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MESH NETWORK DEVELOPMENT PROJECT IN GREAT STONE INDUSTRY PARK

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Wireless Mesh network (WMN) are increasingly becoming popular as low cost alternatives to wired network for providing broadband access to users. A wireless mesh network (WMN) is a communication networks made up of radio nodes organized in a mesh topology. It is also a form of wireless network. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways, which may, but need not, be connected, to the Internet. In this paper, we discuss different radio frequency range in wireless connected to Access Point (AP) and the project from Belarus – China great stone industry park in Mesh network. The China-Belarus industrial park is a territorial entity with the area of approximately 80 sq. km with a special legal status for the provision of comfortable conditions for business conducting. The Park is located in a unique natural complex 25 km far from Minsk, the capital of the Republic of Belarus. It is in close proximity to the international airport, railway lines, a transnational highway Berlin-Moscow. The result of analysis shows distribution of AP and covering services in great stone industry park. Mesh network provides robustness and load balancing in wireless networks communication.

Keywords: Mesh *network, equipment, project, testing.*

1. Mesh Network Introduction

More demanding about wireless broadband access by person follow with wireless communications and mobile computing development of technology. Wireless Mesh Networks broadband access technology as the «last kilometer» is the most interesting for scientists and engineers in development. Wireless Mesh Network which combines the advantages from wireless local area network WLAN and Ad Hoc networks. It is a high capacity, high speed, covering widely networks. At the same hierarchical topology, wireless Mesh network has reliable transmission, global coverage, scalability and low upfront investment properties. The principle of wireless Mesh network technology is a low-power multi-hop system. The message packet passes from one node to another node until the packet reaches the destination in Mesh network.

2. The advantages in Mesh network

1. Reliability is greatly enhanced to compared with a single-hop networks. For example there is a temporary local interference (such as another radio signal or an object) may prevent or reduce a data rate of conventional networks; alternative path mesh technology could simply unaffected by a transmission data. Similarly, any node in a mesh network hardware failure will not cause mesh completely ineffective. Redundant mesh technology also increases the effective bandwidth because multiple data streams can be transmitted simultaneously. For example, home networking environment can put the video data stream from the living room to the bedroom for DVD player, a TV set. At the same time, the audio data stream from a home computer connects to a portable MP3 player pool.

2. The low cost of laying infrastructure for wireless access to Internet is currently the main way through the laying of Wi-Fi hotspots. It is basically a wireless local area network (WLAN). It consists of a plurality of WLAN wireless network. Wireless 802.11is based WLAN users access to Internet. In order to make the entire city we can achieve wireless access because of the limited coverage of 802.11 signals. You must establish a lot of access points with the help of wired or fiber optic cables that are connected to the Internet. It is clear that the costs will be high-

er. At the same time too wired access is also greatly reduced by laying speed. There is wireless Mesh network to Internet with only a few access points, so this network greatly reduces network infrastructure costs. Laying speed can be reduced from 70% to 75% of using operating system costs of a wireless network service providers.

3. Flexible networking, easy to maintain due to the characteristics of wireless Mesh networking is we should add wireless router (WR) where needed and other small wireless devices with existing facilities to broadband wireless access network consisting of wireless mesh network selection feature is the link interrupted or partial expansion and upgrade. It does not affect the entire network operation, thereby increasing network flexibility, feasibility and compared to traditional networks that are more powerful and more perfect.

4. Mesh network has two advantages to compare with the cellular network. The first is transmission rate greatly improved: the current network using wireless Mesh network technology, and can be fused with other wireless network technologies (such as Wi-Fi, UWB, etc.), the rate can theoretically reach 54 Mbit/s, or even higher. At present, the development of the 3G technology, the theoretical transfer rate in the high-speed mobile environment supports only 144 Kbit/s, walk slow moving environment supports 384 Kbit/s, even in the stationary state also reach 2 Mbit/s. The second is mesh network has low investment costs. A significant reduction in Wireless Mesh Network backbone network construction costs, not only its infrastructure AP, IR (Intelligent Router, intelligent router), WR than the cellular mobile communication system base stations and other equipment cheaper and network configuration and maintenance should be simple and more convenient.

5. The wireless Mesh network compared with WLAN (Wi-Fi) has two advantages. The first is in expanding coverage: Today transmission distance Wi-Fi network maximum 300 m. And because of its ability to penetrate poor, can not pass through metal, water, or other high-density material. So under normal circumstances, in general home or office Wi-Fi network transmission distance is about 25~50 m, and is prone to «blind spots.» The multi-hop routing based wireless Mesh network and its approximate unlimited scalability, can easily be completely cover a larger area. The second is about robustness: Implementing network robustness usual approach is to use multiple routers to transmit data. If a router fails, the information is transmitted through an alternate path from the other routers. E-mail is one such example, the message information is divided into several packets and then sent over the Internet via a plurality of routers, and finally reach the information assembled into a user's inbox. Mesh network is more robust than single-hop network, because it does not depend on the performance of one single node.

Wireless Mesh network not only has an irreplaceable role in specific areas battlefield, disaster relief but also in our daily public communication services has a great potential. It will bring major changes in the field of wireless broadband wireless Mesh network technology.

3. The Theory of Wireless Mesh Networks

Wireless mesh network is the third topology infrastructure in following figer. Fig. 1 [1]. Each device in a wireless mesh network is typically called a mesh node and is connected with multiple other mesh nodes at the same time. Wireless mesh networks are also multi hop networks because each mesh node can reach another node going through multiple hops and leveraging other nodes as repeaters. The major advantage of wireless mesh networks is the intrinsic redundancy and, consequently, reliability because a mesh network is able to reroute traffic through multiple paths to cope with link failures, interference, power failures or network device failures.

Two types of wireless mesh networks are usually implemented for commercial and government applications.

3.1. Structured wireless mesh networks

In an unstructured wireless mesh network, each mesh node typically uses an Omni-directional antenna and is able to communicate with all the other mesh nodes that are within the transmission range. Wireless links in an unstructured wireless mesh network are not planned and link availability is not always guaranteed. Depending on the density of the mesh network, there may be many different links available to other mesh nodes or none at all. Unstructured mesh networks are usually implemented with non-line of sight radios

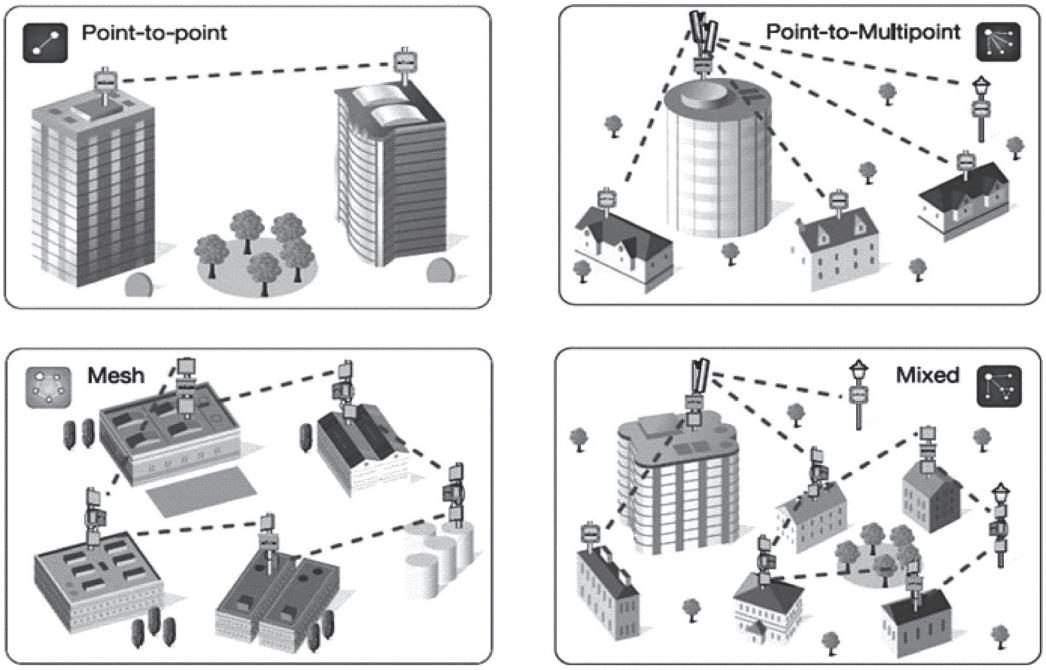


Fig. 1. Point-to-point, Point-to-Multipoint and Mesh Networks

(NLOS) using low frequency and low bandwidth radios operating, for example, in the UHF bands, such as 400 MHz or in the license-free band at 900 MHz. Unstructured wireless mesh networks leverage one single channel shared by all the radios. Therefore, the higher the number of hops a transmission requires, the lower the overall throughput of the network will be.

Structured wireless mesh networks are planned networks typically implemented using multiple radios at each node location and multiple directional antennas. A ring topology using multiple directional wireless links is commonly used in a structured wireless mesh network to enable each radio to seamlessly reroute traffic through different paths in the event of node or link failures. Structured wireless mesh networks can provide two or more alternative paths from each mesh node location and typically use high frequency radios and microwave links with directional antennas. The distance between nodes in a structured wireless mesh network can be up to tens of miles using long-range directional microwave links. Structured wireless mesh networks are often used for mission-critical applications such as wireless video surveillance, public safety, and industrial automation. They provide the ideal network architecture in case a site requires a highly reliable and available wireless network for a broadband application such as video, voice and data streaming. Each link in a structured wireless mesh network operates on an independent channel and, therefore, the number of hops for a specific transmission does not affect the overall throughput of the network.

Wireless mesh networks have been studied for many years in academia since the early ‘90s, initially mainly with military applications in mind, and then they started to get significant commercial traction between 2005 and 2010. Fig. 2 [2].

Temporary wireless mesh video surveillance: military and government organizations use wireless mesh networks frequently for rapid deployment of wireless video surveillance in war zones or during hostage situations. Wireless mesh networks have also been used to provide temporary video surveillance to protect major sporting or political events.

Urban wireless video surveillance and public safety: law enforcement agencies have been using wireless mesh networks to create city-wide wireless network infrastructure and stream high resolution video across large cities without compromising reliability or needing to trench large portions of the city area. In the United States most mesh networks for public safety work on the 4.9 GHz public safety band.

Industrial Automation and Condition Monitoring: large industrial plants and oil & gas facilities have been using low-frequency unstructured

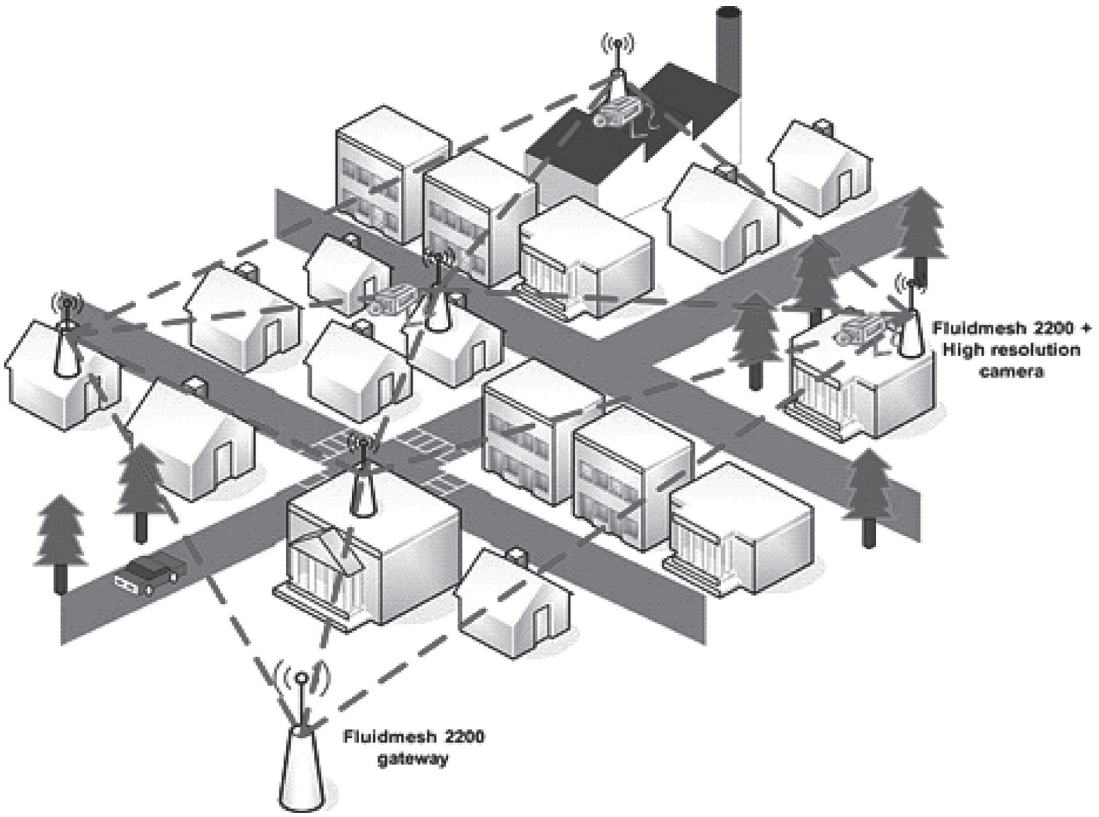


Fig. 2. Wireless Mesh Network

mesh networks for condition monitoring and sensor data collection. At the same time, industrial automation has leveraged structured mesh networks operating at 5 GHz (5.4 GHz, 5.7 GHz and 5.8 GHz license-free bands) to high-throughput applications such as video and voice streaming.

Mining Automation: Mines have been pushing to constantly increase their efficiency leveraging automaton and technology. Large open pit mines have been using outdoor wireless mesh networks for video surveillance, truck automation and condition monitoring. Both low throughput and high throughput applications in mines often rely on a wireless mesh network due to the lack of any other telecom infrastructure.

Environmental monitoring and precision agriculture: farming is using increasingly more automation and technology to increase profitability. Farmers are adding sensors to their fields, tractors and vineyards to be able to act in a more precise and timely manner, spending less money and wasting less resources. Low frequency wireless mesh networks using sensor networks have been deployed frequently for environmental conditional monitoring both in vineyards and industrial crop farming. At the same time, high frequency wireless mesh networks in the 5 GHz band 5.4 GHz, 5.7 GHz and 5.8 GHz license-free bands) are getting more traction for tractor automation and precision agriculture as high resolutions cameras become a critical component in automating tractors and in collecting aerial images from drones.

3.2. Wireless Mesh Network Equipment

The single-radio wireless AP be used as a wired terminal nodes AP and wireless endpoint applications. AP RF 2.4 GHZ contains an access module. Single-radio wireless AP does not have the Mesh routing functions. Multi-RF wireless AP.

Multi-RF wireless AP is a high-capacity equipment, used as a core node Mesh Network under normal circumstances. It has a multi-RF wireless AP contains four high-performance wireless module, which three 5.8 GHZ backhaul module, a 2.4 GHZ access module.

3.3. Wireless Mesh Solutions of Outdoor

In large LAN planning, you need to choose a different networking according to the needs of specific business. According to network planning and operational needs of different network types as follow: Fig. 3 [5].

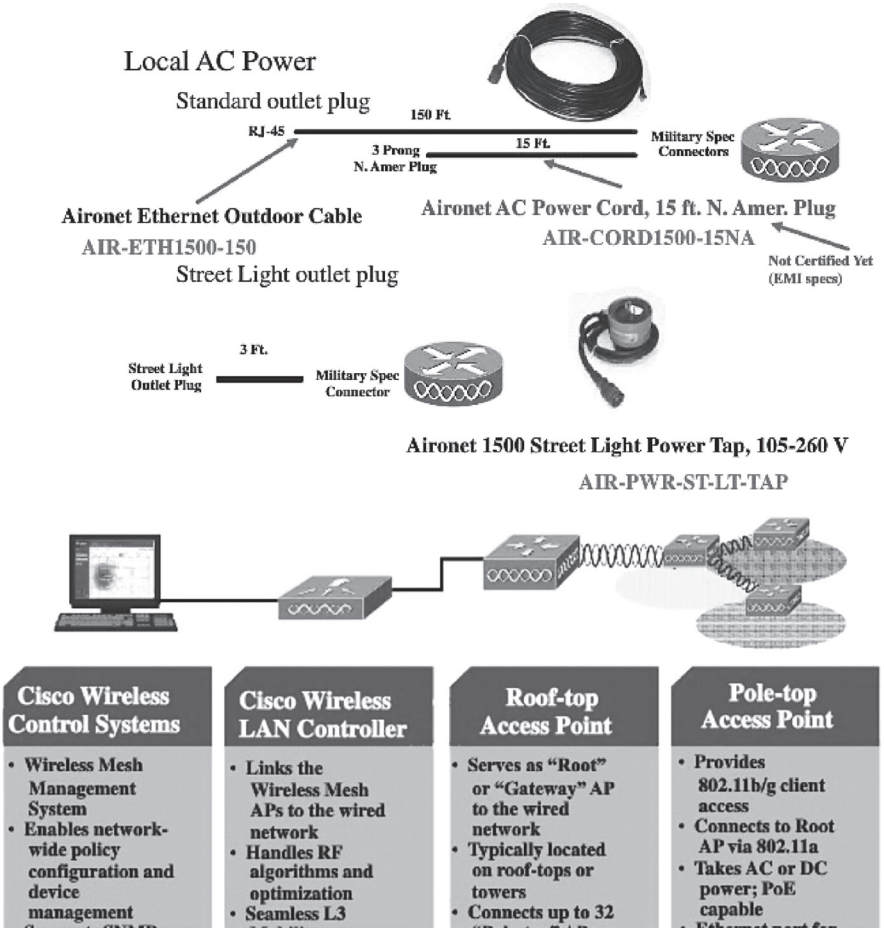
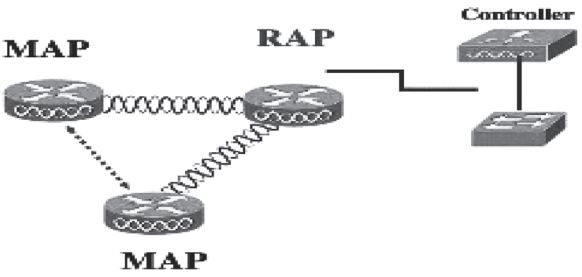


Fig. 3. Equipment and organization structure in Mesh network



MAP	Mesh Access Point
RAP	Roof-top Access Point

Fig. 4. Mesh Encryption

If to select a common standard 802.11a protocol, the maximum output rate of 54 Mbps, the average throughput of 20–25 Mbps frequency: 5.15–5.25 GHz, 5.25–5.35 GHz, 5.47–5.725 GHz, 5.725–5.875 GHz.

If to select 802.11b maximum output rate of 11 Mbps, the average throughput of 5 Mbps frequency range: 2.4–2.5 GHz.

802.11g maximum output rate of 54 Mbps, an average throughput of 10–20 Mbps, the frequency range: 2.4–2.5 GHz.

802.11n maximum output rate of 540 Mbps, the average throughput of 200 Mbps, the frequency range: 2.5 or 5 GHz.

APs automatically establish connection to controller Roof Top AP RAP) via wired connection Pole-top AP (POP, also MAP) via self-configuring backhaul connection Pole-top AP uses Cisco's Adaptive Wireless Path Protocol to establish best path to Root AP authenticates to controller and downloads configuration and radio parameters. Fig. 4 [6].

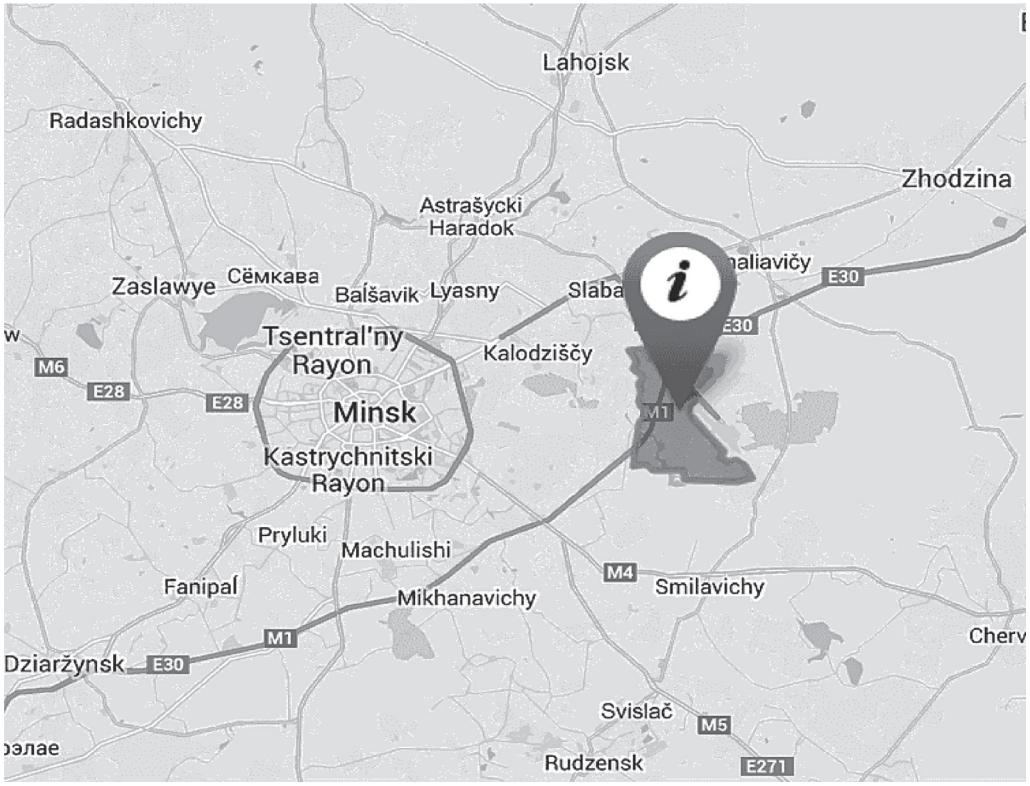


Fig. 5. The location of great stone industrial park

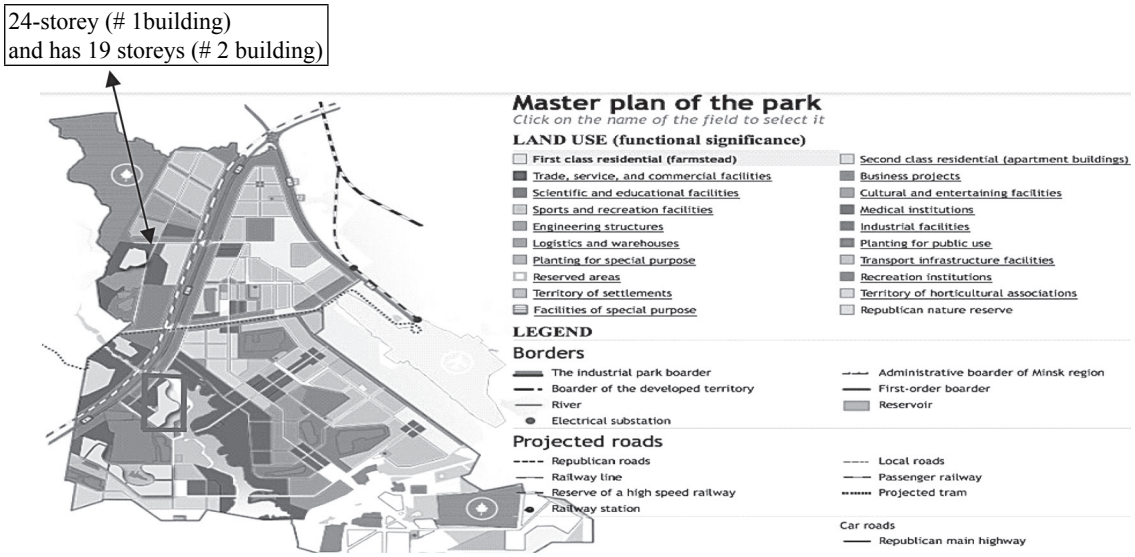


Fig. 6. Location of Marked building in industrial park

4. Background of the project

The China-Belarus Industrial Park. Fig. 5 [7]. (Russian: Китайско-Белорусский индустриальный парк, Chinese: 中国-白俄罗斯工业园) is a special economic zone in Belarus, established under the intergovernmental agreement between the People's Republic of China and the Republic of Belarus。The planning area is 91.5 square kilometers.

Park infrastructure will include industrial, transportation facilities and residential areas, providing social occasions, office and shopping centers, as well as financial and research centers.

Primary residence and secondary residence are located in the southwest and central industrial park continues about 8–9 km away. There will be check-expected 120, 000 employees. In order to create a cozy and comfortable living environment for employees and provide convenience of information

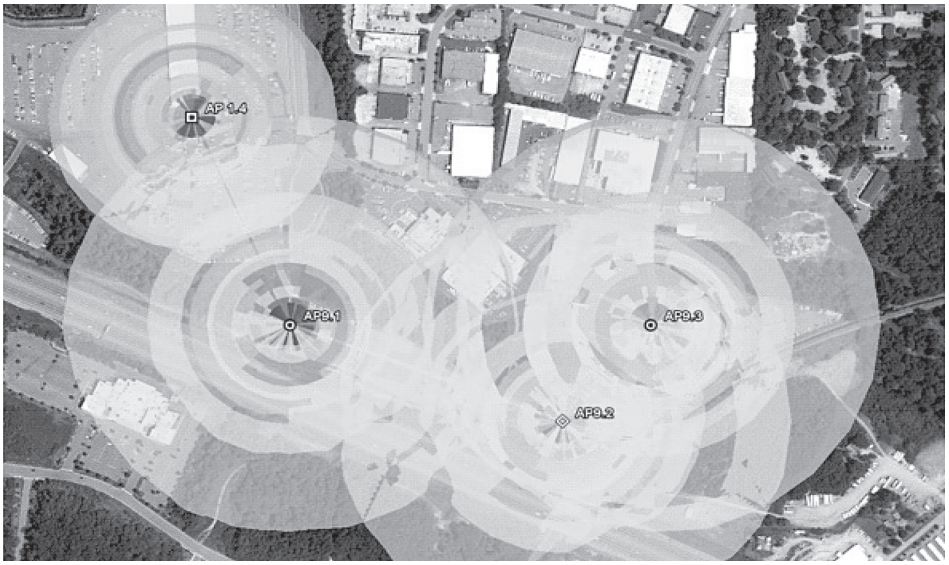


Fig. 7. Coverage distance of mesh access point

(to different international customers and experts) to visit, at the same time in order to increase competitiveness and attract more talent, industry Park raised the need for residential requirements of the overall wireless coverage. At the beginning of this program for the apartment building all the rooms offer broadband Internet access, the latter for security considerations will increase the number of video surveillance and Wi-Fi languages. Fig. 6 [8].

Case for modern apartments in the southwest area coverage. As shown in this area there is an apartment about apartment 50 m, width 34 m, 24-storey (# 1), another apartment 70 meters long from north to south, east to west 50m, has 19 storeys (# 2). There are two apartments around 6–4 layers of low apartment.

Designing

1. The cover from the outdoor to indoor.

2. Equipment laying try to select relatively high position.

3. For network services, can provide a private network and public network separate VLAN settings.

According to conclusions, per square kilometer (0.62137 square miles), and finally by calculating the entire industrial park would need at least 315 to ensure complete coverage of AP obtained. According to calculations required at this time covering at least two AP.

According to Building 2 were covered with projections at this time need 4 AP. Fig. 7 [8].

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ПРОЕКТ БЕСПРОВОДНОЙ ЯЧЕИСТОЙ СЕТИ ДЛЯ ИНДУСТРИАЛЬНОГО ПАРКА «ВЕЛИКИЙ КАМЕНЬ»

Беспроводная ячеистая сеть (WMN) все чаще становится популярным решением из-за низкой стоимости как альтернатива проводной сети для предоставления широкополосного доступа для пользователей. Беспроводная ячеистая сеть (WMN) представляет собой коммуникационные сети, состоящие из радио узлов, организованных в топологии сети.

Беспроводные сети состоят из сети клиентов, сетевых маршрутизаторов и шлюзов. Клиенты сети -это часто ноутбуки, сотовые телефоны и другие беспроводные устройства, в то время как сетевые маршрутизаторы пересылают трафик и из шлюзов, которые могут, но не обязательно, быть подключены к Интернету. В статье рассматриваются разные каналы радио беспроводной связи, подключенные к точке доступа (AP) в рамках Белорусско- Китайского проекта индустриального парка «Большой Камень», который является территориальным образованием площадью около 80 кв. Км с особым правовым статусом для предоставления комфортных условий для ведения бизнеса. Парк расположен в уникальном природном комплексе в 25 км от Минска, столицы Республики Беларусь. Он находится в непосредственной близости от международного аэропорта, железнодорожных линий и транснациональной магистрали Берлин-Москва. Результат анализа показывает распределение точек доступа, обеспечивающих принципиальные функции на территории индустриального парка. При этом обеспечивается надежность и балансировка нагрузки в беспроводных ячеистых сетях связи.

Ключевые слова: *ячеистая сеть, оборудование, проект, тестирование.*

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