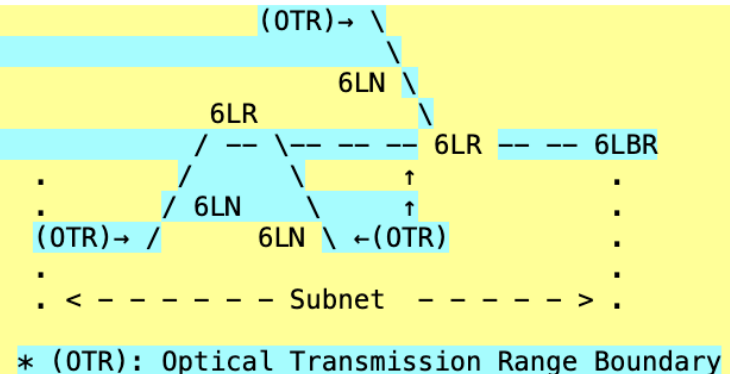


Figure 8: Example of isolated OWC Device Multi-hop Network

In multihop (i.e., more complex) topologies, DAD requires the extensions for multihop networks, such as the ones in [RFC6775].

Concluding Remarks

- **What has been improved in § 5 ...**
 - ✓ Clarified Internet connectivity scenarios
 - ✓ Introduced Optical Transmission Range (OTR)
 - ✓ Improved topology illustrations
 - ✓ Better reflects IEEE 802.15.7 characteristics
- **Next Steps ...**
 - Collect implementation feedback
 - Resolve remaining editorial comments
 - Prepare for “WGLC” (Target: IETF 129~130)

**Please read the draft
and
welcome any feedback !!**

Thank you.

Ref.#1: Short-Range Optical Wireless Communications (OWC) ?

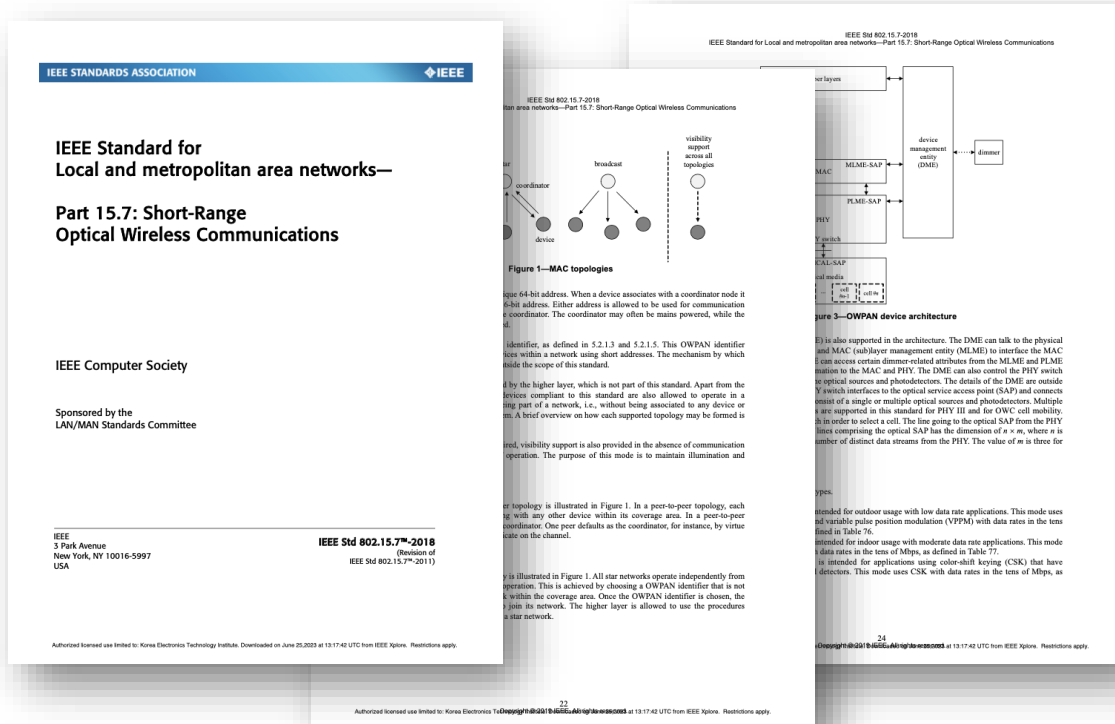
- OWC uses **intensity modulation of optical sources**, such as **Light Emitting Diodes (LEDs)**.
- OWC combines lighting and **bidirectional data communications**.
- OWC can be applied to various domains including area **lighting, signboards, streetlights, vehicles, traffic signals, displays, LED panels,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



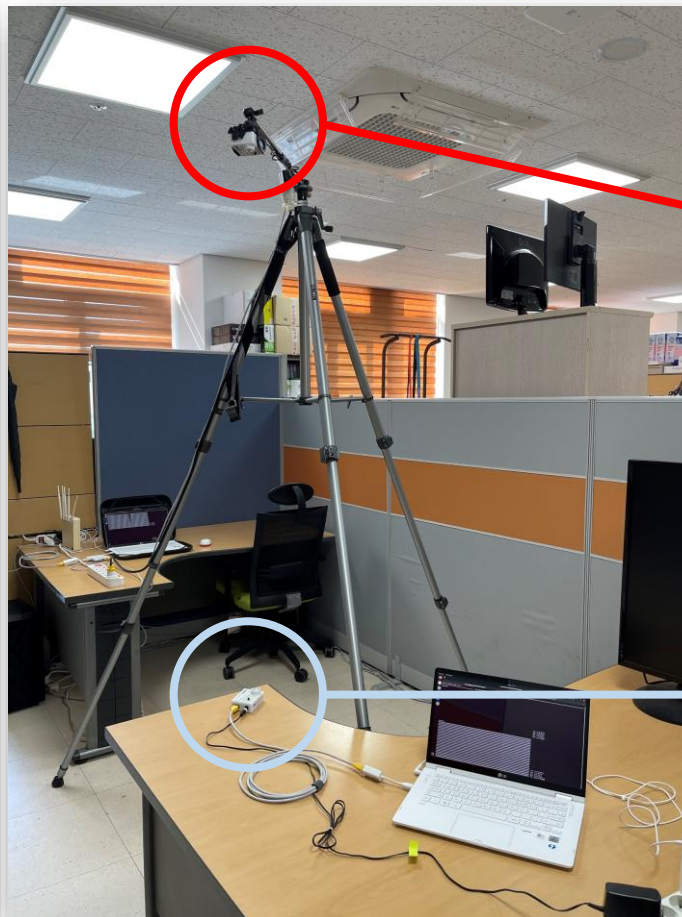
Ref.#2: OWC v.s. IEEE 802.15.7

- OWC is defined by **IEEE 802.15.7 standard** providing six key characteristics, including

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



Ref.#3: Test-bed for "IPv6 over OWC"



Ref.#4: 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

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	::e0:4cff:fe5a:dd06	::1cfd:8ff:fe73:8567	UDP	134	51991 → 1234 Len=100
2	0.000000505	::e0:4cff:fe5a:dd06	::1cfd:8ff:fe73:8567	UDP	134	51991 → 1234 Len=100
3	0.000000599	::e0:4cff:fe5a:dd06	::1cfd:8ff:fe73:8567	UDP	134	51991 → 1234 Len=100

> Frame 1: 134 bytes on wire (1072 bits), 134 bytes captured (1072 bits) on interface enx988389fde577, id 0
> Ethernet II, Src: RealtekS_5a:dd:06 (00:e0:4c:5a:dd:06), Dst: SamsungE_fd:e5:77 (98:83:89:fd:e5:77)
> 6LoWPAN, Src: ::e0:4cff:fe5a:dd06, Dest: ::1cfd:8ff:fe73:8567

▼ IPHC Header

011. = Pattern: IP header compression (0x03)
...0 1... .. = Traffic class and flow label: ECN and flow label inline (0x1)
.... .1.. = Next header: Compressed
.... .10 = Hop limit: 64 (0x2)
.... 0... = Context identifier extension: False
.... 1.. = Source address compression: Stateful
.... 11 = Source address mode: Compressed (0x0003)
.... 0... = Multicast address compression: False
.... 1.. = Destination address compression: Stateful
.... 01 = Destination address mode: 64-bits inline (0x0001)
00.. = ECN: 0
..00 = Padding: 0x00
.... 1100 1011 0001 1001 0000 = Flow label: 0x0cb190
[Source: ::e0:4cff:fe5a:dd06]
Destination: ::1cfd:8ff:fe73:8567

▼ UDP header compression

1111 0... = Pattern: UDP compression header (0x1e)
.... .0.. = Checksum: Inline
.... ..00 = Ports: Inline (0)
Source port: 51991
Destination port: 1234
UDP checksum: 0xc4fa

> Internet Protocol Version 6, Src: ::e0:4cff:fe5a:dd06, Dst: ::1cfd:8ff:fe73:8567
> User Datagram Protocol, Src Port: 51991, Dst Port: 1234
> Data (100 bytes)

Ref.#5: IEEE WCL about “IPv6 over OWC”

The screenshot shows the IEEE Xplore article page for the paper "6LoWPAN Over Optical Wireless Communications for IPv6 Transport in Internet of Things Networks". The page includes the IEEE Xplore logo, navigation links (Browse, My Settings, Help), and a search bar. The article title is prominently displayed, along with the publisher (IEEE) and options to cite or download the PDF. The authors listed are Cheol-Min Kim, Sang-Kyu Lim, Jin-Doo Jeong, Younghwan Choi, and Seok-Joo Koh. The abstract describes the research on using 6LoWPAN over OWC networks for IoT services. The page also features a sidebar with document sections, a "More Like This" section with related articles, and a footer with publication details like the date (14 March 2022) and DOI (10.1109/LWC.2022.3159257).

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6LoWPAN Over Optical Wireless Communications for IPv6 Transport in Internet of Things Networks

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3 Paper Citations 417 Full Text Views

Abstract

Document Sections

- I. Introduction
- II. General IPv6 Model for OWC-Based IoT
- III. Proposed 6LoWPAN Model for OWC-Based IoT
- IV. Experimental Analysis
- V. Conclusion

Abstract:

As an emerging technology for the Internet of Things (IoT) wireless connectivity, there have been a lot of research and standardization activities on Visible Light Communications (VLC) and Optical Wireless Communications (OWC) using Light Emitting Diode (LED) lights. In the meantime, the Internet Protocol version 6 (IPv6) over Low Power Wireless Personal Area Network (6LoWPAN) has been discussed to provide the IPv6-based IoT services in wireless networks. However, the study on IoT systems using 6LoWPAN over OWC networks has not been made so far. This letter proposes a new architectural model to effectively use 6LoWPAN between IoT gateway and IoT device in the OWC-based IoT networks. The proposed model is easy to implement and provides the performance enhancement in OWC-based IoT networks, compared to the general IPv6 model. From testbed experimentations, it is shown that the proposed model provides the delay gain up to 5% and the throughput gain up to 19.52%, compared to the conventional IPv6 transport model.

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