

Supplement

ITU-T L Suppl. 59 (11/2023)

SERIES L: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

Supplements to ITU-T L-series Recommendations

ITU-T L.1700 series – Low-cost sustainable telecommunication solution in rural and remote areas using WLAN/Wi-Fi for conventional telecom services like voice calling using SIP

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Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

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Supplement 59 to ITU-T L-series Recommendations

ITU-T L.1700 series – Low-cost sustainable telecommunication solution in rural and remote areas using WLAN/Wi-Fi for conventional telecom services like voice calling using SIP

Summary

Supplement 59 to ITU-T L-series Recommendations provides a low-cost sustainable solution in rural and remote areas using WLAN/Wi-Fi for conventional telecom services such as voice calling using session initiation protocol (SIP). Access to communication and information and communication technology (ICT) infrastructure in rural areas of most developing countries is still a challenge. The inadequacy of crucial infrastructure like electricity in rural and remote areas presents a significant problem. Deployment of telecommunication solutions which are low-cost and low maintenance and that can be deployed easily is an inevitability in such cases. WLAN/Wi-Fi network infrastructure, configured to provide traditional telecom services such as voice calling, being an overall low-cost solution can prove to be viable in such cases in order to provide low-cost sustainable telecommunication.

History*

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Introduction

This solution proposes use of a WLAN/Wi-Fi network to facilitate session initiation protocol (SIP) based calling to other mobile or landline networks through the core network of a conventional mobile network service provider. The WLAN/Wi-Fi access point (AP) used in this solution is a multi-radio platform. The same AP is used to provide Hotspot connectivity at 2.4 GHz as well as point-to-point (P2P)/point-to-multipoint (P2MP) configuration at 5 GHz by using suitable antennas.

A WLAN/Wi-Fi access network at a location is provided by WLAN/Wi-Fi equipment in a Hotspot, P2P and P2MP configuration. The user devices use SIP client to generate voice over IP (VoIP) calling over a WLAN/Wi-Fi network which is directed to the telecom service provider VoIP core and terminated at mobile/landline networks through respective gateways and vice versa.

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1 Scope

This Supplement aims at identifying a low-cost sustainable solution based on WLAN/Wi-Fi networks which can provide conventional telecommunication services such as voice calling to other cellular as well as fixed line phones. This solution also utilises renewable sources of energy, and cost efficient backhaul in areas where optical fibre penetration is low or not present at all.

2 References

- [ITU-T L.1210] Recommendation ITU-T L.1210 (2019), *Sustainable power-feeding solutions for 5G networks.*
- [ITU-T L.1380] Recommendation ITU-T L.1380 (2019), *Smart energy solution for telecom sites.*
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[IEEE 802.11ax] IEEE 802.11ax, *IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems Local and Metropolitan area networks- Specific Requirements Part 11, Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment 1: Enhancements for High-Efficiency WLAN.*

3 Definitions

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AAA	Authentication, Authorization & Accounting
AP	Access Point
FCAPS	Fault Management, Configuration, Accounting, Performance and Security
P2P	Point-to-Point
P2MP	Point-to-Multipoint
SIP	Session Initiation Protocol
VoIP	Voice over IP
VSAT	Very Small Aperture Terminal
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network

5 Conventions

None.

6 System architecture

Typical system architecture for this solution based on WLAN/Wi-Fi networks is shown in Figure 1.

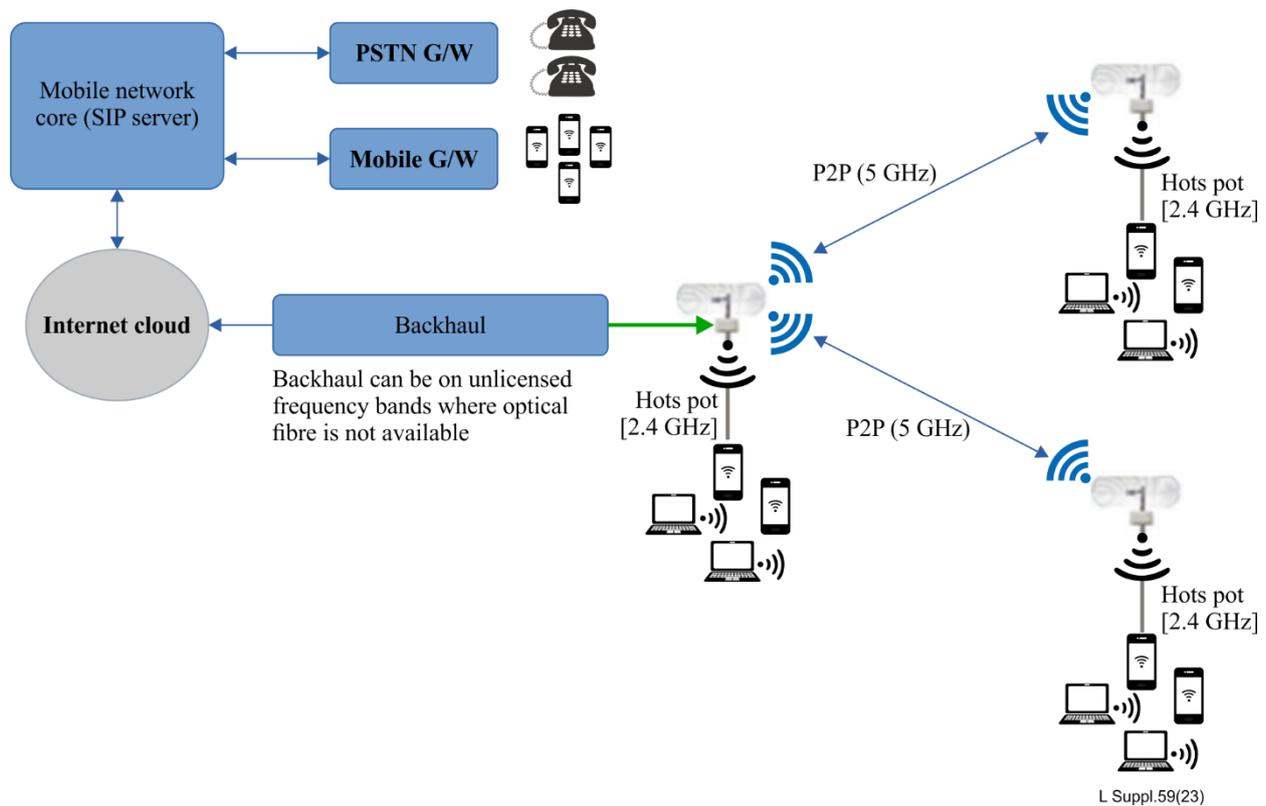


Figure 1 – Telecommunications solution based on WLAN/Wi-Fi networks

7 Network components in the solution

A typical deployment of this solution comprises the network components listed and described in Table 1.

Table 1 – Network components

Sr. No.	Equipment	Details
1	WLAN/Wi-Fi access points	Frequency of operation: 2.4 GHz, 5 GHz Mode of operation: P2P, P2MP and Hotspot configuration Technology: IEEE 802.11a/b/g/n/ac/ax
2	Antennas	Sector and long-range antenna for access as well as point-to-point (P2P)/point-to-multipoint (P2MP) links
3	SIP client	Software for placing calls to mobile/landline networks through WLAN/Wi-Fi network
4	Power supply	Solar panels and cells to make up this solution based on renewable source of energy. However, conventional power supply wherever available can also be used.
5	Backhaul connectivity	Can be based on backhaul using P2P or P2MP configuration in unlicensed bands of 5 GHz or 2.4 GHz of WLAN/Wi-Fi APs using long-range antenna. This option of backhaul connectivity can offer a low-cost solution. However, other conventional backhaul solutions such as:

Table 1 – Network components

Sr. No.	Equipment	Details
		<ul style="list-style-type: none">• Optical fibre wherever available• Conventional microwave backhaul wherever available• Satellite communication based (VSAT) backhaul can also be employed where they are already available. This can also reduce the cost of setting up new equipment and readily available options can be used.
6	Element management system	To manage and configure the WLAN/Wi-Fi access points (APs) and other related network devices at remote locations from a centralized location. This will ensure better maintenance of the network operations from point of view of handling of faults, alarms, etc.
7	Core network of mobile service provider	Mobile core network with SIP server or VoIP enabling core network components.

8 Overview of the solution

The solution aims to provide WLAN/Wi-Fi coverage in rural and remote areas where coverage by other conventional sources is limited or not present at all. A brief overview of the system is provided below:

- WLAN/Wi-Fi access points (APs) deployment and WLAN/Wi-Fi coverage provision

The WLAN/Wi-Fi APs will be deployed at different locations in a region where coverage has to be provided. The WLAN/Wi-Fi AP can be used with sector antennas instead of omnidirectional antennas to extend the coverage. One of the sectors of the WLAN/Wi-Fi AP can be used to extend P2P link to backhaul. The necessary authentication, authorization & accounting (AAA) provisions are made to ensure necessary AAA functionalities. Fault management, configuration, accounting, performance and security (FCAPS) functionality for service provisioning for users and network equipment management is also deployed.

- SIP client-based voice calling over WLAN/Wi-Fi to mobile and landline networks

SIP based calling through a WLAN/Wi-Fi network can enable making or receiving calls to and from mobile and landline networks. The call is routed through the SIP server installed in the core network of the anchor service provider (mobile or fixed line service provider). The service provider will authenticate the user and provide him with a unique calling number (based on the relevant numbering scheme employed in the network) which will be entered in the SIP client to facilitate calling to other mobile or fixed line networks. Whenever the user makes a call through the SIP client, the called party will be display this number allocated to the user. The called party will receive the call as normal mobile or fixed-line telephone call and no SIP client or any other VoIP client needs to be installed at the user device of the called party. This facility will enable users to make conventional calls using WLAN/Wi-Fi in rural and remote areas where coverage of mobile or landline networks is limited or not present at all. This will also curb the capacity planning issues of the mobile network service providers in certain areas as the traffic in this case is being offloaded over the WLAN/Wi-Fi network.

Examples of application of this concept are available in [b-dot], [b-tec] and [b-cdot].

9 Different communication scenarios of the solution

Figure 2 shows different communication scenarios of the solution.

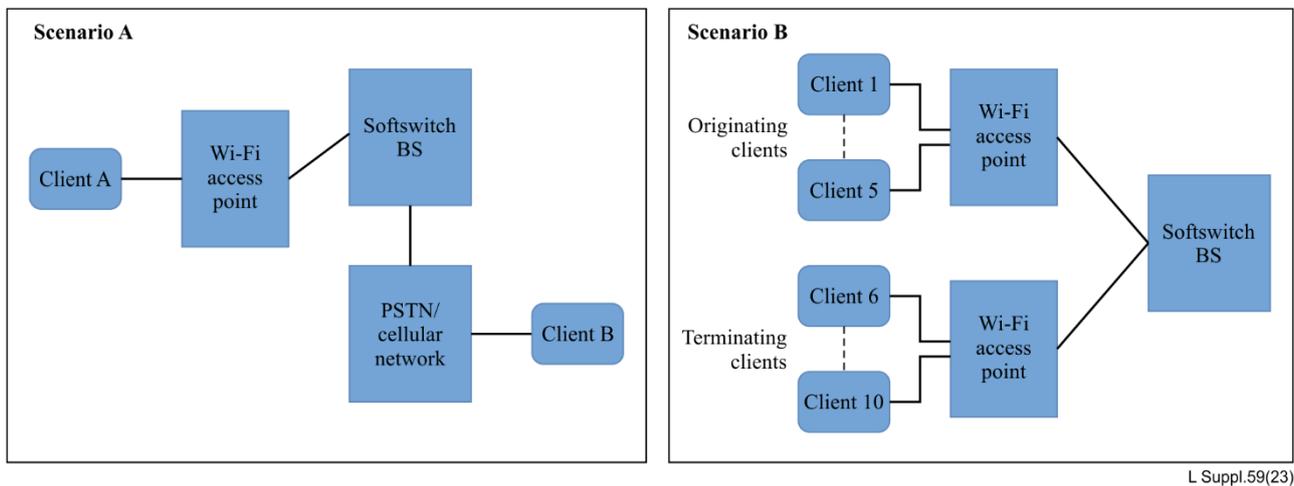


Figure 2 – Different communication scenarios of the solution

10 Features of the solution

- i) **Low cost:** The solution offers conventional services such as voice calling apart from data services over WLAN/Wi-Fi network which reduces the charges of licensed spectrum for providing access, mobile network equipment charges, backhaul spectrum charges, etc. This will also curb the capacity planning issues of the mobile network service providers in certain areas as the traffic in this case is being offloaded over the WLAN/Wi-Fi network.
- ii) **Solar based power supply:** The whole WLAN/Wi-Fi AP system with sector-based coverage and backhaul on a WLAN/Wi-Fi link can also be powered by a solar based power supply system which not only provides environmental sustainability but also reduces the dependence of the network on conventional grid power supply thereby aiding in increasing the reliability of the solution in rural and remote areas and reducing the environmental impact. See [ITU-T L.1210], [ETSI ES 203 700] and [ITU-T L.1380] for information on how to use solar to power ICT equipment.
- iii) **Easy deployment and management:** WLAN/Wi-Fi networks are easily deployable due to their low degree of complexity as compared to other conventional telecommunication networks. In remote and rural areas, there may be shortages of skilled manpower to manage and operate complex networks. The degree of complexity in Wi-Fi networks being lower, the manpower in such remote and rural areas can be trained in an easier and faster way.
- iv) **User authentication:** The user authentication for use of SIP client-based calling can be facilitated by the anchor service provider. Different anchor service providers can provide services in different or same areas.

11 Conclusion

The solution proposed here offers a low cost and environmentally sustainable way of extending coverage in rural areas through WLAN/Wi-Fi deployment and of providing conventional services such as voice calling (using SIP client) along with the data services.

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