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Light Fidelity (LiFi)

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Outline

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2. LiFi Architecture
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5. Potential Applications of LiFi
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1. What is LiFi

Light Fidelity (LiFi) is a new wireless communication technology similar to Wi-Fi, but it uses visible light communication (VLC) instead of radio frequency used by Wi-Fi.

LiFi technology enables high-speed data transmission via “pulsating light sources” that seem static to the naked eye.

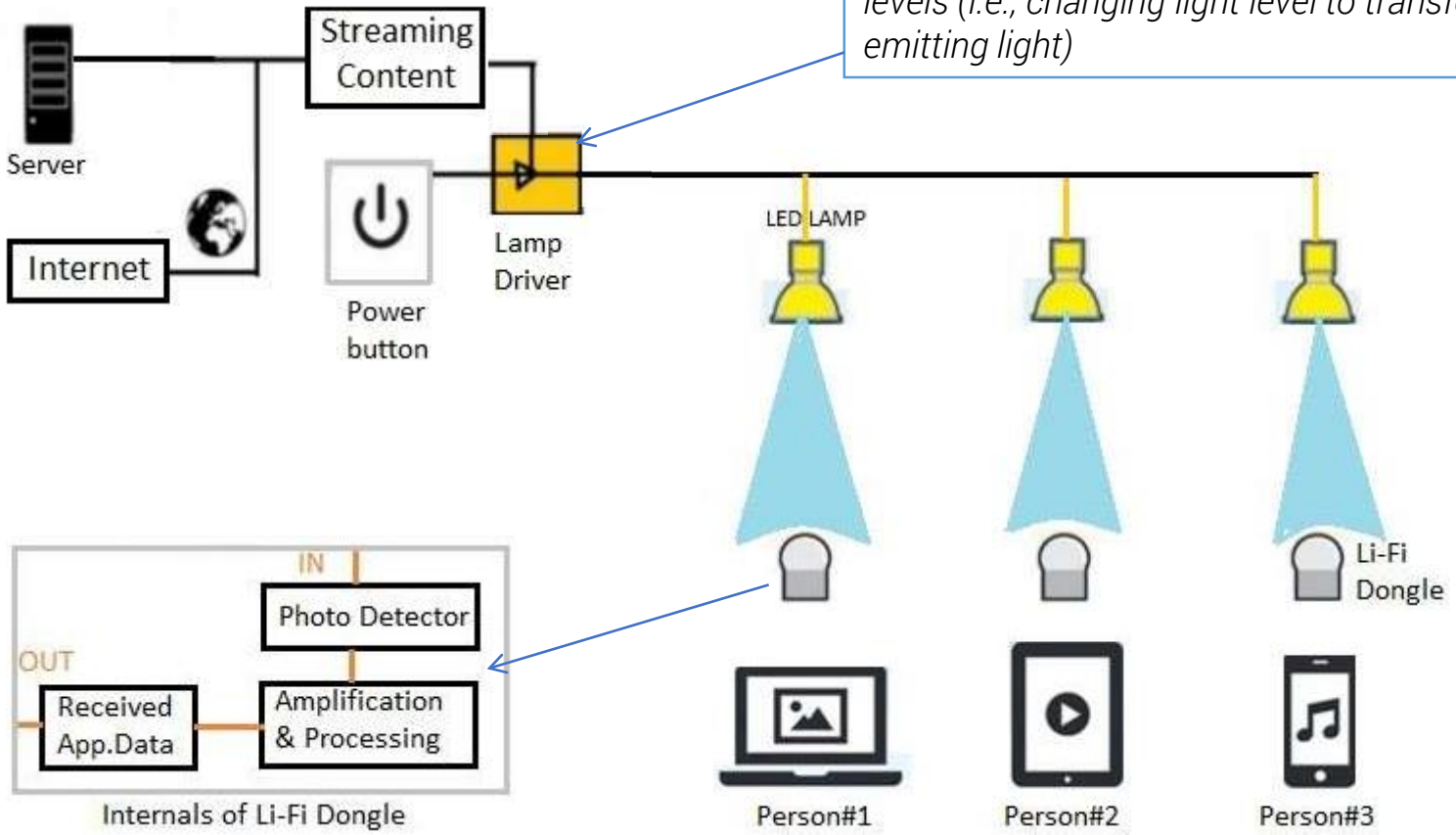
Light-Emitting Diodes (LEDs) bulbs can be used to:

- light a room as well as
- “pulsating light sources” for high-speed transmission because they can flicker on and off at a very high rate not even noticeable to the human eye

LiFi was introduced by Prof. Harald Haas, from the University of Edinburgh in the UK, in his 2011 TED Global Talk titled "Wireless Data from Every Light Bulb".

2. LiFi Architecture

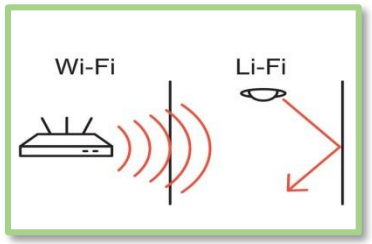
Converts streaming content into a sequence of discrete voltage levels (i.e., changing light level to transfer encoded data in the emitting light)



3. Advantages of LiFi

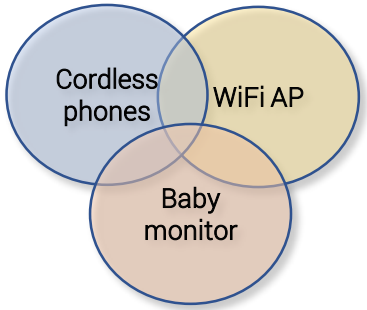
Security

- Radio Waves can penetrate through walls and hence can be intercepted
- Any one with skills and bad intention can intercept them
- LiFi signals cannot penetrate walls and are confined to the illuminated area, making Li-Fi a much more secure system



No-interference

- WiFi user can experience interference from nearby WiFi AP, Cordless Phones, baby monitor, garage door …etc as all of them use unlicensed spectrum
- LiFi AP cannot easily interfere with each other because lights are so confined

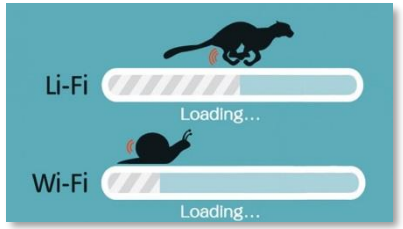


Safety

- Visible light itself is everywhere, necessary for life on earth, and inherently safe for humans
- Unlike WiFi Radio Waves, LiFi has no restriction in petrochemical plants, hospitals, aircraft, etc.

Speed

- The fastest WiFi (802.11ac) is 6.93 Gbps, just shy of 7Gbps
- Theoretically LiFi can reach range of 224Gbps

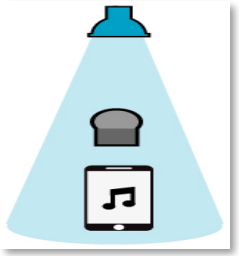


4. Drawbacks of LiFi

Cost
A whole new infrastructure is required to deploy LiFi system

Light Source
Requires a light source (i.e., must turn on light on during day-time even when you have enough sunlight)

Coverage
- Li-Fi has a range of just a few meters
- WiFi (2.4Ghz) can reach up to 46 m for indoors and 92 m for outdoors
- WiFi (5 Ghz) has a range of approximately one-third of WiFi (2.4Ghz)



External Light Interference
Interferences from external light sources like sun light and normal bulbs can cause interruption in communication

Outdoors
If used outdoors, it can be intercepted by the unwanted people

5. Potential Applications of LiFi

Hospitals

Radio frequency energy from wireless devices may affect some sensitive electronic medical equipment.

Petrochemical plants

Radio frequency can generate antenna sparks that could ignite flammable vapor–air mix (i.e., gasoline vapor)

Airplanes

Radio frequency from wireless devices have the potential to cause interference on airplane's navigation system

5. Potential Applications of LiFi

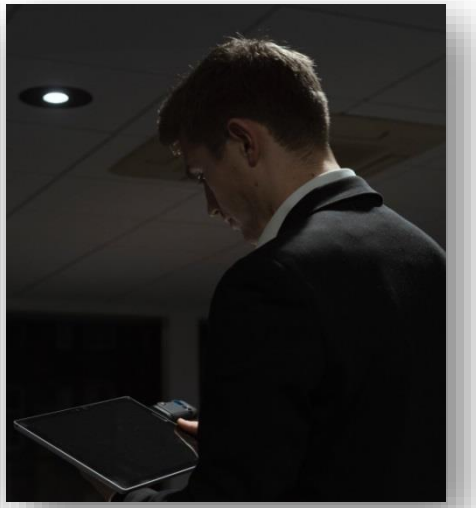
Smart Cities

Shopping Malls and Transportation Hubs

Enterprise offices

Disaster Operations

Defense



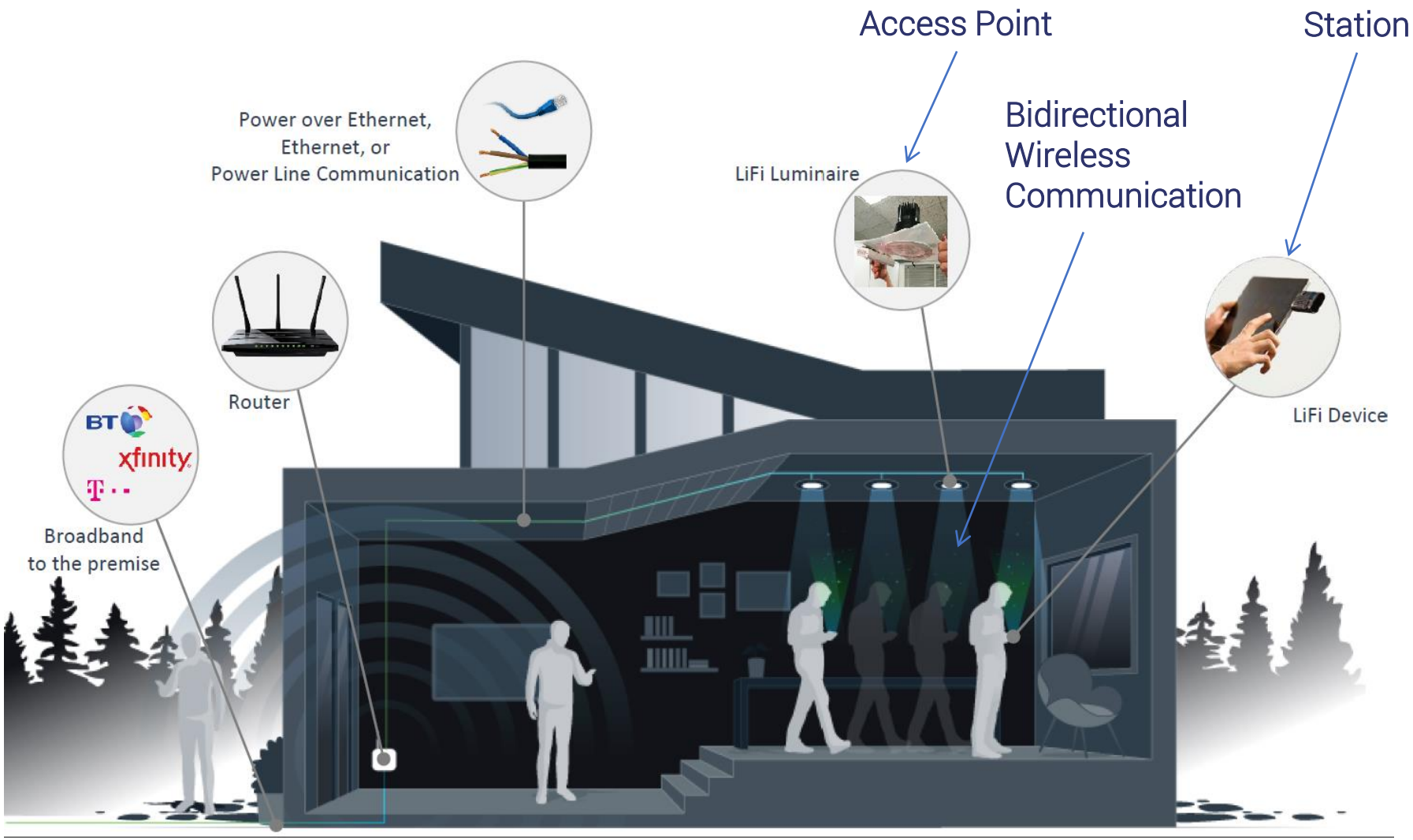
5. Potential Applications of LiFi

Accurate Location Based Services (LBS) on for Retail, Museum, supermarket, and the like

Homes

Class Room

6. Deployment of LiFi – Pure LiFi Solution

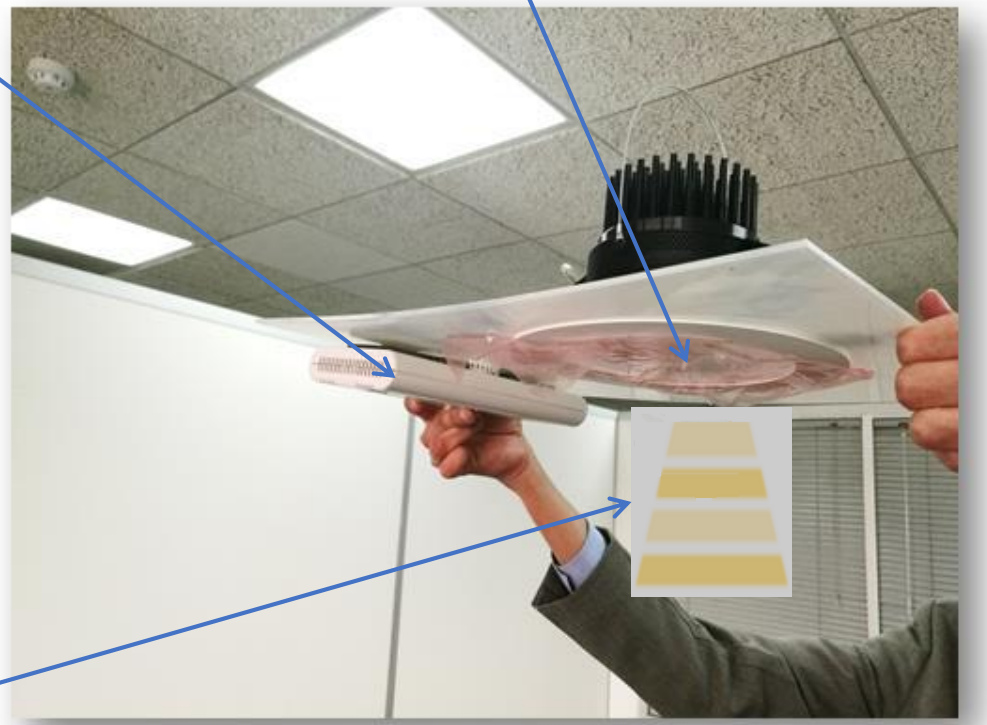


Source: PureLiFi

6.1. LiFi Access Point

Signal Processing
- Modulates LED current to encode network data
- Demodulates received light into network data
- Serves multiple users simultaneously

Transmitter
LED Cluster that provides both
- Illumination
- LiFi Communications to Station



Receiver
Detects invisible Infrared transmissions from the user device (Station)

Modulation Light
- Subtle changes in brightness in the order of millions of times per seconds.
- Perceived as constant illumination by the eye, but LiFi Device can detect

6.2. LiFi Station

Signal Processing
- Demodulates received light into network data
- Modulates the infrared LED current to encode network data
- Roaming between APs

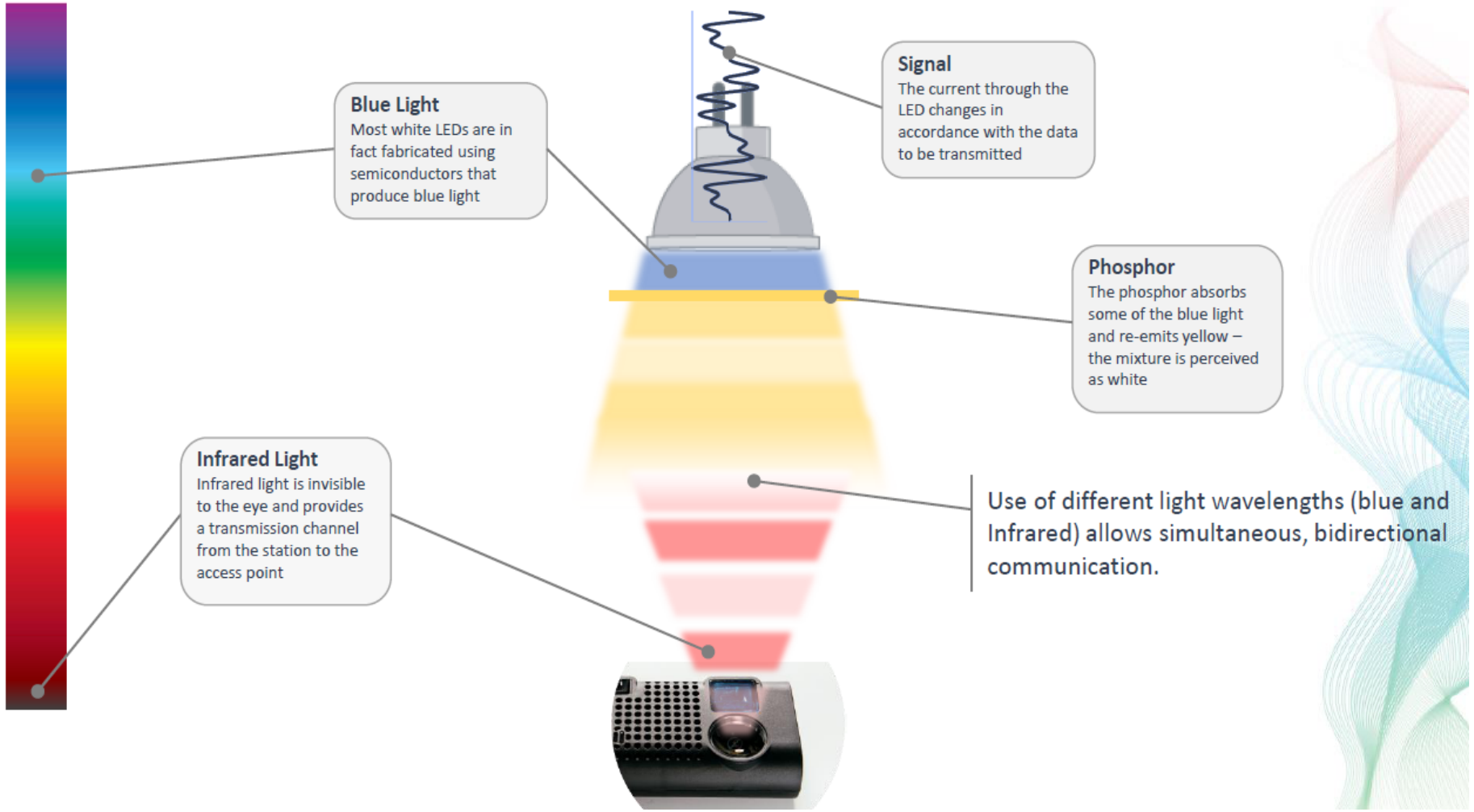
Standard USB 2.0 Connector
- Provides Power
- Present the station like any wireless network device

LED Status
- Dim Red: issue with Station, Driver, insufficient power on USB port
- Orange: Station unable to receive a Signal form the AP
- Green: Station is receiving a signal from the AP

Transmitter
Emits invisible modulated infrared light to LiFi AP

Receiver
Detects the light produced by the LED

6.3. Bidirectional Wireless Communication using light



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Thank you.