Exploration of FTTR+X innovation scenarios

China Unicom

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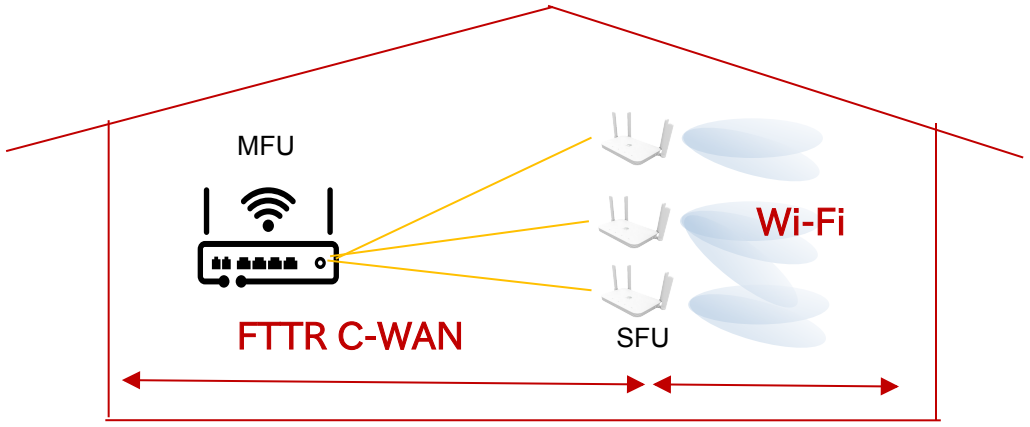
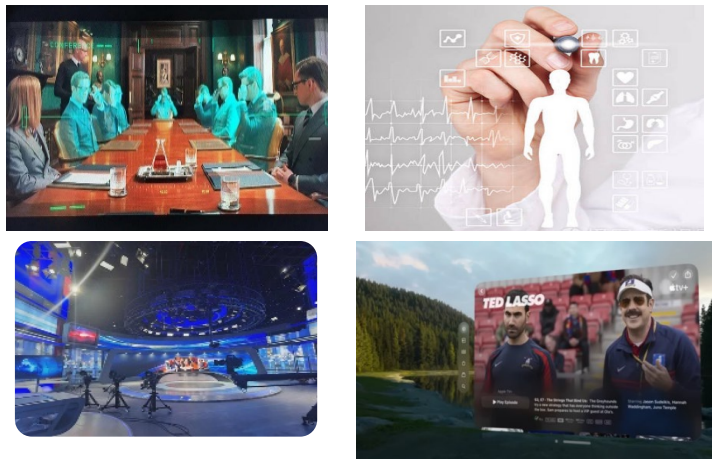
FTTR brings more opportunities



Excellent network facilities

- The development and deployment of FTTR provide in-in-premises network with large bandwidth, guaranteed quality, and full coverage of wireless and wired.
- The research on C-WAN and WMCI achieve a good collaborative mechanism between fibre and WIFI, providing users with a better network experience



Diversified scenarioes

- Based on FTTR, operators further extend fiber to rooms, giving operators the opportunity to develop more diverse services and applications in-home.
- In the 2B scenario, the deployment of FTTR also brings more possibilities, such as large studios, stadiums, etc.

FTTR+Millimeter Wave

FTTR+Sening

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The current spectrum cannot meet China's future needs

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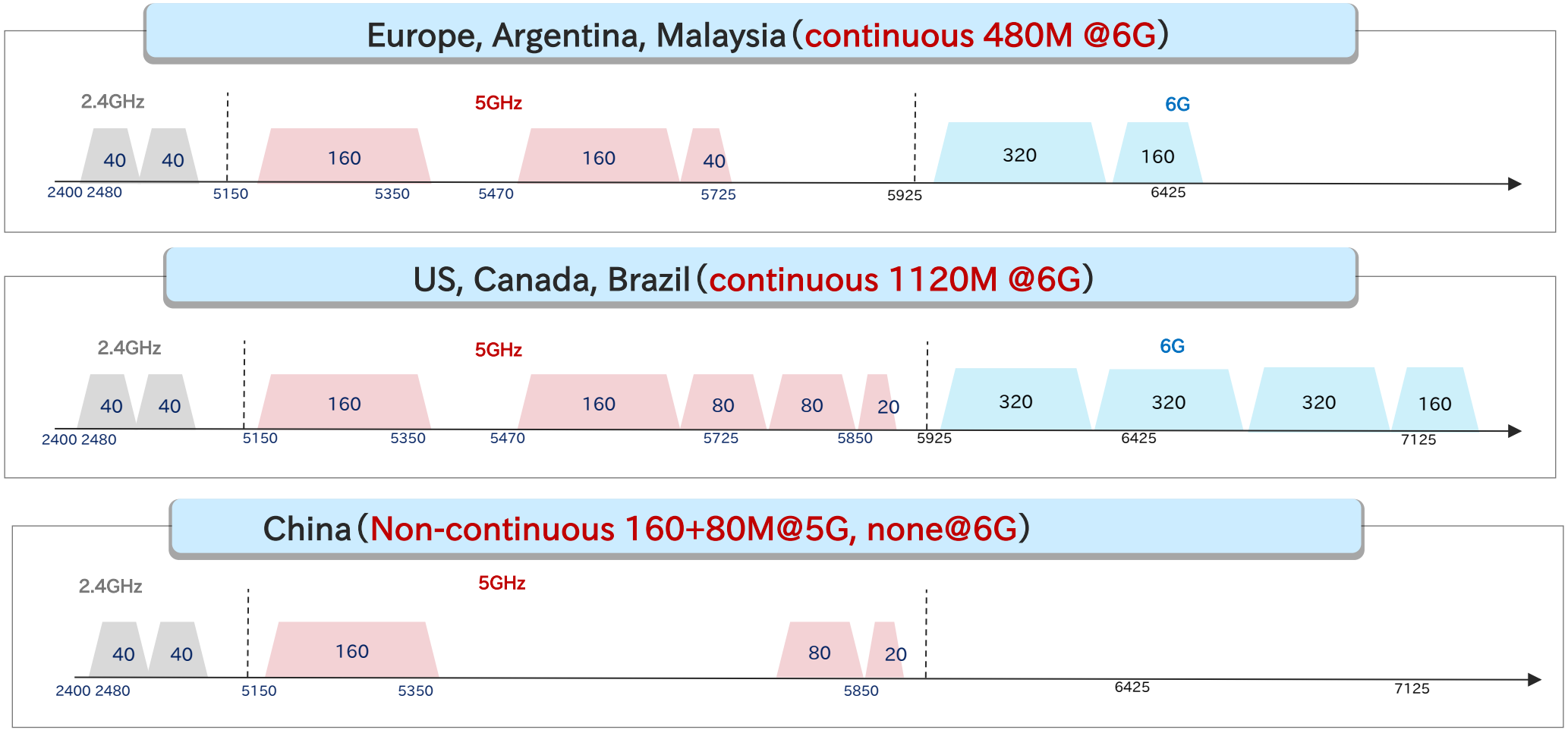
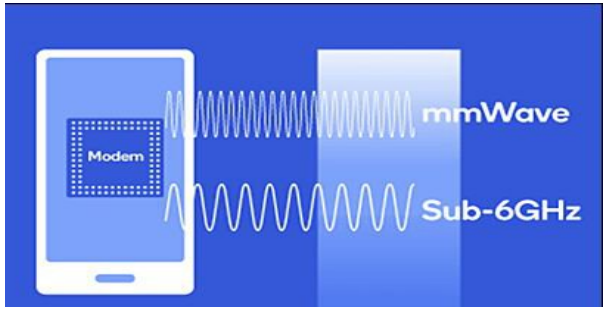


- Based on China's spectrum resource situation, it is very challenging for Wi-Fi 6/7 to carry future high-quality services, and Wi-Fi 8 Sub-6G also can not achieve big improvement in speed. Therefore, it is necessary to find a new way out.

Why mmWave?

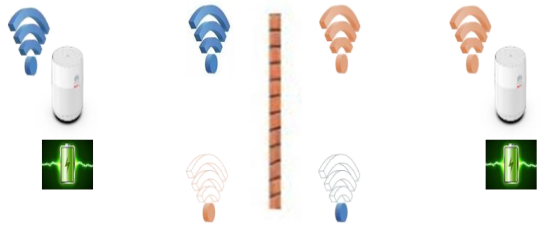


- Large bandwidth, transmitting more data at the same time

p The project research is based on 45GHz millimeter wave (42.4-48.3), with a total of 5.9GHz spectrum bandwidth, which can provide sufficient bandwidth guarantee.

- Narrow beam can support more concurrent transmission

p Through beaming technology, the directional transmission of multi-point concurrency is effectively realized, and the concurrency efficiency is improved.



- Unable to penetrate the wall, no interference between different rooms

p Millimeter wave has great energy loss after penetrating the wall. The power after passing through the wall is close to 0, which can be regarded as almost no adjacent interference indoors. FTTR, as the millimeter wave transmission carrier between different rooms, can be perfectly matched.

Current status of Wi-Fi millimeter wave research

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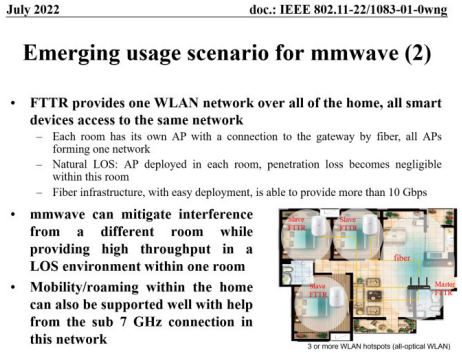
e development of millimeter wav… cribed in the ITU-T Q3 researcha… report (GSTP-HNAFS);

The feasibility description of the …ation of fiber and millimeter wave … proposed on IEEE802.11 WNG

…TSI F5G proposed UC for indoor …limeter wave WLAN coverage;

…CCSA has completed a research …rt on millimeter wave with FTTR.

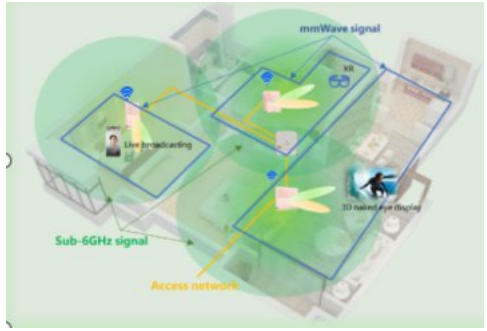
- Section 7.2.2 of the research report briefly introduces the development of IEEE 802.11 standards for high band Wi Fi;


July 2022 doc.: IEEE 802.11-22/1083-01-0wng

Emerging usage scenario for mmwave (2)

- **FTTR provides one WLAN network over all of the home, all smart devices access to the same network**
  - Each room has its own AP with a connection to the gateway by fiber, all APs forming one network
  - Natural LOS: AP deployed in each room, penetration loss becomes negligible within this room
  - Fiber infrastructure, with easy deployment, is able to provide more than 10 Gbps
- **mmwave can mitigate interference from a different room while providing high throughput in a LOS environment within one room**
- **Mobility/roaming within the home can also be supported well with help from the sub 7 GHz connection in this network**

- In a speech in IEEE 802.11 WNG in 2022, fiber based millimeter wave can provide an interference free environment.



- UC: FTTR is the best matching return network for millimeter wave WLAN, which can provide high throughput, low latency, etc

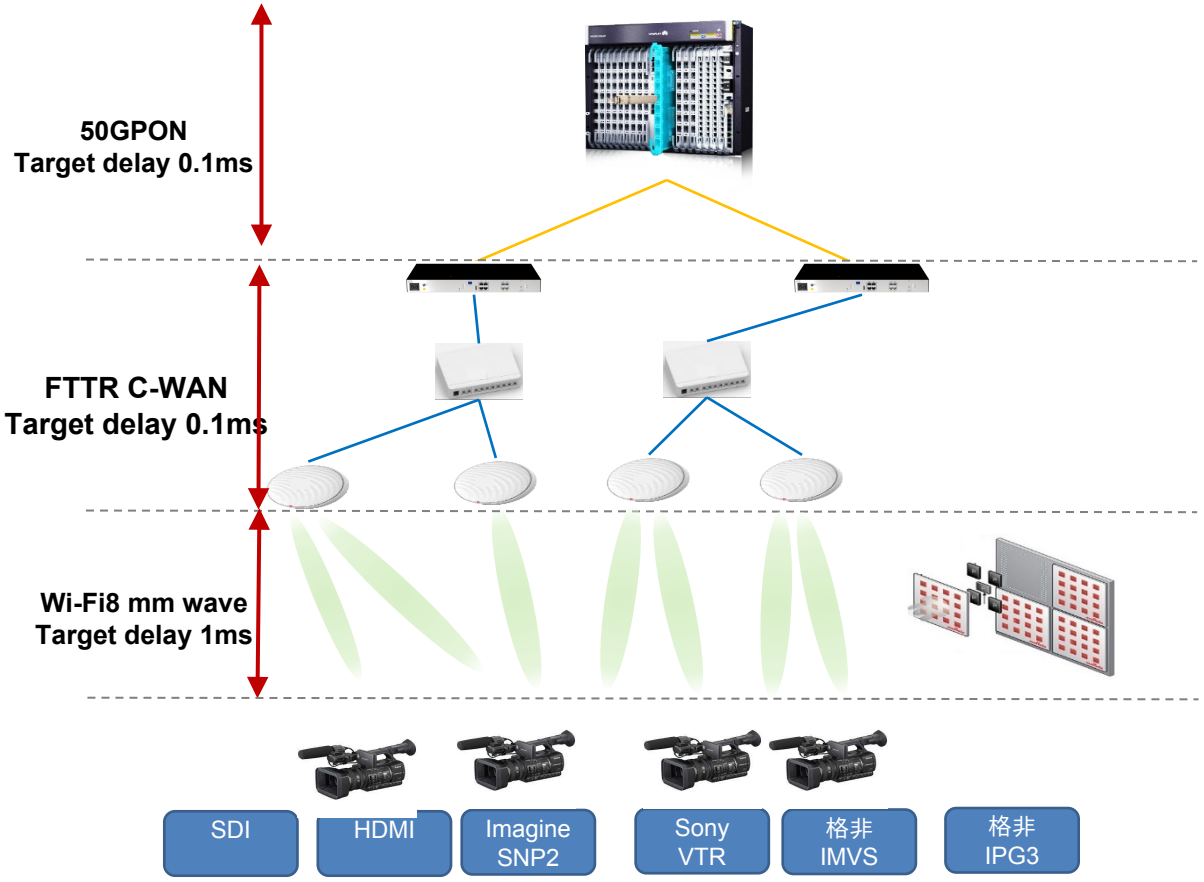
- CCSA has conducted research on the scenario requirements, key technologies and industry development of this technology;

Real scenario test

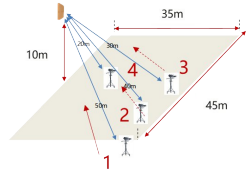
p China Unicom cooperated with Huawei to complete a FTTR+millimeter wave (45GHz) test in one shooting base.

- In the scene of shooting/live recording, 1. High resolution video also needs more storage space, but too much storage space will make the recording equipment inflexible. Therefore, the recorded video needs to be uploaded to the server for storage and subsequent processing. 2. Live recording is shot by multiple devices at the same time, and needs to be rendered quickly before broadcast. Therefore, the network needs to provide large bandwidth, ultra-low latency and concurrency capabilities to achieve fast processing and playback of live video.

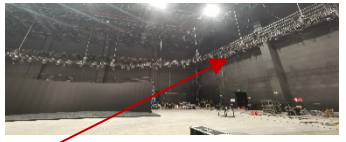
Test environment architecture

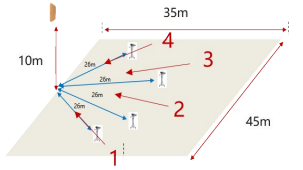


Current network scenario and test results

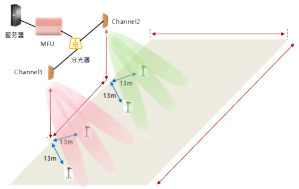


MM wave stable at 1Gbps@2ms





Multi terminal concurrent:uplink 2ms dela guaranteed



No interference in cross frequency networking

zero frame loss
under 4m/s moving rate tracking

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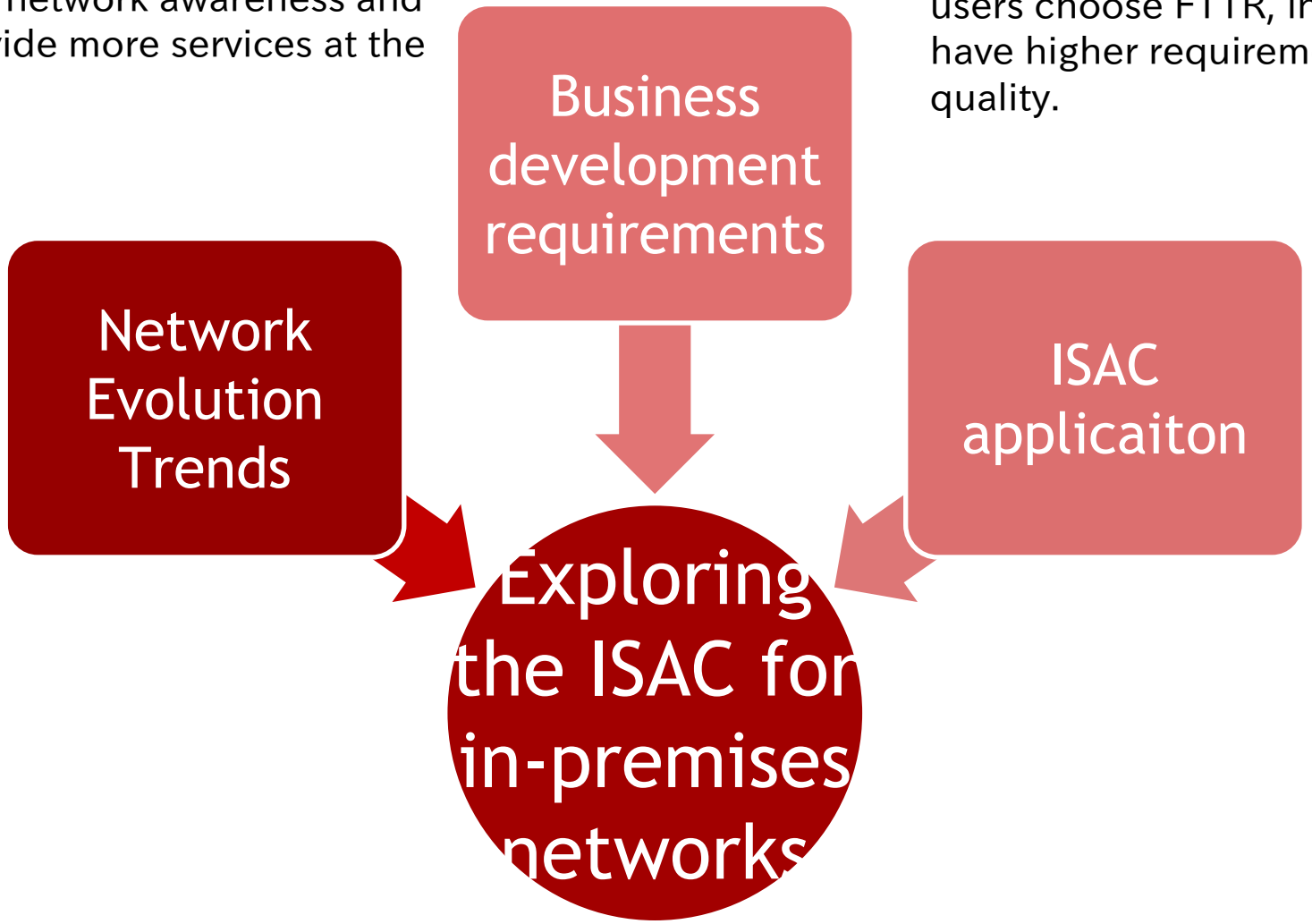
Why exploring ISAC for in-premises network?

- Operators need to apply more intelligent technologies to realize network awareness and management, and provide more services at the same time.

- In the 2H and 2B scenarios, more and more users choose FTTR, indicating that users have higher requirements for network quality.

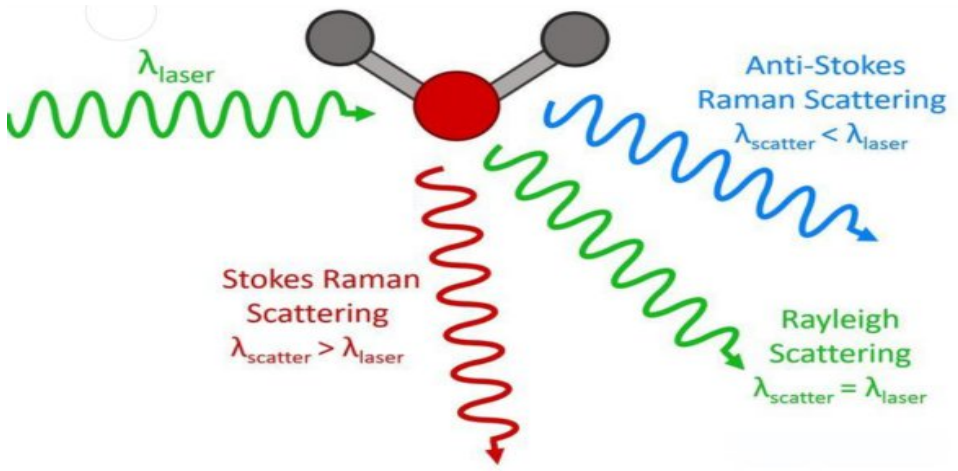


- Optical networks with only communication functions are gradually unable to meet various application needs. The deep integration of communication, sensor and other systems has become a new trend in the development of optical network technology.

- ISAC can make full use of optical fiber and wireless capabilities to mange the status of the internal network based on sensing technology in premises network.

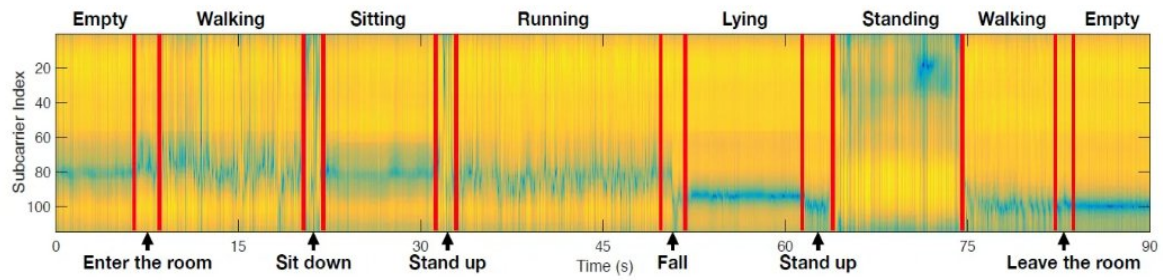
Introduction to perception technology

Optical fiber sensing technology



- Optical fiber sensing technology can detect anomalies and events by analyzing the characteristics of reflected and back-scattered optical signals, such as optical signal intensity, wavelength/frequency, phase, polarization, and so on.

Wi Fi sensing technology



- One type of data that can be perceived based on Wi-Fi is called Channel State Information. In wireless communication, CSI data describes how a signal propagates from a transmitter to a receiver through a channel. It characterizes the synthesis of a series of influences, such as scattering, fading, and energy decay over distance. Therefore, when people move around the house, it can affect the propagation of signals, which are

Application scenarios

Application

•Indoor temperature, pressure, vibration and other characteristics can be detected to determine the safety of the environment.

✦IFDN O&M

• ISAC technology can be used for fault detection, fault point localization, resource visualization, fault prediction, especially in 2B.

✦Environmental monitoring

✦Health monitoring

•Intrusion can be effectively detected, overcoming blind spots in traditional security systems

✦Security monitoring

…

• it can detect breathing and heartbeat to analyze the user's health status.

Use case: Smart home care

- Due to age, the ability of elderly and children to take care of themselves is limited and requires more care. With the development of society, aging has become a major trend, and children are also the foundation of continuous social development. Therefore, smart home care has become a very large demand and has formed a large industrial scale.Currently, visual identity based on camera is the mainstream technology, but there are limitations, which sensing of Wi-Fi and fibre can provide better results.

Home environment monitoring: It is important to monitor the status of the house, such as whether the temperature and vibration inside the room are abnormal, in order to avoid related emergency. Based on fiber sensing of temperature and vibration, it can effectively grasp the state of the house and prevent the occurrence of some dangers.

Intrusion monitoring:Based on perception technology, it is possible to detect intruders and enhance home security protection capabilities

Health monitoring:Based on perception technology and related algorithms, it is possible to perceive and analyze human motion, breathing, etc. This can monitor the health status of family members, detect emergency in time, and ensure the health of users.

Summary--Furture Study

MM Wave

1. Beamforming technology
2. Power control technology to achieve power saving and interference isolation
3. Fast roaming
4. Channel division

ISAC

1. The use case & requirements of ISAC in premise network.2. The study of interference analysis between sensing and communication.3. The study of integrated sensing technology of fibre and WLAN.4. The system functions for the application of ISAC in premise network.5. The technical directions for further study.

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Thanks!