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MESH Concept for Mobile Distribution Point Architecture of ICT Infrastructure

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INTRODUCTION

In situations of failure of communication systems or lack of access to telecommunications infrastructure, it is necessary to use alternative solutions. One way is to use vehicles equipped with a variety of data transmission methods. An example of such a vehicle is the Mobile Distribution Point of ICT Infrastructure (MPDIT) which integrates modern and sophisticated ICT solutions. The vehicle is equipped with many different transmitting and receiving devices, however, the range of which is limited. One of the methods of increasing the range and reliability of communication links is the use of MESH networks. MESH nodes are carried by people, they create a dynamic structure, the functioning of which is possible even if some nodes stop working. The paper also presents a way to solve the problem of simultaneously ensuring high network throughput and large ranges by integrating two types of MESH networks.

HIGH-SPEED MESH NETWORK FOR MPDIT

The functional model of the MESH network dedicated to the transfer of large amounts of data was based on Ubiquity MESH network modules. Exemplary measurement results are presented in the figures 1 and 2. They show that the typical distance between network nodes in an open space should not exceed 150 m or 200-250 m in the use of sector antennas. Range decreases quickly in the presence of signal-suppressing obstacles such as dense vegetation.

LONG-RANGE MESH NETWORK FOR MPDIT

Due to the existing need for data transmission over longer distances, it was proposed to build a MESH network based on GoTenna devices operating in two frequency ranges: VHF and UHF. GoTenna is a device designed to transmit small amounts of data, limited mainly to short text messages and geographic coordinates with a low frequency, generally below 1 Hz, which is justified because the position of a walking person does not change quickly and the accuracy of satellite navigation is limited. The research tests were started in rural conditions due to the expected maximum range in kilometers in open space. In rural conditions, when the signal has to overcome barriers such as trees and sporadic buildings, for the lowest signal power available (0.5 W), the range for the UHF band is approx. 1500meters (Fig. 3). For this reason, it was decided to carry out further tests in suburban conditions, which are more reproducible - mainly because most plots and houses are of a similar size. Attempts were made to set the starting and ending point of the tests so that there were as many houses and metal fences as possible between them (Fig. 4). The results of the range depending on the signal strength and the frequency band are shown in Fig. 5. From the obtained results, it can be concluded that the goTenna device is better adapted to work in the UHF frequency range. Moreover, an increase in signal strength does not always result in a significant increase in coverage.

CONCLUSIONS

In order to reduce the limitations in communication-related to the relatively small range, it is advisable to use two technologies simultaneously:

- Ubiquity MESH - for transmitting large amounts of data (audio/video) over shorter distances,
- GoTenna - for transmission of short text messages and location data (geographical coordinates) over long distances.

In both cases, it is possible to use MESH network terminals in the form of portable devices (smartphone). The integration diagram is shown in Fig. 6.

ACKNOWLEDGMENTS

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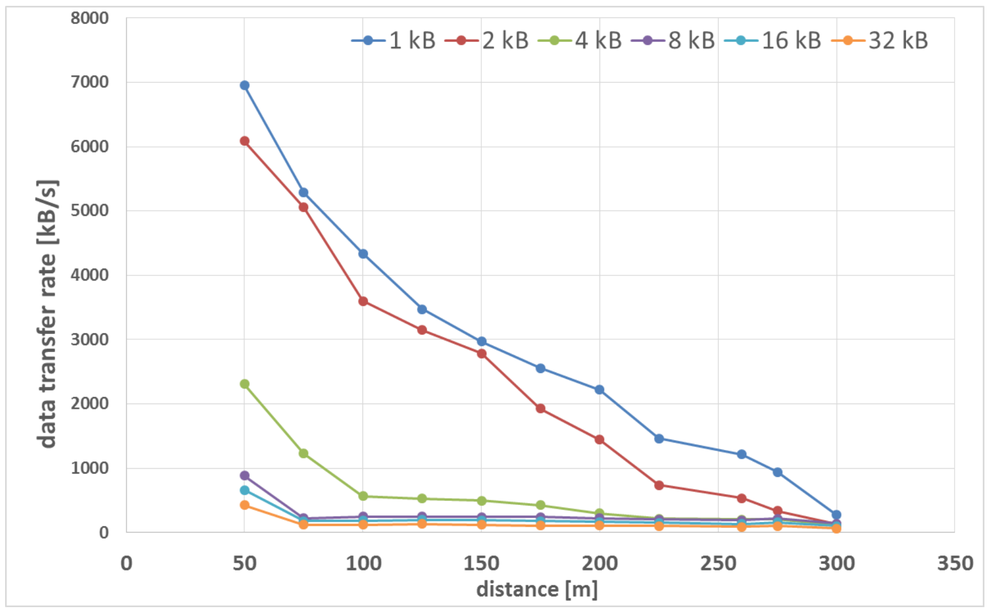

Fig.1. The rate of data reception by UAP-AC-M with UMA-D antenna sent by UAP-AC-M as a function of the distance between these devices

	open area		area with trees	
distance [m]	high quality (HD)	low quality	high quality (HD)	low quality
50	no distractions	no distractions	no distractions	no distractions
75	no distractions	no distractions	occasional disruptions	occasional disruptions
100	no distractions	no distractions	**no transmission**	**no transmission**
125	no distractions	no distractions	**no transmission**	**no transmission**
150	occasional disruptions	no distractions	**no transmission**	**no transmission**
175	occasional disruptions	occasional disruptions	**no transmission**	**no transmission**
200	occasional disruptions	occasional disruptions	**no transmission**	**no transmission**
225	occasional disruptions	occasional disruptions	**no transmission**	**no transmission**
250	**no transmission**	**no transmission**	**no transmission**	**no transmission**

Fig.2. Summary of video and audio data transmission depending on image quality and terrain type

Fig.3. Range in a rural area (1500 m) – GoTenna MESH network

Fig.4. Range in the suburban area (700 m) – GoTenna MESH network

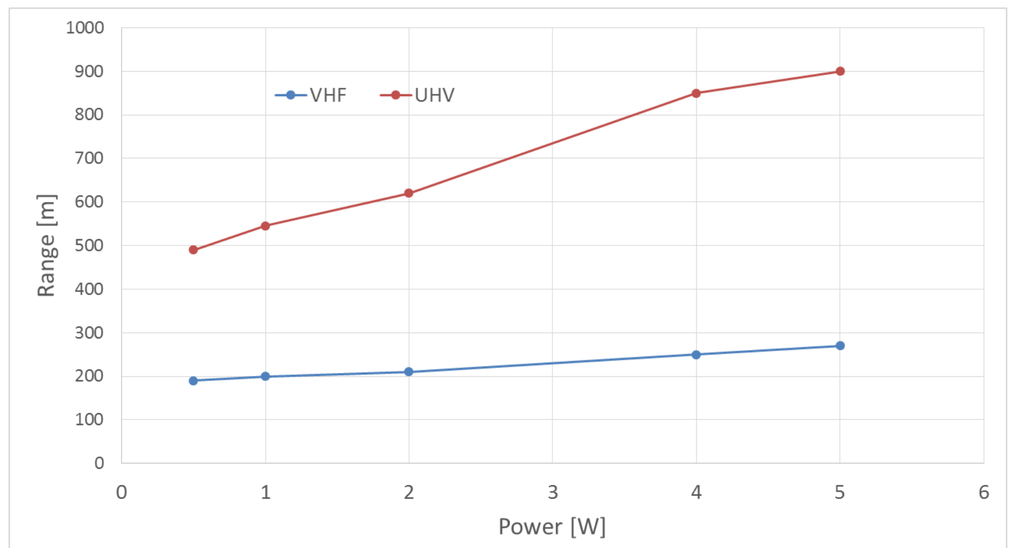

Fig.5. Signal range in a suburban area depending on the signal strength and frequency range – GoTenna MESH network

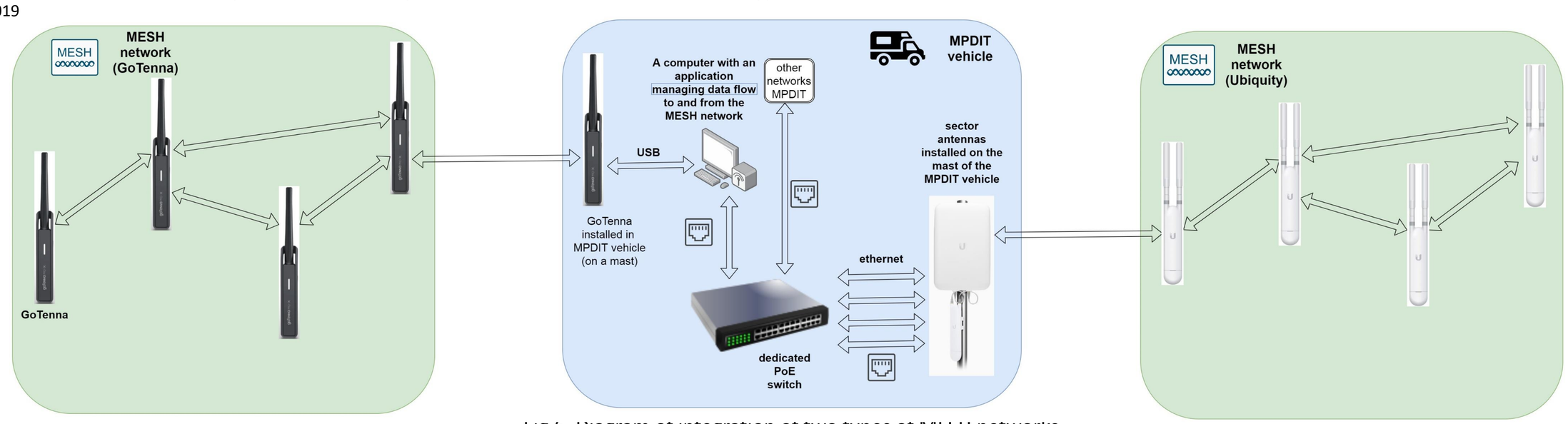

Fig.6. Diagram of integration of two types of MESH networks