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**ANVIA ENTERPRISE WIRELESS LOCAL AREA NETWORK MARKET  
ANALYZES AND BUSINESS MODEL ENHANCEMENTS**

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Industrial Management

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Business Administration

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# TABLE OF CONTENT

ACKNOWLEDGMENTS .....	2
TABLE OF CONTENT.....	3
LIST OF ABBREVIATIONS.....	6
LIST OF TABLES .....	9
LIST OF FIGURES .....	10
ABSTRACT .....	11
1. INTRODUCTION .....	12
1.1 Motivation.....	13
1.2 Scope of the Research.....	14
1.3 Research Objectives .....	15
1.4 Research Methodology .....	15
1.5 Outline of the Thesis .....	16
2. BACKGROUND .....	18
2.1. Brief History of WLAN .....	18
2.2. WLAN Elements.....	19
2.2.1. Infrastructure and Architecture .....	19
2.2.2. IEEE 802.11 Standards.....	20
2.2.3. The Performance comparison between the main amendments .....	22
2.3. Security.....	24
2.4. Application Areas .....	24
2.5. Technological Innovation Overview .....	25
2.5.1. WFA Hotspot 2.0 Specification.....	25
2.5.2. IEEE 802.11ac .....	28
2.6. WLAN Regulations.....	30
2.6.1 Operator’s Responsibilities .....	31
2.6.2. Information Security .....	32
2.6.3. Quality and other technical requirements.....	33
2.6.4. Identification data .....	34
2.7. WLAN Industry .....	35

2.7.1. Enterprise WLAN .....	35
2.7.2. Enterprise WLAN Value Chain .....	36
2.8. Wi-Fi Roaming Overview .....	38
2.8.1. National Wi-Fi Roaming.....	38
2.9. Global Wi-Fi Roaming.....	39
2.9.1. Premium public-Wi-Fi aggregators: .....	40
2.9.2. Community residential Wi-Fi aggregators .....	44
2.9.3. Crowdsourced long-tail public Wi-Fi .....	45
3. THEORETICAL FRAMEWORK.....	48
3.1. SWOT Analysis.....	48
3.2. Business Model Ontology.....	48
3.3. Business Model Pillars.....	49
3.3.1. Pillar 1: Service/Product .....	49
3.3.2. Pillar 2: Customer interface.....	50
3.3.3. Pillar 3: Infrastructure management.....	52
3.3.4. Pillar 4: Financial aspects .....	53
4. WLAN MARKET OUTLOOK .....	55
4.1. Anvia Enterprise WLAN Analysis .....	55
The following part of this thesis contains confidential information. Therefore, it is removed from the public version and remains secret. ....	56
4.2. Regional WLAN Market Analyzes .....	57
4.2.1. SOHO Market Analysis .....	57
4.2.2. SMEs Analyzes .....	58
4.3. Global Wi-Fi Roaming Service Providers' Comparison.....	59
4.4. Global Wi-Fi Roaming Service Providers' Analysis .....	60
4.5. Service Providers' Enterprise WLAN Marketing Strategies.....	63
4.5.1. Bundled services.....	63
4.5.2. Cloud Computing.....	65
4.5.3. Providing cellular services as complementary to Enterprise WLAN .....	67
4.5.4. Wi-Fi roaming.....	67
4.5.5. BYOD.....	68
4.5.6. Voice over WLAN.....	70

4.6. SWOT Analysis.....	71
5. BUSINESS MODEL ENHANCEMENTS .....	72
6. CONCLUSION .....	73
REFERENCES .....	75
APENDIXES.....	82
Apendix A. ....	82
Apendix B. ....	86
Apendix C. ....	91

## LIST OF ABBREVIATIONS

3G	3 <sup>rd</sup> Generation
4G	4 <sup>th</sup> Generation
AAA	Authentication, Authorization, And Accounting
ADSL	Asymmetric Digital Subscriber Line
AES	Advanced Encryption Standard
AP	Access Point
AR	Access Router
ASA	Adaptive Security Appliance
BYOD	Bring Your Own Device
BW	Bandwidth
CCK	Complementary Code Keying
CCMP	Counter Cipher Mode With Block Chaining Message Authentication Code Protocol
CPE	Customer-Premises Equipment
CVN	Curated Virtual Network
DB	Data Base
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DSL	Digital Subscriber Line
DSSS	Direct Sequence Spread Spectrum
EB	Exabyte
FICORA	Finnish Communications Regulatory Authority
GB	Giga Byte
Gbps	Giga bit per second
GHz	Giga Hertz
HD	High Definition
HTTP	Hypertext Transfer Protocol
HW	Hardware
IaaS	Infrastructure as a Service
ICT	Information Communication Technology

ID	Identity
IEEE	Institute Of Electrical And Electronics Engineers
IP	Internet Protocol
ISM	Industrial, Scientific and Medical
ISP	Internet Service Provider
KAM	Key Account Manager
L2	Layer 2
L3	Layer 3
LAN	Local Area Network
LTE	Long Term Evolution
MAC	Medium Access Control
MAN	Metropolitan Area Network
Mbps	Megabit Per Second
MCC	Mobile Country Code
MDM	Mobile Device Management
MHz	Mega Hertz
MIMO	Multiple Input, Multiple Output
MU-MIMO	Multiple User MIMO
NAPT	Network Address And Port Translation
OFDM	Orthogonal Frequency Division Multiplexing
OMX	Open Mobile Exchange
OS	Operating System
PaaS	Platform as a Service
POS	Point of Sale
PDA	Personal Digital Assistance
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
QoE	Quality Of Experience
QoS	Quality Of Service
RADIUS	Remote Authentication Dial In User Service
RF	Radio Frequency

SaaS	Software a as Service
SDK	Software Development Kid
SDMA	Spatial Division Multiple Access
SOHO	Small Office Home Office
SLA	Service Level Agreement
SME	Small Medium Enterprise
SP	Service Provider
SSID	Service Set Identifier
SSL	Secure Socket Layer
SW	Software
SWOT	Strengths, Weaknesses, Opportunities, Threats
UE	User Equipment
URL	Uniform Resource Locator
VNI	Visual Networking Index
VoIP	Voice over IP
VoWLAN	Voice over WLAN
VPN	Virtual Private Network
WAN	Wireless Access Network
WBA	Wireless Broadband Alliance
WEP	Wired Equivalent Privacy
WFA	Wi-Fi Alliance
Wi-Fi	Wireless Fidelity
WISPr	Wireless Internet Service Provider roaming
WLAN	Wireless Local Area Network
WLC	Wireless LAN Controller
WMM	Wi-Fi Multi Media
WN	Wireless Network
WPA	Wi-Fi Protected Access
WPA2	Wi-Fi Protected Access 2

**LIST OF TABLES**

Table 1. Wi-Fi standards performance and comparison.....	23
Table 2. The applied laws on how the responsibilities are divided.....	32
Table 3. List of iPass partners. ....	42
Table 4. Global WLAN Roaming service providers' comparison. ....	59

**LIST OF FIGURES**

Figure 1. Cisco visual networking index .....	12
Figure 2. WLAN Network Architecture.....	20
Figure 3. IEEE 802.11 standards data rates.....	23
Figure 4. Switching the current operator.....	27
Figure 5. The importance of Wi-Fi Roaming.....	28
Figure 6. IEEE 802.11ac Data Rates.....	29
Figure 7. Value chain and players for corporate mobile IP Services.....	37
Figure 8. iPass global Wi-Fi coverage.....	42
Figure 9. Boingo global Wi-Fi coverage.....	44
Figure 10. Choice of curator client for the best Wi-Fi connection.....	46

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**ABSTRACT:**

For almost 15 years, since it has been released, Wi-Fi has been one of the dominant technologies in telecommunication world. However, because of its weaknesses related to security, interference and weak quality of service it has not been accepted as a viable business. Furthermore, it also operates in unlicensed spectrum bands which magnify these issues. On the other hand, technological innovations through new improvements in the world of Wi-Fi have made it one of the most popular indoor communication solutions for enterprises as well as in outdoor common meeting points. Therefore, it has become imperative to study this subject due to its popularity and several issues associated with this technology to create a viable business model for Anvia Oyj.

In an attempt to contribute towards this field, present thesis provides a comprehensive theoretical framework that addresses WLAN technology from different aspects including Wi-Fi roaming as well as the description of business model segments. In order to strengthen enterprise WLAN business models, a comprehensive data was collected through different resources. First, an internal interview in Anvia Oyj based on its current enterprise WLAN business model was conducted. Secondly, two surveys were conducted in different enterprise WLAN customer segments; 32 interviews with small office home office (SOHO) enterprises and 10 interviews with SMEs/LEs and municipalities. Thirdly, a global enterprise WLAN market analysis was conducted through Internet resources. Based on these, analyzes, recommendations and business model enhancements are suggested in this thesis. The findings of this research will help Anvia Oyj to achieve better performance in enterprise WLAN business segment.

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**KEYWORDS:** Enterprise WLAN, WLAN services, Wi-Fi, Wi-Fi roaming, Business model.

## 1. INTRODUCTION

Mobile data consumption is in a fantastic increasing phase that does not seem to slow down but expected to increase in coming years. User driven demands for advanced/innovative mobile devices such as smart phones, tablets and other mobile devices with wireless connection capabilities, as well as high data transmission required mobile applications are considered to be what cause this enormous mobile data growth (Cisco 2012). Based on Cisco VNI, the growth in mobile internet traffic is going to reach 15,9 EBs per month in 2018 at a compound annual growth rate of %61 from 2013 to 2018 (Figure 1) (Cisco 2014). Video is seen to cause the biggest impact on this growth as it is predicted that the two-thirds of mobile data traffic will be video and the main drivers for this impact are observed to be new services such as catch-up TV and social video sites, HD content which requires higher bandwidth and, innovative improvements in screen technology that creates a demand for HD content (Cisco 2014).

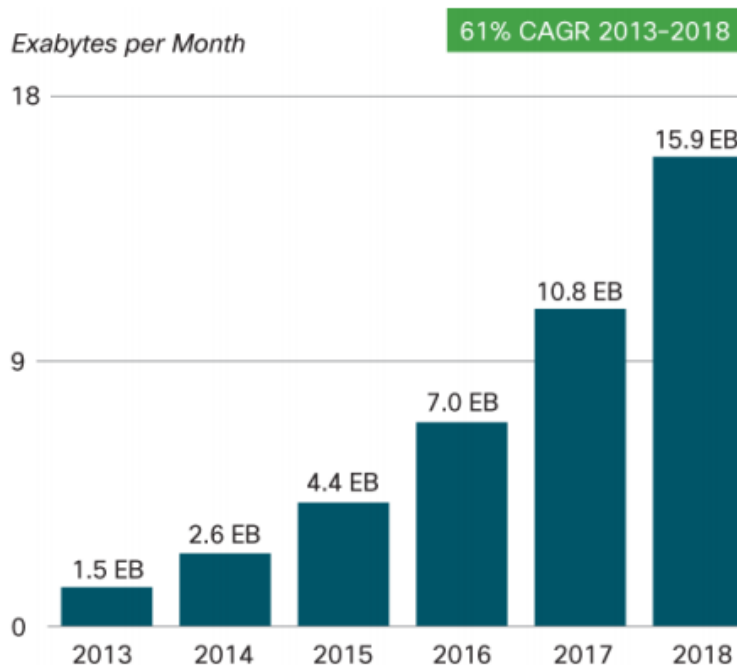


Figure 1. Cisco visual networking index

It is highly believed that mobile operators have a vital role in such increase in mobile data traffic by subsidizing the price of data-centric mobile devices and encouraging their usage through unlimited data plans. Besides, they have supported high data content applications such as mobile TV, video and social networking. Although, they are now stressed to manage this growth by obtaining new spectrum and rolling out LTE networks in terms of an increase in capacity the demand and expectation from subscribers' side continue to rise. Such considerations are indeed believed to be solved with next generation wireless access networks and WLAN may undertake a big portion of this solution and even become dominant that may threaten the existence of mobile operators. (Cisco 2012b).

While 3G mobile networks were being built and 4G get into the market WLAN technology has come of age to represent a worthwhile wireless access network by providing a broad coverage and by being pleasingly used as an alternative to cellular mobile networks (Cisco 2012b). WLAN is becoming a crucial need in the enterprise level customer segment as it is found to be a dynamic solution for the inside-building mobility, it answers the need for the business applications that requires high data rates, it provides much cheaper roaming services compared to cellular roaming services etc. Although, Wi-Fi is ready as a substitute for, or complement to, cellular mobile networks it requires well planned business models to be profitable for the WLAN network operators as correctly deployed business model can provide noteworthy business benefits.

## 1.1 Motivation

It has been over a decade that Wi-Fi has existed in the telecommunication market. As it operates in unlicensed spectrum and had weaknesses related to security, interference and weak quality of service issues it was not taken into account to be a viable business. However, due to the technological innovations in the world of Wi-Fi, cellular network

operators have accepted the existence of Wi-Fi as an alternative wireless network solution and started to allow Wi-Fi capable devices to connect on their networks (Cisco 2012b).

The number of Wi-Fi hotspots is rapidly increasing by robust mobile operators in all around the world and in some cases; the number of Wi-Fi hotspots is more than that of cellular base stations (tefficient 2012). Besides, WLAN capabilities may be seen in almost all of the mobile communication devices such as laptops, tablets, smartphones, cameras, TVs etc. Over 35% of mobile users take advantage of a public hotspot at least weekly, with 12 percent doing so more than once per week (Cisco 2012). 75% of smartphone owners use Wi-Fi on their devices (Analysis Mason 2013). These implementations show that there is a great need for additional wireless network solution and WLAN is considered to fulfill the need in terms of mobile data communication. With this information in mind, one may easily forecasts that the birth of a new business segment is on the board in the telecommunication industry.

The aim of this research is to provide enterprise WLAN business model enhancements to ANVIA in order to achieve a comprehensive profitability in mobile communication market.

## 1.2 Scope of the Research

This master thesis concentrates on investigating enterprise WLAN market to provide robust business model enhancements for Anvia in terms of enterprise level customer segment. For this purpose, interviews with Anvia and their current/potential customers in Vaasa are held to analyze the internal enterprise WLAN market in Finland. In addition to this, global WLAN operators' marketing strategies are explored through their websites in order to perceive different enterprise WLAN services/ideas. Based on all the data collections and CANVAS business model, detailed business model

enhancements are proposed for Anvia to achieve success and competitiveness in enterprise WLAN market in Finland.

### 1.3 Research Objectives

The research objectives can be defined as follows:

- To define and analyze the current situation of Anvia in enterprise WLAN market in Finland.
- To analyze the current/potential customers of Anvia and analyze their enterprise WLAN services point of view.
- To analyze national and global enterprise WLAN market based on their service offerings.
- To propose Anvia WLAN business model enhancements for enterprise WLAN customer segment based on the gathered data/information.

### 1.4 Research Methodology

This research includes literature survey, interviews and a case study based on proposed business model enhancements. It is not an easy task to acquire some recent, complete and free material of applied enterprise WLAN business models as such data/information is confidential in operators' own policies. Therefore, academic studies, white papers, market analyzes including questionnaires and interviews are used as the main information sources.

First, a comprehensive literature survey is presented in an adequate level to give the reader the readiness to understand the further analyzes. Subsequently, an interview is held to figure out the current situation of Anvia in enterprise WLAN communication market. Next, interviews are held with Anvia's current/potential enterprise WLAN customers to conduct a market survey and also inform them about the Anvia's enterprise WLAN service offerings. Finally, the data gathered in literature survey and from those interviews are used to provide the enterprise WLAN business model enhancements for Anvia.

## 1.5 Outline of the Thesis

### Chapter 1

Provides an overview of the subject, motivation, scope of the research, research objectives, research methodology and the outline of this research.

### Chapter 2

Presents background information of the thesis. Here, WLAN is studied in several aspects (Architecture, standards, security, innovations, regulations, its role in mobile communication market and roaming) to give reader a comprehensive understanding for the further reading.

### Chapter 3

Describes the business model structure that is used in this study. Anvia WLAN business model enhancement propositions are constructed based on nine blocks that are introduced in Alex Osterwalder's CANVAS business model.

#### Chapter 4

Stands for the data collection and analyzes of the current enterprise WLAN market in order to propose robust business model enhancements in chapter 5; the current situation of enterprise WLAN business in Anvia, enterprise WLAN customers' point of view and other service providers marketing strategies based on given services that may support enterprise WLAN business. Besides, SWOT analyzes are performed based on the results gained from the WLAN market analyzes.

#### Chapter 5

Presents enterprise WLAN business model enhancement propositions in terms of different enterprise WLAN customer segments. For each customer segment business model enhancements are proposed separately as the customer segments and the services provided varies significantly.

#### Chapter 6

Includes the conclusion for this thesis work and gives recommendations for the future work.

## 2. BACKGROUND

### 2.1. Brief History of WLAN

In the late 1970s and early 1980s, LANs become common and popular to deliver sharing of resources and peripherals such as printers, shared storage devices and access servers among PCs, terminals and other distributed computing devices (Pushendra Kr. V., Shekhar P., Shekhar J. 2011). However, installation costs and lack of mobility in LAN deployments were drivers for the born of enterprise wireless LANs, seen first in market in the late 1990s (bell 2010). WLAN uses electromagnetic waves in order to perform data exchange between wireless client and base station (AP) that is connected to operator's wired backbone. Due to this implementation UE gains the ability of wireless movement within the coverage of WLAN (Inter Digital 2012). In today's technology, wireless data transmission/reception capabilities are seen in an enormous number of mobile communication devices that use wireless technology to accomplish WLAN network connections.

In 1990, IEEE set up a new IEEE committee called IEEE 802.11 standards family for getting an open standard started. In 1997, IEEE developed IEEE 802.11 standard that defines the implementation of over-the-air interface between wireless client and pre-existing networks or between two or more wireless clients. Since then, IEEE 802.11 standards family has matured and enlarged in capabilities by the addition of new amendments. These amendments define new specifications to IEEE 802.11 standards family such as the characteristics of the transmitter and receiver, operating frequency, modulation techniques and maximum speed of operation. (Intel 2012).

The terms WLAN, IEEE 802.11 and Wi-Fi simply refers to the same system in common parlance; however, they should not be confused to be synonymous. While WLAN

stands for a network of computers which are linked to one other to communicate by using high radio frequency signals Wi-Fi is a branding term for products that are belong to a category of WLAN devices and IEEE 802.11 is standards technology that lies behind WLAN.

## 2.2. WLAN Elements

### 2.2.1. Infrastructure and Architecture

Network Management manages all the network elements at all layers, it has a high importance for the network configuration and monitoring. DNS is a vital component for the functionality of the Internet. It stands for the translation between easily remembered domain names and numerical IP addresses, for instance, [www.example.com](http://www.example.com) is equivalent of 192.0.43.10 numerical IP address. By the use of Internet Protocol (IP), the Dynamic Host Configuration Protocol (DHCP) server is essential to allocate IP addresses to devices connected to a network in terms of providing them internal communication on that network. Gateway/Network Address and Port Translation (NAPT) is required as gateway in case of connection with external IP networks such as Internet. Hyper Text Transfer Protocol (HTTP) server provides application level services for users. Billing System stands to process the accounting data. While Authentication, Authorization, and Accounting (AAA) server is required for the IP connectivity and other services, User data base (DB) is used to store the subscribers' user identities such as login names, passwords, and user profiles. The local services as a common box provide services at IP level or above, such as local web content and mail servers. (Garg 2010).

User Equipment (UE) is a wireless client that is used by user such as a Personal Digital Assistance (PDA), smartphone, tablet or a laptop. WLAN Access Point (AP) is a Layer-

2 (L2) bridge between UE and the Ethernet. L2 distribution network enables L2 connectivity towards the first IP routing device, access router (AR). AR simply provides routing of user IP packets. (Garg 2010).

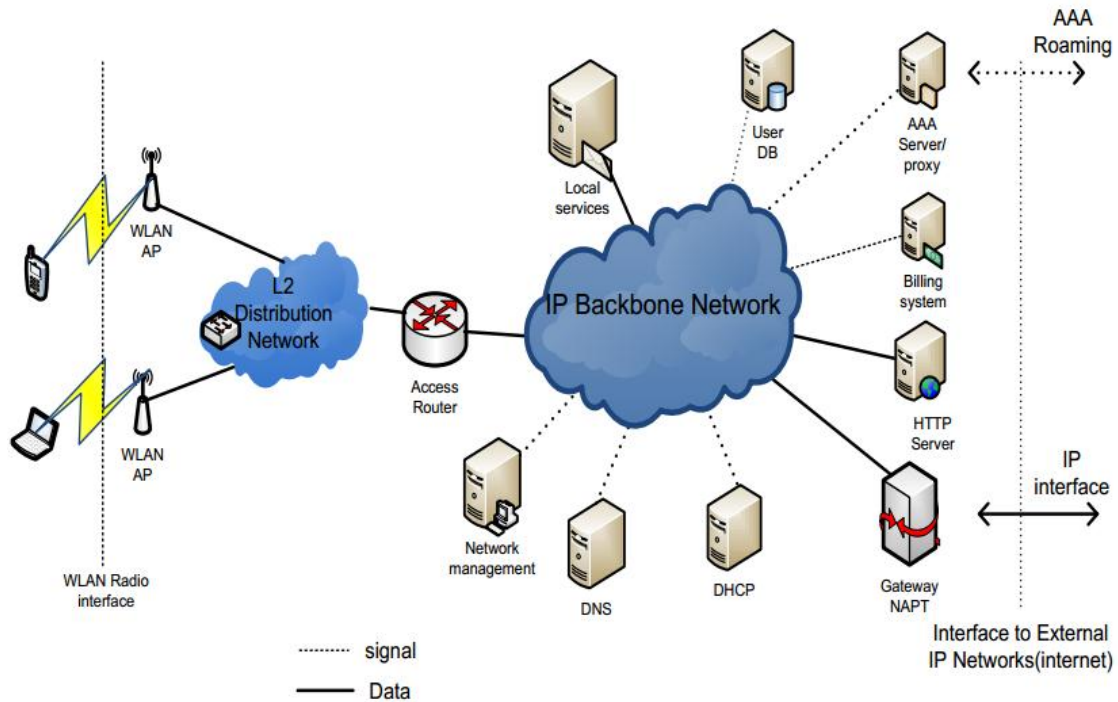


Figure 2. WLAN Network Architecture

### 2.2.2. IEEE 802.11 Standards

IEEE 802.11 standard, stands for a set of standards for WLAN communications, is developed by the IEEE LAN/MAN standards committee in two unlicensed frequency bands, ISM (industrial, medical and scientific) band of 2,4 GHz and available 5 GHz bands (5.15-5.35 GHz, 5.47-5.725 GHz, and 5.725-5.825 GHz) (Kaushik S., Kaushik M. 2012).

By the addition of new amendments to IEEE 802.11 standards family the capabilities of WLAN has notably increased (Berg 2011). In this section, all the main amendments to

IEEE 802.11 standards family are introduced one by one with their main features and characteristics.

#### *IEEE 802.11a*

As its operating frequency is at 5 GHz this amendment causes less RF interference and provides data transfer speed up to 54 Mbps by using OFDM waveform (IEEE Std 802.11a 1999). Although, it allows data communication at higher rates compared to 802.11b it suffers from hardware expenses and high operating frequency that causes short coverage range due to absorption by physical obstacles in their line of sight.

#### *IEEE 802.11b*

Less hardware expenses and wider coverage range by providing data communication up to 11 Mbps, 802.11b was the most acceptable amendment. This amendment uses DSSS waveform with CCK modulation schema and it is operating at 2.4 GHz frequency band (IEEE Std 802.11b 1999). 2.4 GHz frequency band is used as a garbage band in the market as it is used by variety of devices such as baby monitors, microwave ovens, Bluetooth devices and cordless phones. This wide usage of ISM band causes interference to 802.11b amendment. By limiting the sources of RF interference it is considered to mitigate the problem; however, this situation cannot be mitigated every time (Telecom Regulatory Authority 2003).

#### *IEEE 802.11g*

Unlike 802.11b, this amendment uses OFDM and CCK modulation and it allows communication that allows data communication up to 54 Mbps (IEEE Std 802.11g-2003). It is fully backward compatible with 802.11b and compared to 802.11a it provides same throughput with a less expensive hardware equipment and wider coverage range. However, as it is operating at 2.4 GHz frequency band this amendment also suffers from RF interference. (IEEE Std 802.11g 2003).

*IEEE 802.11n*

Providing Multiple Input Multiple Output (MIMO), operating at both unlicensed frequency bands and using wider bandwidth (BW) channels, 802.11n provides data rates up to 600 Mbps (IEEE Std 802.11n-2009).

*IEEE 802.11u*

The ninth amendment of IEEE 802.11-2007, IEEE 802.11u, which stands for communication protocols between APs and UEs, is new protocol of IEEE 802.11 family that is published on February 25, 2011. IEEE 802.11u supports interworking of WLAN with external networks to provide external authentication, authorization and accounting as well as network selection, encryption, resource management and policy enforcement. (Rukus 2013b).

*IEEE 802.11ac*

The latest amendment to IEEE 802.11 family that is also known as Gigabit Wi-Fi is built upon 802.11n by providing improvements in bit rates, reliability, RF bandwidth and network usage efficiency. This standard is designed to meet the throughput requirements of high-definition video and wireless voice applications and while it augments the standard with new enhancements it will continue to support the legacy 5 GHz Wi-Fi devices.

### 2.2.3. The Performance comparison between the main amendments

Since it has been in the market, IEEE has developed IEEE 802.11 standards' capabilities by introducing new amendments to this family (Table 1). IEEE 802.11u is not a main technical amendment; however, it brings seamless Wi-Fi roaming feature to the standards family. Therefore, IEEE 802.11u may have different technical characteristics as it is indicated in Table 1. For example, while it might have 600 Mbps maximum data rate in case of having 802.11n standard capabilities, it will have 6,77 Gbps if it has 802.11ac capabilities.

Table 1. Wi-Fi standards performance and comparison.

	802.11a	802.11b	802.11g	802.11n	802.11u	802.11ac
Approved	July, 1999	July, 1999	June, 2003	Oct, 2009	Feb, 2011	Jan, 2014
Max. data rate	54 Mbps	11 Mbps	54 Mbps	600 Mbps	600 Mbps – 6,77 Gbps	6,77Gbps
Multiplexing Technique(s)	OFDM	DSSS and CCK	OFDM and CCK	MIMO, DSSS and OFDM	MIMO, DSSS, OFDM, SDMA, MU-MIMO	MU-MIMO, SDMA
Modulation Technique(s)	PSK or QAM	PSK	Various	Various	Various up to 256QAM	Various up to 256QAM
Throughput	27	5	22	144	144	4,9Gbps
Frequencies GHz	5	2.4	2.4	5 and/or 2.4	5 and/or 2.4	5
Channel BW MHz	20	20	20	20, 40	20, 40	20, 40, 80, 160

In Figure 3 one may easily observe the typical data rates for each amendment of IEEE 802.11 standards family. There are several aspects that effects on the throughput; Multiplexing and modulation techniques, channel bandwidth, frequency band, the number of antennas deployed on AP and the distance to AP effects on the throughput achieved from AP.

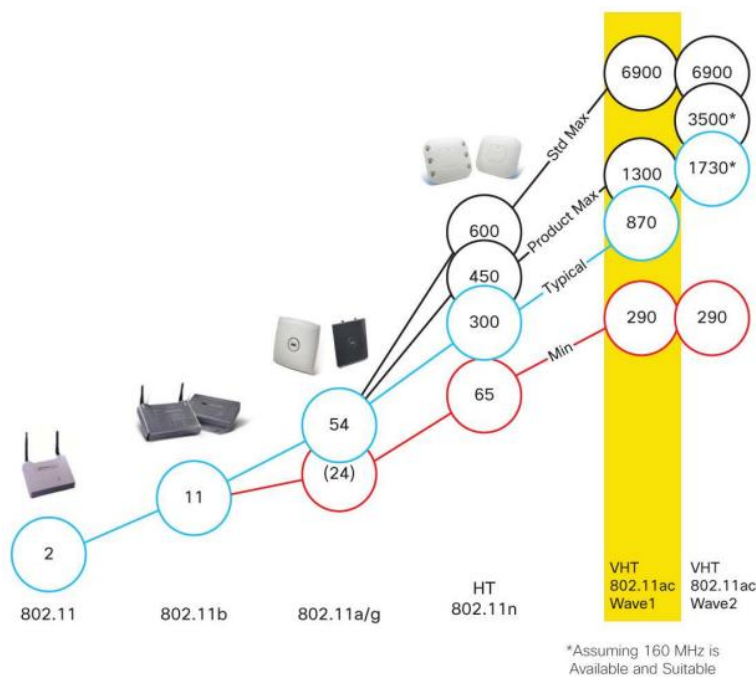


Figure 3. IEEE 802.11 standards data rates.

### 2.3. Security

Communication medium has a high importance in terms of security and when the medium is air it is much more critical compared to the cable medium (Nakhjiri M., Nakhjiri M. 2005). The communication medium between UEs and APs is air. Therefore, security is essential in terms of Wi-Fi communication. WFA has introduced security solutions through the time to overcome the vulnerabilities of the previous security solutions and provide wire equivalent security to Wi-Fi systems.

WEP was the first introduced security solution in 2000; however, being devoid of replay detection and having a short key length, WEP was weak (Sukhija S., Gupta S. 2012). While IEEE 802.11i was still being developed in 2003, WFA introduced WPA (the subset implementation of IEEE 802.11i) to overcome cryptographic vulnerabilities of WEP (Wi-Fi Alliance 2012b). As WPA was not the complete implementation of 802.11i it was a short term security solution to meet the market demand; however, you may still observe its usage in market. With the ratification of 802.11i, WFA introduced WPA2 in 2004 and it became mandatory for the certification of new devices in 2006. WPA2 provides stronger encryption method and well trusted security solution by including CCMP protocol with AES block cipher (Wi-Fi Alliance 2012b).

### 2.4. Application Areas

IEEE 802.11 standards family has gained an enormous acceptance in the market due to its cost efficiency and being deployed easily. IEEE 802.11 is one of the most broadly deployed wireless technology solutions in the world as it is widely available at offices, residential places, public transport stations, airports, hotels and campuses (Jahanzeb Farooq, Bilal Rauf 2006) as well as at healthcare industry.

Wi-Fi capabilities are available in computers, laptops and mobiles which allow terminals to connect easily. A businessman surely utilizes this technology to increase workers' output and achieve efficient workforce at workplace.

The usage of POS terminals and Wi-Fi gain retailers to order, sell and keep records of goods. In healthcare environment, Wi-Fi implementation increases the accuracy and the speed of healthcare. For instance, patient information may be available for the related personnel for the well-being of patient that provides ease in communication. Students at universities and corporations may easily facilitate their Wi-Fi devices to perform access to required information. In hotels, customers' check in and out, the track of room service orders, laundry requests, etc. and in restaurants, table status, food and drink orders, number of people waiting for the entry, etc. are easily performed due to Wi-Fi implementation (Malladi R., Agrawal D. P. 2002).

In enterprise environments Wi-Fi is chosen to be the networking technology as it provides industry-standard security performance and protections. WFA keeps developing certification technologies and programs to provide enterprise applications that include Voice-Enterprise, WMM-Admission Control and WPA2-Enterprise

## 2.5. Technological Innovation Overview

### 2.5.1. WFA Hotspot 2.0 Specification

WFA Hotspot 2.0 specification is developed by WFA based on IEEE 802.11u amendment and it is the technology that lies behind the Wi-Fi CERTIFIED Passpoint certification program. The Wi-Fi CERTIFIED Passpoint program is formed to test and provide interoperability between Wi-Fi devices from different vendors. This amendment is added to IEEE 802.11 standards family to support Passpoint capable devices to

simply discover, select and associate to a Passpoint capable Hotspot without any user intervention in a highly secure manner. (Ruckus 2013a)

In legacy Wi-Fi networks that do not support WFA Hotspot 2.0 specification, users are required to open the connection manager on their devices, search for a suitable network and request connection to the AP at each time of connection. With Hotspot 2.0, all this process is automated, establishing a seamless connection between Hotspot 2.0 capable devices and APs while providing the highest security. (WFA 2014).

While providing a cellular-like connection, WFA Hotspot 2.0 Specification brings value to operators in the following ways (WFA 2014);

- It supports data offload with instant network discovery, selection and association.
- Creates new value streams through inter-carrier Wi-Fi roaming, reaching new devices and new venues for the existing subscriber base
- Enhances customer satisfaction and shrinks churn
- Delivers the best security for SIM and non-SIM devices alike.

WFA Hotspot 2.0 Specification - Release 1 was introduced in June 2012 and defines capabilities for automated network discovery, selection, authentication and over-the-air security (Ericsson 2012). In Hotspot 2.0, the key protocols are IEEE 802.11u, EAP methods and IEEE 802.11i which run on top of IEEE 802.11 standard (Ruckus 2013a). Release 2 is not yet in the market; however, it is promised to add features enabling creation of new accounts and operator-managed network selection (Wi-Fi Global Congress 2013).

#### *WFA Hotspot 2.0 Specification in Market*

A recent study conducted among 2000 users of both smartphone and tablets in Europe (France, Germany, Sweden and the UK) shows a huge demand for seamless experience from user side in terms of Wi-Fi usage. Moreover, providing advanced features such as seamless authentication, Wi-Fi roaming and on-site enrollment is highly promising to present operators with compelling opportunities to drive business value.

Among the findings:

- 92% of the participants perform wireless connection with a tablet or a smartphone while traveling by using both cellular and Wi-Fi networks.
- 58% indicated that they are willing to pay more for Wi-Fi roaming from their service provider.
- 91% seem to stay with their current service provider in case of being offered with such advanced features.
- 84% highly value having seamless authentication in Wi-Fi hotspots.

From this study it is seen that the carrier Wi-Fi opportunity spreads further than smartphone. Tablets are being used at homes and on public Wi-Fi networks almost as the same rates of smartphones' usage and on the rise.

Seamless authentication on Wi-Fi networks is going to play a vital role in terms of service provider selection. By providing seamless connectivity features service providers may easily enlarge the number of their subscribers. While 19% of the participants would right away switch their current service provider 54% would wait until their contracts are ended and then switch to an operator that provides seamless Wi-Fi connectivity (Figure 4).

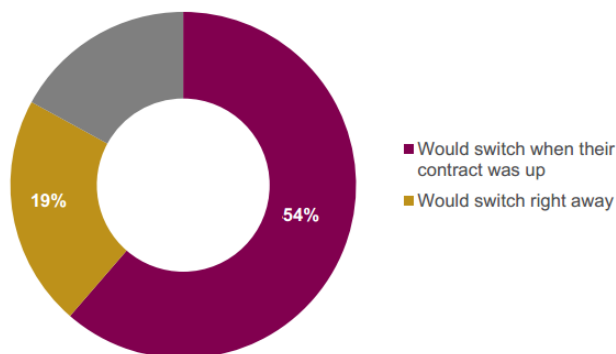


Figure 4. Switching the current operator.

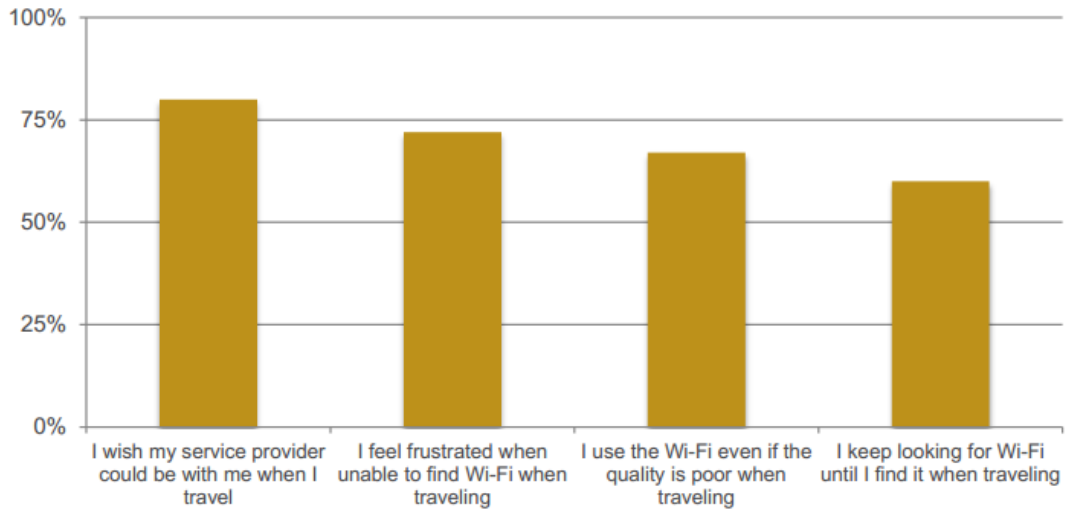


Figure 5. The importance of Wi-Fi Roaming.

In case of traveling, mobile Internet connectivity plays a vital role. Although, cellular roaming is common around the world the low data rates and high roaming costs directs users to another solution that is Wi-Fi roaming. The following figure shows the importance of Wi-Fi roaming for the travelers (Figure 5).

#### 2.5.2. IEEE 802.11ac

As 802.11ac technology is applied at chip level the HW replacement will be required without displacing 802.11n. Two standards are considered to be used at the same time in order to be able to provide service to devices that may not function at 5 GHz frequency band. 802.11ac clients will operate in 802.11n infrastructure at 5GHz and 802.11n clients will be supported in 802.11ac infrastructure at full performance and with the best possible coverage.

One of the enhancements in 802.11ac is multi-user MIMO that allows different users to use the same channel at the same time in terms of downstream transmission. Fortunately, this feature supports legacy amendments without any upgrades.

More efficient channel bandwidth is achieved due to statistical multiplexing. Wide channel transmission provides higher number of users to quickly complete the transmission of data. As a result of this, the battery consumption is decreased and QoS is enhanced that users do not need to wait for better QoS. (Cisco 2014)

Although, 802.11ac is recently approved in January 2014 and there are over 340 devices that are Wi-Fi CERTIFIEDac by the end of February 2014.

Wi-Fi has continued to evolve to meet users' data and usage demands and to improve access to content, without sacrificing core competencies like interoperability and security. ABI Research predicts that shipments of dual-band Wi-Fi chipsets – including both Wi-Fi CERTIFIED n and Wi-Fi CERTIFIED ac - will exceed 1.5 billion by the end of 2014.

Nominal Configuration	Bandwidth (MHz)	Number of Spatial Streams	Constellation Size and Rate	Guard Interval	PHY Data Rate (Mbps)	Throughput (Mbps)*
<b>Amendment max</b>	40	4	64QAMr5/6	Short	600	420
<b>802.11ac wave 1</b>						
<b>Min</b>	80	1	64QAMr5/6	Long	293	210
<b>Low-end product</b>	80	1	256QAMr5/6	Short	433	300
<b>Midtier product</b>	80	2	256QAMr5/6	Short	867	610
<b>High-end product</b>	80	3	256QAMr5/6	Short	1300	910
<b>80 MHz amendment max</b>	80	8	256QAMr5/6	Short	3470	2400
<b>802.11ac wave 2</b>						
<b>Low-end product</b>	160	1	256QAMr5/6	Short	867	610
<b>Midtier product</b>	160	2	256QAMr5/6	Short	1730	1200
<b>High-end product</b>	160	3	256QAMr5/6	Short	2600	1800
<b>Ultra-high-end product</b>	160	4	256QAMr5/6	Short	3470	2400
<b>Amendment max</b>	160	8	256QAMr5/6	Short	6930	4900

Figure 6. IEEE 802.11ac Data Rates.

With the implementation of IEEE 802.11ac, enterprise networks support WPA2-Enterprise, provide great capacity that enables enterprise applications requiring high throughputs (multimedia, video conferencing, etc.) and able to handle heavy traffic and growing connectivity demands caused by employees bringing their own devices. (Wi-Fi Alliance 2014d)

The data rates and throughputs in IEEE 802.11ac vary in a very large scale based on the channel BW, the number of spatial streams and the modulation technique (Figure 6). While maximum 6930 Mbps physical data rate is achieved with a BW of 160 MHz, 8 spatial streams and 256 QAM modulation technique, minimum 293 Mbps physical data rate is perceived with a BW of 80 MHz, 1 spatial stream and 64 QAM modulation technique.

## 2.6. WLAN Regulations

In case of providing a communication network service to users with no prior restrictions, a telecommunications operator is considered to practice public communications that is responsible to notice the Communications Market Act and the Act on the Protection of Privacy in Electronic Communications and the provisions issued under them. There are several separate services that the wireless broadband service is consisted of; (Wlan\_memorandum 2007)

- Wireless access network in L1/L2 layers
- Connection on network layer (IP, L3) that enables communication in terms of MAN.
- Internet connection service provided by ISP
- Communication network access control that another service provider can be responsible for.

Internet access is viewed publically. Therefore, SP is obligated to follow requirements for all communications services and Internet access services (FICORA 2007).

### 2.6.1 Operator's Responsibilities

Telecommunications operator has right to decide on features and functionality of the network as well as access to network by technical means; however, a further provider has no right for technical features of the network to change except choosing network's users. (Wlan\_memorandum 2007)

While an operator providing Internet access is responsible for duties related to the access for both home and enterprise connections, SP is responsible for the information security or interference related issues. In addition to this, SP holds the right to disconnect a subscriber in case of having control of DHCP server of the access. (FICORA 2007).

In case of launching public telecommunications operations, operators are required to submit a written notification to FICORA and also a notification takes place whenever some changes occurs in activity and in its termination.

There are several Acts that stand for the laws to be applied in terms of wireless broadband communications. The table below shows how such laws are applied and how the responsibilities are divided in case of a small Enterprise (Café) provides WLAN access to its customers. (FICORA 2007).

In the table below, the small enterprise (café) is assumed to have an Internet access from a telecommunications operator (such as Anvia) and share this Internet connection in the café by a wireless router.

Table 2. The applied laws on how the responsibilities are divided.

<b>Applicable legal provisions</b>	<b>Division of responsibilities</b>
Provisions of the Communications Market Act regarding network service/Internet access service	The provider of network/Internet access service is responsible to the café keeper for compliance with provisions. The café keeper or ISP does not have an operator's responsibility in relation to the café's customers.
Provisions of the Communications Market Act regarding communications services provided via Internet access, e.g. e-mail, VoIP	The provider of the communications service is responsible for compliance with the provisions in relation to his own end customer regardless of the place where the communications service is being used.
Provisions of the Act on the Protection of Privacy in Electronic Communications regarding telecommunications operators	The provider of network/Internet access service is responsible to the café keeper for compliance with provisions. The café keeper or ISP does not have an operator's responsibility in relation to the café's customers.
Provisions of the Act on the Protection of Privacy in Electronic Communications regarding corporate or association subscribers	The café keeper is responsible to the café customer for compliance with provisions, if the café keeper's practice meets the definition of section 2 paragraph 11 of the Act on the Protection of Privacy in Electronic Communications, i.e. processes messages, identification data or location data.
Consumer Protection Act	The café keeper is responsible to the customer for compliance with provisions, in cases where the Consumer Protection Act applies.

In such an example, there is no connection between the customer in the café and the telecommunications operator as indicated in the Communications Market Act. Therefore, telecommunications operator may not be required for any compensation to customer in the enterprise if there are some faults in service functionality; however, they are responsible to café owner for the provided service. The rights of the user are provided in details in the Communications Market Act by introducing a scenario in which the user is a subscriber of a telecommunication operator.

Moreover, both the Communications Market Act and the Act on the Protection of Privacy in Electronics Communications bring necessities on reliability, safety, technical functionality and information security of WLAN.

### 2.6.2. Information Security

The security of information has a high importance and it is defined in chapter 5 in the Act on the Protection of Privacy in Electronic Communications. Besides, more

information is provided in FICORA's memorandum. Some of the main rights and obligations are as follows (Act on the Protection of Privacy in Electronic Communications 2011);

- Operators and SPs shall maintain information security by taking measures to ensure operating security, communication security, HW and SW security and data security.
- Communications are required to be protected against illegal access. If the communication medium is not encrypted users must be informed about the risks and the means of protection against these threats. The minimum requirement is to provide information regarding to these threats on the website of the organization.
- Operator is required to be able to disconnect a user from the network in case of misuse or any ruckus to the network. This might be held by closing the user account or revocation of MAC address of the user device.
- Operator must notify FICORA in case of noteworthy faults and disorders such as spreading malware or significant data breakings trials.
- In case of collecting user ID and location data, the security of such information data must be ensured.

### 2.6.3. Quality and other technical requirements

Regardless of its type all the communications networks and services are required to address QOS requirements indicated in 128<sup>th</sup> section of the Communications Market Act (Communications Market Act. 2011);

- Besides of giving high standard technical quality, telecommunication networks must deal with predictable mechanical, climatic and electromagnetic interferences.
- Telecommunication networks and services must not cause any interference.

- Network use related charges must be reliable and accurate.
- Even in case of network disruptions, the access to emergency services must be secured.
- Privacy and information security must be protected and users or other persons must not be put at a risk in terms of health and other assets.

#### 2.6.4. Identification data

Identification data of users is not obligated to be collected as it is indicated in the Act on the Protection of Privacy in Electronic Communications, chapter 3; however, if data is collected its purpose should follow the following attributes (Act on the Protection of Privacy in Electronic Communications 2011);

- billing
- marketing
- determination of technical faults and development
- statistical analyzes
- prevention and investigation of misuse
- Information security in delivery of network communications and value added services are to be ensured.

In case of a request from police department or rescue authorities on stored information of identification related to WLANs, SP must provide the required information as long as a present legal justification is presented.

## 2.7. WLAN Industry

There are three different operating segments in WLAN market environment which are residential, enterprise and public environments.

**Residential Environment:** This section includes apartments and homes that the WLAN is only available to residents and their guests. The owner and the user are most likely the same person; however, WLAN service may be used by more than one user in a multi-tenant building. Residential (home) WLAN enables the simple, cost-effective sharing across multiple Wi-Fi devices.

**Enterprise Environment:** Offices and corporations are considered to be in this section. Although, the users of such environment is restricted to company's employees a limited usage of WLAN may be provided for guest access. In such environment, the service is primarily provided for its users in terms of internal data communication.

**Public Environment:** In this section, the service is provided to users at public places in order to access Internet and/or their corporate computing facilities and the public presence is not restricted to some specific areas. Public environment includes outdoor areas, retail stores, hotels, streets, stations, restaurants etc.

### 2.7.1. Enterprise WLAN

#### *Intranet*

It is a computer network within an organization by using IP technology to share information and computing services. The aim is to keep each person's effort and cost to achieve productivity, cost efficiency, well-timed and competitiveness.

An Intranet is generally private to an organization which means it is protected from users that do not have permission for the access. Network gateway and firewall is used for such purpose. In small organizations, private IP addresses may be used to create an Intranet. Intranet access may be provided to out of site employees by using VPN or any other access method that requires encryption and user authentication.

### *Guest Access*

Guest access in enterprises has become a very common necessity; the visiting guests are in need to remain productive and in touch. The guest network is for sure separated from Intranet; however, guests are allowed to surf in Internet (Perhaps reading their emails) or access to their company's Intranet. Such guest access is provided to company's guests over a second SSID by taking advantage of the existing network infrastructure built in company. To avoid the cost and complexity, enterprise's existing wired and wireless infrastructure should be used in the implementation of the guest access network and the following elements should be taken into consideration (cisco 2014).

- A dedicated guest WLAN/SSID: Its implementation is required at the locations that guest access is required.
- Guest traffic segregation: it is related to the implementation of techniques in L2-L3 across network to limit guest navigation at certain locations.
- Access control: guest access is required to be kept under control whether through an external platform or through access control.
- Guest user credential management: Administrator may create temporary credentials on behalf of guests that this functionality might be an element of AAA or within access control platform or some other management systems.

### 2.7.2. Enterprise WLAN Value Chain

There may be 4 key players considered in Enterprise WLAN value chain as they are mentioned following (Kotovirta 2009);

The network operator: It is an operator that owns a communication infrastructure in its ownership to provide transmission, distribution by means of selling access and connectivity or simply running the network (e.g, Anvia, TeliaSonera, Elisa).

Service Operator: It is also known as Mobile Virtual Network Operator that is a wireless communication SP. Although, it does not own a wireless network infrastructure it has an agreement with a network operator to achieve bulk access to network services. Service operator decides on pricing independently and it may have its own customer service, sales personnel and billing systems.

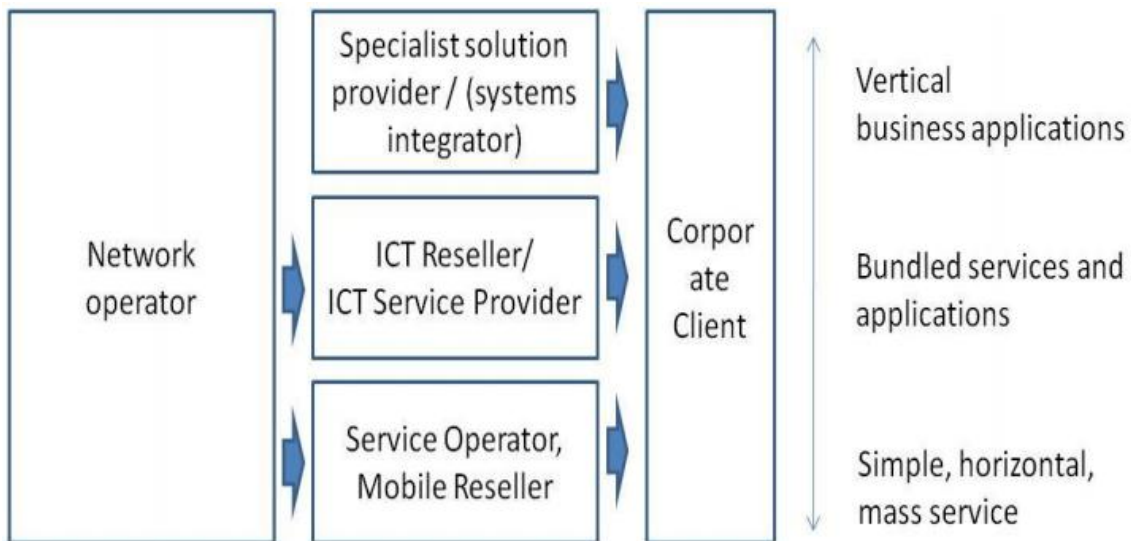


Figure 7. Value chain and players for corporate mobile IP Services.

ICT reseller or an ICT Service Provider: This player combines IT equipment and telecom services into the same package as a service offering.

Specialist solution provider: This type of player provides vertical business applications which means of a SW application that is created for a specific industry or organization. They do not resell mobile services or provide one-stop-shopping to their customers.

## 2.8. Wi-Fi Roaming Overview

Wi-Fi Roaming is the ability of being connected to Internet based on a pre-determined plan over other local infrastructures that are not under the coverage of the user's home operator's service area. In this section, both national and international Wi-Fi Roaming SPs are analyzed. It is considered to be a beneficial decision to get into partnerships with Wi-Fi Roaming SPs for the following reasons to mention a few (Cisco Web 2014);

- Wi-Fi Roaming is not common in Finland. Therefore, being in a partnership with such Wi-Fi roaming SPs will provide first-mover advantage to the operator and attract international travelers.
- Operators can lessen the risk of causing costly mistakes and offer propositions that have proven market potential by leveraging best practices learnt from Wi-Fi roaming SPs.

### 2.8.1. National Wi-Fi Roaming

#### *Langaton WPA*

Langaton-WPA aims to form a common, fast and secure data network by distributing WLAN network connection among its members of the companies, organizations, home users, etc. It is simply based on sharing of your WLAN connection over a second SSID that provides you to automatically connect to internet over other members' WLAN connections without any extra charges. By doing this members extend their WLAN coverage at many points at different cities in Finland.

Anvia has built a network connecting service utilizing leading solutions, a similar implementation that is seen with edurom. Anvia has a WLAN hotspot network that consists of 100 APs in public places in Vaasa, Seinäjoki and Kokkola and it is going to

be expanded. Anvia is already in a partnership with Langaton Tampere and the overall network consists of 1000 APs.

Anvia provides WLAN service in operator level technology and servers are housed in secure data centers. The network is controlled, secure and easy to use as Anvia coordinates network authentication services.

Anvia offers a full package of service deployment;

- WLAN network design, construction and maintenance
- WLAN service design
- Private internal network
- Guest WLAN network client called for by the implemented
- WIRELESS-WPA auto-guest network guest accounts and maintenance
- Compatible base stations, base station controllers and proxy server
- WLAN network interconnection to other WLAN networks
- AAA (RADIUS) server design and implementation of authentication, or the provision of a service

## 2.9. Global Wi-Fi Roaming

Global Wi-Fi roaming is a service that provides Wi-Fi connectivity to users who travel outside of their service provider's footprint and still wish to have Wi-Fi connectivity in other countries. It has been speeded by the establishment of WBA in 2003 and first Wi-Fi roaming agreement between WBA's members performed starting from 2004. Operators are aiming to broaden their footprint of Wi-Fi hotspots in as many foreign locations as possible by keeping it in an easy-to-use manner to guarantee a positive user experience and achieve customer satisfaction. (Informa 2013)

The appearance of Wi-Fi network operators and roaming agreements provided the emergence of Wi-Fi roaming hubs and aggregators, such as iPass and Boingo. The mentioned companies have shown a high effort in terms of time and resources to establish bilateral inter-carrier agreements between Wi-Fi networks to form global hotspot footprints. (Informa 2013)

There are three types of potential global Wi-Fi roaming partners that operators might want to get into a partnership; Premium public-Wi-Fi aggregators, Community residential Wi-Fi aggregators and Crowd sourced long-tail public Wi-Fi. Although, all three types aim to provide global Wi-Fi roaming services they are created in a different way. Therefore, it is important for operators to have a good understanding of the major differences between those there types and accordingly choose one that fits best in their corporate objectives of a roaming strategy. (Informa 2013)

#### 2.9.1. Premium public-Wi-Fi aggregators:

By acting as roaming hubs, the players in this category offer their members access to a wide-ranging global footprints of premium public Wi-Fi hotspots. iPass is known to be the largest player that is followed by Boingo and Trustive.

##### *iPass*

iPass provides cloud-based Wi-Fi connectivity and mobility management services to global enterprises and telecommunications carriers. It simply offers a platform for enterprises and individuals by gathering commercial Wi-Fi sites into a single global network for operators' subscribers and enterprise employees. (iPass Web 2014)

There are three focus areas for the company; providing connectivity to enterprise business travelers, global Wi-Fi availability to telecommunication carriers' subscribers and providing Wi-Fi and WAN to retailers, enterprise branch offices, real estate holders and telecom providers.

iPass provides Open Mobile Exchange (OMX) that is known to be the major commercial Wi-Fi roaming and exchange platform for SPs. By providing WISPr to over 150 distinct Wi-Fi networks with a total of 2.2 million commercial Wi-Fi hotspots in over 130 countries and territories worldwide.

iPass Mobile Network delivers easy, reliable connectivity virtually anywhere roaming takes place such as in hotels, airports, business venues and airplanes. Some venues that include: Starbucks, Hilton, Sheraton, Crowne Plaze, Marriott hotels and resorts etc.

Features;

- 2.2 million Hotspots
- 537,4761 in North America; 679,689 in Europe; 913,636 in Asia
- 130 countries and territories
- The world's major cities
- Over 61000 free, open access hotspots
- Over 72000 hotel and convention center venues (Major hotel chains)
- Over 95% of the world's top 100 airports (over 3,400 airport hotspots worldwide)
- Premium inflight on 2000 planes (Inflight Internet service is mainly available in the US but also available in most of the Lufthansa Airlines planes and in some airplanes of Transaero and Japan Airlines)
- Over 150 Wi-Fi operators connected



*Boingo*

Boingo is one of the largest players in international Wi-Fi roaming world in terms of market share and net worth. Boingo has more than 700,000 free and paid hotspots around the world. Like iPass, it has a multi-platform client and unlike iPass, it offers service to private consumer. Boingo has a wide range of service offerings with different pricing plans for mobile devices, regional, pay-as-you-go plans. Prices differ from 5,95e per month for Boingo mobile (unlimited usage with two non-laptop mobile devices) and up to 49e per month for Boingo global (2000 minutes on any Wi-Fi devices). (Boingo Web 2014)

Boingo is in a partnership with large network operators, including Skype, Verizon, Korea Telecom, and Orange. Boingo aims to get into new partnerships with network operators and promises the following attributes;

- increasing revenue
- more convenient guest access
- extend coverage
- Increase location visibility via hotspot directory searches
- Off-loading from cellular operators
- Taking advantage on dense mobile device traffic

Network operators in a partnership with Boingo have different SSIDs; however, these SSIDs are introduced to Boingo mobile application and when you are in a Boingo hotspot, you get online with one single click. Some partners' SSIDs are; Boingo Hotspot, Swisscom, orange, WIFI-AIRPORT, ChinaNet, Wayport, Access, attwifi and homerun.

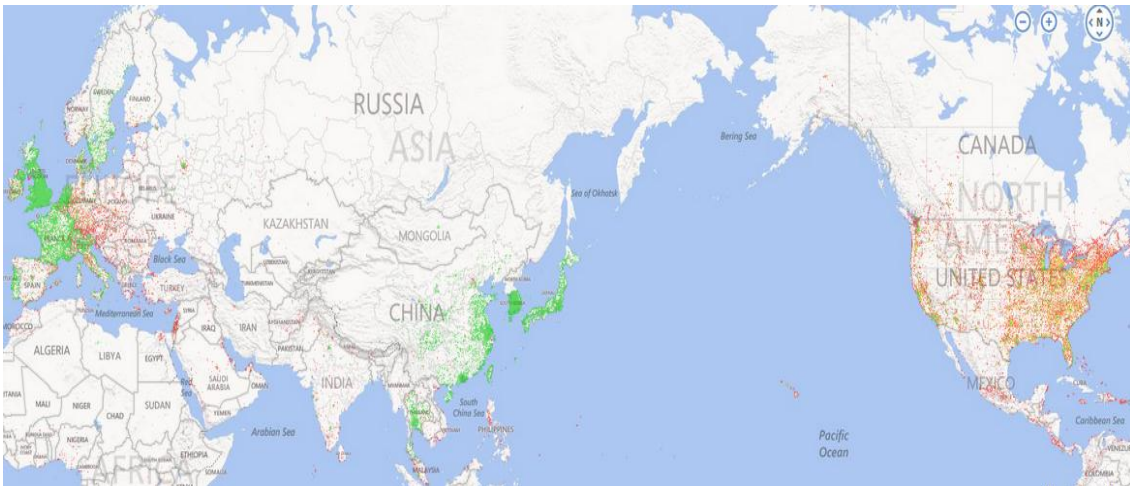


Figure 9. Boingo global Wi-Fi coverage.

### 2.9.2. Community residential Wi-Fi aggregators

In this category, players have established a global Wi-Fi roaming network that mainly consists of privately owned residential hotspots that can provide Internet service to any member of the community service. Fon is considered to be the largest one by providing access to over 12 million hotspots. Fon is the only player that provides global service in this category. Ziggo in Netherlands and Free in France can be considered in this category as domestic networks.

#### *Fon*

Fon solution is based on sharing of your home WLAN access that in return provides access to other Fon's millions of hotspots worldwide. Becoming a member of Fon is an easy step to take as buying a Fon Wi-Fi router and connecting it to the broadband connection is enough and there are no monthly fees. One other way to benefit from Fon's service is to sign up with the Fon's telco partner if there are any available at the location. (Fon Web 2014)

Fon is considered to be seen very powerful to be in a WLAN roaming partnership. It has over 12 million of Wi-Fi spots and it is mainly seen to be dominant in UK, France, Japan, Portugal, Moscow and somehow in Poland, Germany and Brazil and, slightly in rest of the Europe and US.

Fon lets fixed-line broadband operators extend their Wi-Fi offering outside the home or business. By building Fon technology into your CPEs (existing DSL or cable modems with Wi-Fi), you create a Fon Spot and give your subscribers access to our global Wi-Fi network by default.

There is no need for a second router or special configuration by your users. Integration is fast and easy.

### 2.9.3. Crowdsourced long-tail public Wi-Fi

By crowdsourcing free and publicly accessible hotspots into a single network, players in this category built large global networks of hotspots. There is not a contract based relationship between hotspot owner and the service aggregator. The largest player in this category is Devicespace that has a curated network consists of over 12 million hotspots worldwide.

#### *Devicespace*

Devicescape is a virtual, curated network of public and amenity Wi-Fi APs and its network is called to be Devicescape Curated Virtual Network. It is global and built from carrier-class client software. With the software installed on Wi-Fi devices, QoS is measured and maintained based on the data gathered on network performance. Software deployed on the connected Wi-Fi devices feed the performance of AP back to Devicescape in real time. APs are taken in or out of the curated network based on performance. Currently there are about 20 million approved hotspots out of 315 million

monitored connections and Devicescape expects to hit 100 million hotspots by 2017. (Devicescape Web 2014)

There are three essential buildings in its service platform which are Curator Client, Curator Cloud and Curated Virtual Network (CVN).

### *Curator Client*

It is fast and an reliable client software that stands for seamless connectivity with both Wi-Fi and cellular networks by using adaptive network selection and real-time QoE detection based on operator's parameters and user preferences.

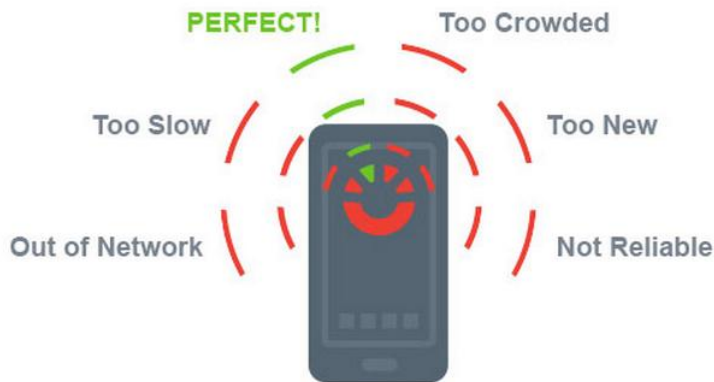


Figure 10. Choice of curator client for the best Wi-Fi connection.

- It can be downloaded or integrated to device and it is also available as an SDK (Software Development Kit) that can be integrated into operator's application.
- Without user intervention Curator Client confirms visible hotspots, observes accessing methods, establishes connection, and switches data traffic.
- Like a master key that opens all doors, Devicescape's patented Curation Auto-Connect technology allows devices on which the client is installed for the easy access procedures.
- The Client software is always working at the background and it is available to be overwritten manually.

Telecom operators may define how the client behaves; for example;

- Enabling Wi-Fi connectivity automatically to connect Wi-Fi hotspots.
- Client scanning for all APs in CVN or just a subset.
- including operator's and subscriber's personal Wi-Fi assets in the auto-connection mechanism
- Whether switching between networks will be based on QoE or operator defined parameters.
- Selecting the right time for a user to be on either Wi-Fi or the mobile network.

### *Curator Cloud*

It guides Curator Client for the selection of the best network at the best time.

- Curator Cloud is updated constantly by millions of active devices that runs the client.
- Among all the APs, Devicescape takes away those slow, unreliable, inaccessible, firewalled and the one cause high latency. The remaining number of APs that stands for the 10% of the total number of APs are monitored and reevaluated constantly.
- Due to the Curator Client installed on the device, operators are able to view analytics on any carrier network as client keeps reporting to Devicescape service platform that monitors usage, offloading, and performance trends.

### *Curated Virtual Network (CVN)*

It is identified as the world's largest network by Devicescape as having high quality of hotspots which are evaluated, qualified and monitored.

- Due to machine learning algorithms and real-time quality of experience (QoE) measurements it identifies the best available networks.
- Devicescape's tests are required for an AP to be counted in the CVN.
- Around 20 million APs are selected out of 300 million APs as defined to be providing a good QoS.
- There is a registry of login methods that may be locally stored or re-accessed dynamically before the authentication is held.

### 3. THEORETICAL FRAMEWORK

#### 3.1. SWOT Analysis

The concept SWOT analysis has been popularized during 1960s and has been increasingly used to evaluate the existing strategies in search of the best alternative (Sevкли, Oztekin, Uysal, Torlak, Turkyilmaz & Delen, 2012). By combining the Peter Drucker idea of the company's success, Philip Selznick concept of "distinctive competences" and "environmental uncertainty" and Alfred Chandler environmental variables Andrew (1965) proposed SWOT analysis.

In theory SWOT matrix provide a mechanism of linking firm's external (strengths and weaknesses) and internal factors (threats and opportunities) for identifying and formulating strategies (David, 2007). Due to the abovementioned advantages SWOT analysis has been frequently as strategic management tool in various business settings to ensure effective decision making (Sevкли et al., 2012).

#### 3.2. Business Model Ontology

Business model ontology explains the process involved to create value which firm offers to one or several consumer segments by relying on its network of partners and key resource to generate revenues and profits. Based on his doctoral dissertation "*THE BUSINESS MODEL ONTOLOGY A PROPOSITION IN A DESIGN SCIENCE APPROACH*", Alexander Osterwalder proposed a business model called CANVAS. In this model Osterwalder outlined several building blocks and activities which enable business to have a simultaneous focus on operational and strategic aspects of management and marketing plans (Osterwalder 2004). By using Osterwalder's

CANVAS model this research will provide an ontology that allows us to accurately describe the business model for Anvia WLAN.

### 3.3. Business Model Pillars

In order to achieve the objective, nine areas will be described which encompass the important business aspects of Anvia WLAN business model. These nine areas are categorized into to four major pillars (Osterwalder 2004);

- Product: Identification of company's business area through products and service offerings. Value proposition is described in this pillar.
- Customer interface: Describes the target customer segments, the channels to reach them and customer relationship management.
- Infrastructure management: Identifies the way of powerfully performing infrastructural and logistical issues in key resources, key activities and partner network.
- Financial aspects: Stands for the cost and revenue structures.

#### 3.3.1. Pillar 1: Service/Product

##### *Value Proposition*

The term value proposition refers to the set of values and benefits the firm promise to deliver to the customer to satisfy their needs. Usually value proposition is some combination of products, services, information, or experiences offered to a market to satisfy a need or desire.

The decision regarding to what set or bundle of values should be offered to the customer is based on the target customer segment's need (Kotler & Armstrong 2010). In competitive environment firms should offer the bundle of values which outweigh the cost incurs to the customer (Porter 1985). However value prepositions have some direct consequence on the cost of offering, firm's capability to produce value and competitive advantage for producing that set of values. Furthermore, beyond all above mentioned the partner network and channel member capability are also key factors for developing value preposition.

### 3.3.2. Pillar 2: Customer interface

#### *Customer Segments*

Marketer usually divides the potential market of products and service by identifying the groups of customers with homogeneous needs. The process of market segmentation would allow companies to made decision about the value prepositions to be offered to different segments of the consumers. In business, to consumer context, marketing managers use a range of consumers' characteristics like demographic, psychographic, geographic and behavioral to segment markets.

While business to business context companies usually segment customers based on the basis of user status, usage rate, industry type and company size (Kotler & Armstrong 2010). Segmentation provides guideline to the companies for making many strategic decisions, for instance; what value preposition a firm should offer, right marketing channels to reach customer, what are the appropriate relationship management strategies and what are the key resource needed. Segmentation allows companies to use their resource efficiently by paying a close attention to needs of specific segment which ultimately reduce wasteful activities and maximize customer value.

### *Channels*

Channel is one of the four key marketing pillars. Distribution channel is actually a bridge which facilitates the transfer of product and service from producer to buyer. Typically, manufactured products move from production facilities to distributor's warehouse and subsequently to the retailer and consumer. The distribution channels are not only important for tangible products but also for service. For example, a hotel can make available its service directly or through other channel members like direct or through travel agents, tour operators, airlines, tourist boards and centralized reservation systems.

Channel management is very crucial and companies usually deal with channel management by developing relationships with the channel members. However for channel management key concerns for companies are their length, size and mechanisms to control and coordinate with them.

### *Customer Relationship Management*

Identifying and targeting customer and providing the value proposition with efficient channel management is not enough to build sustainable relationship with customer. Firms need to continuously engage with their customer to not only understand their satisfaction but also to make sense of their changing needs and preference. In order to establish enduring relationship with customer the CRM is gaining increasing popularity among academician and practitioners (Reinartz, Krafft, & Hoyer 2004).

Many scholars established the relationship between various aspect of CRM and firm performance. For instance, customer satisfaction and business performance (Kamakura, Mittal, De Rosa & Mazzon, 2002), customer loyalty and profitability (Reinartz, & Kumar, 2000) and impact of CRM on economic performance (Reinartz, Krafft, & Hoyer 2004).

### 3.3.3. Pillar 3: Infrastructure management

#### *Value configuration*

The term value configuration or chain refers to arrangement of resources and activities to create value proposition. In literature, the word value chain is usually used to describe a range of activities needed to perform for producing goods and service from conception to delivery, through various production phases (Kaplinsky 2004). Value chain actually provides a holistic view of firms' activities both from the top down and the bottom up by examining the role of key inputs, used technologies, employed standards and regulations, and market condition that specific to firm or industry (Gereffi & Fernandez-Stark, 2011).

During 1960's and 1970's the concept value chain was used by analyst for charting path for the development of minerals-exporting countries and later adopted in French literature of planning (Girvan 1987). However during 1990 up till now the prevalence of value chain as analytical tool arise from the seminal works of Michael Porter (Kaplinsky 2004). From strategic point of view on value chain a key source of competitive advantage (Lee & Yang 2000).

According to Porter (1985) firm can achieve the competitive advantage if the value they create for customer exceed the cost incurred for creating the value. In this era of globalization importance of value chain is growing because of firms value creation activities are now spreading over diverse geographic regions (Kaplinsky & Morris 2001). Therefore logistics and supply chain management are also receiving increasing attention in strategic management literature (Hoejmose, Brammer & Millington 2013).

#### *Core competence*

Core competence refers to the firm's ability to do things better than the competitor. A firm core competence can be anything from product to process involved to provide value proposition to the consumer. The idea behind core competence is that firm has some capabilities which differentiate it from the rest of market. Core competence is built upon three important assumptions that are; it should provide opportunity to access

a big or diverse market, should increase consumer perceived benefit and hard to copied by competitor. In competitive market environment it is pivotal firm to enhance competence to only to remain in market and but also to respond change in future.

#### *Partner network*

Partner network refers the networks of agreements and cooperation a firm made with other firms to create value. Management literature define partner network as strategic inter-organizational relationships with other firms which play important role in firms value creation process. The strategic relationships are of many types like strategic alliances, joint-ventures are often used to have long-term relationship with key partners (Gulati et al., 2000).

The actual purpose of having this relationship is that firms want to reduce their transaction cost by outsourcing non-core activities. Firms may use partner networks from procuring key input to selling final output depending upon the economies they can achieve by getting it done through partner network. However firms usually face many challenges and trade-offs in establishing the sustained relationship with other firms.

#### 3.3.4. Pillar 4: Financial aspects

##### *Cost Structure*

In theory, cost structure means any kind of cost a firm incurs for producing product and service and there are several types of costs such as; fixed, variable, transactional, sunk and marginal cost. In other words cost structure refers sum of all costs that a firms incur to create and deliver value to the customer. This value creation and delivery process has consequence on the cost structure. For instance firms usually maintain the core activities inside and rely on partner network for non-core activities. However decision regarding what to do inside and what get done by partner are dealt which considering the cost structure.

The formula for profit is very simple and straight that is revenue minus cost. Companies' cost structure determines how much they can produce and sell. By producing more, up to a certain point, company may acquire economies of scale which lead to lower the cost of producing product and services. Lastly, an efficient cost structure is also the source of firms' competitive advantage.

### *Revenue Model*

The company's revenue model actually represents company's ability to generate revenues streams and companies differ considerably in their ability to generate revenues. However, in aggressively competitive business environment, firms usually need some proactive approaches to drive revenue.

Specifically, when firms are unable to offer innovative products/services or target new consumer segments. Then they usually use the cross-sell and up-sell strategies to by selling to their product and service to the existing customers. For example fast food chains commonly use cross-sell -suggesting fries with hamburger- and up-sell-suggesting upsize- to increase the sales/revenues. In today's business environment firms can gain competitive advantage by learning and implementing the cross-sell and up sell strategies. To sum up by cross-selling and up-selling firms have opportunity to increase simultaneously consumer value and sales.

## 4. WLAN MARKET OUTLOOK

### 4.1. Anvia Enterprise WLAN Analysis

Anvia is a comprehensive ICT service provider by delivering all information technology, communication services and security technology services, and equipment as well. It is the fourth largest telecom operator in Finland providing world-class solutions. Anvia has three business areas; Anvia ICT, Anvia Security and Anvia TV. (Anvia web 2014).

*Anvia ICT* provides IT and communication services to consumers, enterprises, government/municipality entities and other operators as well.

*Anvia Security* delivers security technology and unlocking services as well as equipment.

*Anvia TV* provides transmission and reception of TV services.

Before conducting interviews with any customer segments the current and target state of Anvia in enterprise WLAN business is taken into consideration by conducting an internal interview with Reino Lähdemäki (Director, Business Development). By conducting this questionnaire it is also aimed to create a base;

- to perform effective interviews with current and potential targeted customer segments in order to analyze their point of view in Enterprise WLAN services.
- to be able to observe the differences with national and global Enterprise WLAN market based on the service offering and pricing.
- to perceive the enhancement, that could be applied to Anvia Enterprise WLAN business.

The following part of this thesis contains confidential information. Therefore, it is removed from the public version and remains secret.

## 4.2. Regional WLAN Market Analyzes

### 4.2.1. SOHO Market Analysis

In order to perform SOHO enterprise WLAN customer market analyzes, 32 interviews are conducted with the owners of small enterprises in central areas in Vaasa. In these interviews, first the concept of Wi-Fi roaming is introduced to interviewees in terms of regional, national and global sense and later on interviews are held based on predefined questions (index B).

The interviews are mainly conducted with restaurant, café and barbershop owners where people may spend longer times in their premises. Moreover, interviews are also held with other type of small enterprises to figure out SOHOs' common point of view about enterprise WLAN. This is important as this interview is not only conducted to achieve SOHO customers' opinion about Wi-Fi Roaming but also to realize their common point of view on enterprise WLAN.

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#### 4.2.2. SMEs Analyzes

To perform enterprise WLAN market analyzes in terms of SMEs' and large corporations' point of view, 10 interviews are held with the related persons from different companies/organizations in different business fields (Table 4).

At the beginning of each interview a short presentation on Wi-Fi roaming concept is given to participants and subsequently interviews are held with the predefined questions (index C).

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### 4.3. Global Wi-Fi Roaming Service Providers' Comparison

As it has been indicated in Global WLAN Roaming section in Background chapter, there are three types of global WLAN roaming service providers; Premium public-Wi-Fi aggregators (iPass, Boingo), Community residential Wi-Fi aggregators (Fon) and Crowd sourced long-tail public Wi-Fi (Devicescape).

In this section a brief comparison between global Wi-Fi roaming SPs is provided by indicating their most crucial features. Based on this analysis and further questioning, it is believed that a good decision may be taken in case of the selection of global WLAN roaming service providers. Table 5 stands for the main differences between the players.

Table 4. Global WLAN Roaming service providers' comparison.

	<b>iPass</b>	<b>Boingo</b>	<b>FON</b>	<b>Devicespace</b>
<b>Smartphone &amp; Tablet OS support</b>	Open Mobile for iOS: iOS 4.3 or later (including iOS 5.0.x) devices, including iPhone 3GS or later, iPod Touch 3rd Gen or later and iPad Open Mobile for Android: Android 2.3 or later Open Mobile for Windows Touch: Windows 8 and Windows RT Open Mobile for Windows Phone: Windows Phone 8 or later	Compatible with Android OS 2.3 and above and, iOS 4.3 and above.	All	Currently Android OS.
<b>Laptop OS support</b>	All	Compatible with Windows XP, Vista, Windows 7 and, Mac OSX 10.6 and above	All	NA
<b>Commercial Hotspots</b>	2,4 M	700,000	commercial hotspots of partner operators, Considerably very low	In some extend
<b>Total number of hotspots</b>	2,4 M	700,000 + free hotspots	12 M	20 M
<b>Need for second SSID</b>	NO	NO	YES	NO
<b>Partnership</b>	Based on the agreement, roughly 50% share of the revenue of WLAN roaming business. Different pricing for different operators.	NA	250K euros for registration including 2 AP model SW implementation.	Service fee is paid based on the number of users

#### 4.4. Global Wi-Fi Roaming Service Providers' Analysis

In this section, some details/comments are made based on each global Wi-Fi roaming SP separately that may help operator to make a robust decision in terms of SPs selection.

##### *iPass*

- iPass global Wi-Fi roaming service is only provided to Enterprise business travelers and telecommunication carriers' subscribers. The service is not provided as retail. Therefore, it creates business value for operators, a possibility to create different service propositions to drive customer acquisition.
- iPass supports all types of OSs: iOS, Android and Windows 8 (Smartphones and Tablets), Mac and Windows for Laptops.
- A WLAN network has to reach some technical requirements (reliability, security etc.) to be in a partnership with iPass. Therefore, all the hotspots in iPass's network are high standard commercial hotspots that are considered to be reliable and secure to perform business activities.
- No need for a second SSID, automatic authentication at each time of the connection. The SSIDs that are used in operator's own Wi-Fi roaming network are introduced to iPass client. Whenever iPass client installed device is inside the coverage of a Wi-Fi hotspot that defined as iPass hotspot the device attempts to connect through iPass client application.
- iPass is a very fast growing global Wi-Fi service provider. In 2 years, they almost doubled the number of their commercial hotspots around the world through partnerships with network operators, hotels, airports etc.
- iPass does not only get into a partnership with WLAN network operators but also with Cellular mobile operators that may not have WLAN network but yet still sell the service provided by iPass.

- iPass sells the service to enterprise customers that makes iPass a strong competitor to WLAN network operator.

### *Boingo*

- Its global Wi-Fi network does not only consist of commercial hotspots but also free hotspots. This decreases the quality of the network in case of being connected through free hotspots.
- It is considered to be the second best/largest Global Wi-Fi service provider choice coming after iPass.
- The cooperation between Boingo and Swisscom is cancelled that is not good for their reputation. There has been complains about this issue in their linkedin profile.
- No need for a second SSID, automatic authentication at each time of the connection. The SSIDs that are used in operator's own Wi-Fi roaming network are introduced to Boingo's client. Whenever Boingo's client installed device is inside the coverage of a Wi-Fi hotspot that defined as Boingo hotspot the device attempts to connect through the client application.
- Seems that their customer service is not functioning well as there are several complain in their linkedin profile.
- In terms of commercial Boingo hotspots, Boingo is dominant in Japan, South Korea, China, Thailand, UK, France, and Netherlands and considerably in Moscow's center and in some states of USA.

### *Fon*

- The positive side of being in a partnership with Fon is that Fon may provide secure Wi-Fi roaming for operators' residential subscribers.
- Fon holds the largest global Wi-Fi roaming network based on residential users.
- Fon connectivity requires a second SSID.

- Fon brings Wi-Fi roaming capability to operators in their internal networks; however, as the majority of hotspots open to global Wi-Fi roaming is residential operator's subscribers will not enjoy Wi-Fi roaming in common venues. Therefore, a partnership does not seem to be beneficial to fixed line operators, even it might create a negative effect (customer dissatisfaction). Because customers will be promised for global Wi-Fi roaming with over 12 million hotspots around the world and yet most of the subscribers will not be able to get this service in common areas which will be their main destinations to use Wi-Fi.
- Global Wi-Fi is totally free after becoming a partner of Fon; however, there is a subscription fee. Moreover, the Fon SW is installed to two AP models and for more than two AP models Fon charges for each extra model.

### *Devicescape*

- Devicescape is based on an innovative SW technology. Devicescape got “the best use of Wi-Fi” award from telecoms.com for its Curated Virtual Network.
- Devicescape is responsible for the management of the curated cloud as a service to operator and operator delivers this service to its subscribers by setting policies as they want.
- It holds about 20 million hotspots tested/approved in terms of quality, availability, speed and reliability (Simply subscribers' Quality of Experience) and it keeps growing as every new user sniffing out new open Wi-Fi APs to add to its footprint. However, an AP that reaches high standards to be added to curated network of Devicescape might not reach the same performance another day or even another hour. Therefore, the location of APs are not stable.
- Its client SW can be used in operators' client application on mobile Wi-Fi devices. By this way, operator gets credit by providing devicescape client SW capability through its own app.
- There is no restriction on AP's model. It is compatible with all brands and models of APs.

- Devicescape is in a partnership with iPass.
- Devicescape client is unable to support iOS. They are expecting for such support in future releases of iOS.

## 4.5. Service Providers' Enterprise WLAN Marketing Strategies

### 4.5.1. Bundled services

Bundling stands for the company's marketing strategy that combines several products or services in a single package for its consumers. It is very beneficial for both the service provider and its customers.

It may boost the sales as the consumer that is in need of one service may be offered some other services in the same package with an irresistible pricing offer. Moreover, customers may like the additional services provided in a service bundling package that they have not used before and they may want to continue to use it. As a result customers may find those additional services highly necessary along with the main service offering later on.

The services and products that are provided in a bundled package are offered to customers for considerably less money. In addition to this, customers may experience the services without paying the full price.

Service bundling packages should be carefully built for customers' satisfaction and should be enriched with such services that customer observes the value of the additional services and would be willing to use those services in future. One of the main

ideas of bundling services is to keep the bundled package cheaper than the total price of the all individual services.

Network operators in all around the world such as BT from UK and TTNET from Turkey mainly go for bundled service offerings for their enterprise level customers. While the main service offering is the Internet connection with some connection speed limitations, there are several additional services provided along with the main service offering in different bundled packages. The most common additional services used in bundled services are; email, web hosting, internet security, online data space and Wi-Fi roaming.

Bundling service packages mainly divided in to two based on the offered Internet type, whether it is (A)DSL or fiber Internet. While the connection speed for DSL is up to 24Mbps it is over 100Mbps in case of fiber Internet connection.

Some additional services provided through those bundled service packages are as follows;

- Mainly unlimited Internet connection is applied; however, based on the usage the connection speed is lowered in some bundled service offerings and for others there is no download limit as they are sold considerably with higher prices. For example, if the monthly download exceeds 50GB (This limit varies from 25 to 200GB based on the bundled service) the connection speed is lowered to 3Mbps for all bundled service packages.
- In some bundles, there are email services are provided, from 5-10. Additional email addresses are sold with a small compensation separately.
- WEB is included in some packages with 5-10 GB space (In 30 seconds easy internet wizard, 10 minutes professional website with wordpress and joomla. In some advanced service offerings use your own design).
- 3-10 Internet security licenses (McAfee) are provided.

Free services that are included in all bundled service offerings;

- Filtered Internet connectivity, to prevent access to prejudicial content.
- Online data storage, 20GB.
- Wi-Fi Roaming from 600 to 1800 minutes per month or completely free
- Music services, access to listen 30 songs per day for free

In addition to the bundled services described above there might be some products and services at a discount or free for the customer attraction;

- Free connection set-up
- Free modem for new subscriptions or at a discount price.
- In case of a 24 month contract, service provider may offer a discount (or free) in monthly payments for a period of time at the starting phase of the contract.

#### 4.5.2. Cloud Computing

Cloud computing enables a common, on-demand network access of a shared pool of computing resources such as; networks, servers, storage, applications and services that can be easily and quickly provisioned. Cloud computing resources can be released with negligible management effort or service provider interface. There are three different types of service models that are described as follows;

##### *Software as a Service (SaaS)*

In this service model service provider's applications that are running on a cloud infrastructure are used by the consumers. Apps may be reached from various UEs through a thin client interface (e.g. web browser) or a program interface. Except the limited user specific application configuration settings, user does not manage or control the cloud infrastructure.

*Platform as a Service (PaaS).*

By using programming languages, libraries, services and tools supported by SP, user can deploy their applications onto the cloud infrastructure. Users do not manage or control the cloud infrastructure; however, they have control of their deployed applications and perhaps configuration settings for the application hosting environment.

*Infrastructure as a Service (IaaS)*

Consumer is supported to provision networks, processing, storage and other computing resources. Through these resources consumer can deploy and run operating systems and applications. Consumer has control over operating systems, storage and deployed applications and a limited control in selection of networking components such as host firewalls.

Cloud computing is a new way of using Internet and many network operators already provide SaaS and IaaS in their service areas. Through SaaS SPs deliver a software store that includes a wide range of applications that are related to CRM, hosting control panels, hosting packages, safety, OS, content management systems etc. Through IaaS the equipment used to support operations, including networking components, storage, hardware and servers are outsourced by SPs to their customers.

As the cloud computing services are reached through an Internet connection they are accessible from anywhere at any time. Considering such services being used over wireless technology it increases the value of WLAN for enterprises to gain secure, fast and reliable mobility mostly inside and also outside of the organization.

Network operators may provide cloud computing services by having their own cloud system and make agreements with software developing companies to provide their applications through their cloud system to enterprise level customers.

Another way of giving cloud computing services is that SPs may get into a partnership with some cloud service providers as those cloud SPs already has many applications in their cloud services.

TTNET, network operator from Turkey, is in a partnership with PLUSCLOUDS and TTNET provides SaaS services through this cloud computing SP to its customers with considerably cheaper prices than PLUSCLOUDS's own pricing for its service offering. Moreover, by being in a partnership with a cloud computing SP, TTNET's customers can reach over 90 business specific applications that brings the ease to business operations.

In general network operators (like BT Telecom and M1 Singapore) do not have any partnerships with cloud computing SPs, instead they provide few SaaS and IaaS services that might have a common usage in enterprise market.

#### 4.5.3. Providing cellular services as complementary to Enterprise WLAN

Mobility in communication has a great impact in enterprise market. Businesses that have activities in outdoor areas (especially for the ones doing business in middle of nowhere that WLAN would not be present) are in a need for cellular communication services. Therefore, cellular services are preferable for many companies as the availability is much higher compared to WLAN services. Although, WLAN provides high data rates in communication cellular technology is available almost everywhere. This is considered to be the main difference between both technologies.

In all around the world, many fixed-line telecommunication operators also provide cellular services to their customers and the provided services are whether at the same prices or even cheaper. Moreover, customers make only one deal with an operator and through this agreement they benefit both fixed-line and cellular services for their needs.

#### 4.5.4. Wi-Fi roaming

Wi-Fi roaming concept has been described in Background chapter in details. Simply it stands for being automatically connected to Wi-Fi hotspots over your SP's network or its partners' networks. The improvements in Wi-Fi technology; its availability in almost all communication devices, high data rates, considerably being cheaper than cellular and

so many other features have made Wi-Fi very popular and to be deployed in all around the world.

Many operators around the world try to put an effort to build their own WLAN network in most common of their service areas. Moreover, they are also in partnerships with other operators and global Wi-Fi roaming service providers to extend their Wi-Fi coverage.

Wi-Fi roaming service is provided to customers in two phases, whether it is national Wi-Fi roaming or global Wi-Fi roaming. While it is mainly offered as a free service internationally, customers are charged for the global Wi-Fi roaming usage. Global Wi-Fi roaming SPs have different agreements with operators based on operators' potential sales. Therefore, there might be a huge difference between operators' global Wi-Fi roaming service offerings in terms of pricing. For instant, while the operator Alwayson from South Africa charges 11 euros for global Wi-Fi roaming for one day (They do not have a monthly subscription; however, based on daily usage for 30 days makes 330 euros per month), TTNET from Turkey charges only 14e for the whole month.

#### 4.5.5. BYOD

One other issue that makes the WLAN valuable for enterprises is the new concept that is called as Bring Your Own Device (BYOD). With the increase in personal devices usage, employees want to use their own devices in work and they expect the connection to the corporate's network in a same way they do with their "work" device. However, such usage may cause security issues that may require outsourcing support or perform a security management system inside organization.

BYOD may deliver benefits to companies in three categories in case of being well secured and well managed (IDC 2013);

Operational Benefits: Employees job satisfaction and productivity - as having flexible working alternatives by using both company-issued and employee-owned devices.

**Financial Benefits:** Saving money on providing and maintaining employees' devices – although management and support for employees' devices create an ongoing operating expense employees may bring and use their up-to-date devices without the company spends for new models.

**Organizational Benefits:** Employees have more powerful devices at home than at the work place – IT departments are seen to restrict the productivity; however, a well-defined and implemented mobility strategy may still provide overarching security frameworks for devices, applications and content.

There are several challenges introduced in case of allowing the usage of BYOD which are generally security and management related challenges; however, Ruckus solution for dealing with BYOD challenges simplifies the situation not to be complex and cumbersome. By taking advantage of features like Zero-IT configuration, Dynamic PSK and simplified role-based access control enterprises existing network resources may be used to define policies to BYOD users. The user guide to simplifying BYOD with Ruckus is seen to be a beneficial guide to implement BYOD service in an organization. (Ruckus 2012).

Unlike Ruckus, Cisco delivers a wide range of applications in their BYOD solution for different building blocks (Cisco 2013w);

**Workspace management:** Due to Cisco's MDM, policies can be established such as encrypted storage, PIN-lock requirements, track device location, remotely wipe devices and disable features (cameras and audio recorders). Enterprises are able to manage and secure employees devices and workspace.

**Secure mobility:** In this segment, Cisco AnyConnect and Adaptive Security Appliance (ASA) deliver secure access to applications and data over wireless (3G, 4G and Wi-Fi technologies) and wired networks.

**Policy Management:** The Cisco Identity Service Engine stands for policy management to ensure access to information related to employee's identity and the device, and showing the connection type whether wired, wireless or VPN networks.

#### 4.5.6. Voice over WLAN

VoWLAN stands for the vocal conversation over wireless broadband network. It can be used through any internet available device such as laptops, smartphones and so on. Unlike cellular mobile communication, voice is delivered through WLAN network based on IEEE 802.11 standards. The main purposes of using VoWLAN are to take advantage of cheaper national and international calls and as well as free calls to other VoWLAN devices.

Highly available underlying infrastructure, low latency and QoS capabilities are required in terms of the deployment of VoWLAN. High speed Internet connection has a great of value in terms of successfully using VoIP services in a high quality manner. Therefore, in case of using mobile phones, WLAN is the best solution to use voice over IP services compared to 3G/4G connection, especially inside buildings in terms of cost, flexibility and speed.

VoIP services provided through SW applications bring ease and they are considerably much cheaper than HW solution. Enterprises do not require for high HW deployment costs, instead SW applications installed on mobile devices and cloud based SW applications are used.

Cloud PBX; it functions same as an analog PBX by hosting on the Internet that brings ease in usage and provides a high level of flexibility. By this implementation any location having Internet connectivity becomes an office at work. Employees may be anywhere but still the system can be managed with cloud based PBX.

VoWLAN devices use WLAN network that is created by Wi-Fi APs and WLC and be in communication with IP PBX to perform outgoing calls. WLAN networks are open for the connection of any Wi-Fi capable devices such as laptops/PDA/cell phones to Internet/Intranet. Therefore, any mobile phone including cell phones with Wi-Fi capabilities can get registered to the IP PBX as long as a required app is installed on the device.

#### 4.6. SWOT Analysis

The following part of this thesis contains confidential information. Therefore, it is removed from the public version and remains secret.

## **5. BUSINESS MODEL ENHANCEMENTS**

This chapter of the thesis contains confidential information. Therefore, it is removed from the public version and remains secret.

## 6. CONCLUSION

Wireless communication is no longer a luxury but has become a crucial necessity for enterprises from many aspects. Mobility brings freedom to employees and turns the entire enterprise into an office where employees are able to navigate but still remain connected to internal network to continue performing any tasks that can be done with workstations. It converts downtime into productive time by allowing instant access to enterprise network from anywhere that Internet is available, provides employees/customers satisfaction and competitive advantage as well as providing an increase in sales and customer attraction to name a few. Although, there are different wireless communication solutions WLAN is the far most crucial and beneficial wireless solution for enterprises as it provides high data rates and it has low cost charges for the system deployment.

WLAN was not counted to be a viable business; however, due to technological innovations in the world of WLAN, most of the weaknesses that are related to security, QoS and availability have been compromised and with the help of well-planned business models it is seen as a profitable and highly promising business for the enterprise customer segment. Moreover, there are several services such as Wi-Fi roaming, BYOD, cloud computing and VoWLAN that support WLAN business and create an enormous value for enterprises to deploy WLAN in their premises. Such services are considered to increase popularity/sales of WLAN more and also provide additional revenue to ANVIA through their sales being separate than main WLAN service offering.

For the proposition of business model enhancements, there has been a comprehensive research conducted by gathering data from different sources; through academic and white papers from Internet in order to form the theory part and perform enterprise WLAN market analysis by observing other SPs' service offerings, conducting an internal interview in Anvia to figure out the current situation of enterprise WLAN business in company, conducting interviews with SOHO and SMEs/LEs WLAN customer segments to analyze enterprise WLAN customers' point of view and as well as providing a robust analysis on supportive services especially Wi-Fi roaming.

Furthermore, due to these analyzes, enhancements and recommendations for both SOHO and SMEs/LEs WLAN customer segment businesses are provided in two separate business models.

Through the analyzes that are based on interviews it is observed that the increase in sales might face some obstacles such as customer's ongoing contracts with other SPs and customer's lack of knowledge on enterprise WLAN services that may create a high value for their business, and there might be a need for some time to get over those obstacles. Therefore, first two years there might be a small progress at the number of customers; however, following years it is expected to increase and follow a positive slope. The required enhancements and recommendations are provided to Anvia to achieve success in enterprise WLAN business segment.

The following attributes stands for the future work and recommendations;

- It is recommended to keep in contact with SPs and other network operators in national and international phases in case of providing SW applications, equipment, Wi-Fi roaming, BYOD and VoWLAN services.
- The general customers' lack of knowledge on the service offerings they receive or may receive is an obstacle for an increase in number of customers. Based on the recommendations that have been indicated in analyzes part should be followed to gain those customers in case of new subscriptions or sales of other services that may create value for their business.
- Internal control and training of employees has a great of importance. The required actions to be taken and the recommendations that have been indicated to be applied.
- Although, there have been conducted interviews with different enterprise WLAN customer segments it is highly recommended to Anvia to continue with more extended customer surveys through their key account managers.

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## APENDIXES

Appendix A.

### ANVIA ENTERPRISE WLAN MARKET ANALYSIS QUESTIONNAIRE

<b>PURPOSE OF THE QUESTIONNAIRE:</b>			
<p>This questionnaire is prepared to analyze the current and targeted state of ANVIA in Enterprise WLAN business in Finland. By conducting this questionnaire it is aimed to create a base</p> <ul style="list-style-type: none"> <li>• To perform effective interviews with current and potential targeted customer segments in order to analyze their point of view in Enterprise WLAN services.</li> <li>• To be able to make a comparison with national and global Enterprise WLAN market based on the service offering and pricing.</li> <li>• To perceive the enhancement, that could be applied to Anvia Enterprise WLAN business.</li> </ul>			
<b>PARTICIPANT'S DETAILS:</b>			
Title		E-mail	
Full Name		Phone	
<b>Industry concentration/ Customer Segment</b>			
<p><b>1. Who are your current customers? Please categorize them in segments by indicating their importance from high to low.</b></p>			
<b>Value Proposition</b>			
<p><b>2. What kind of main services do you deliver to your customers?</b></p>			
<p><b>3. What value added services do you provide to your customers?</b></p>			
<p><b>4. Have you tried reverse innovation for any customer segment?</b></p>			
<b>Competitiveness</b>			

<b>5. Who are your current and potential future competitors?</b>
<b>6. What differentiates you most from your competitors? What unique service(s) do you provide?</b>
<b>7. Do your competitors provide similar services?</b>
<b>8. Is your competitive advantage sustainable?</b>
Distribution Channel
<b>9. Through which channels do you reach your customers?</b>
<b>10. Which channels work best? How much do they cost?</b>
Marketing Strategy
<b>11. How do you advertise your service offerings?</b>
<b>12. Are you going for the cross selling of your services?</b>
Customer Relationship
<b>13. Do you provide any specific services that are based on customer needs?</b>
<b>14. What kind of after-sale services do you provide for your customers? In each customer segment?</b>

<b>15. How do you keep your relationship on with your customer?</b>
Revenue Streams
<b>16. How is your pricing strategy?</b>
<b>17. How much does Enterprise WLAN revenue stream contribute to the overall revenues?</b>
<b>18. What is your expectation from the enterprise WLAN sell?</b>
<b>19. What are the pricing for the second and the third questions?</b>
Key Resources
<b>20. What key resources does your value proposition require?</b>
<b>21. What is the resource contribution to enterprise WLAN business? (to estimate the cost for E. wlan)</b>
<b>22. What resources are important the most in distribution channels, customer relationships, revenue stream?</b>
Key activities
<b>23. What key activities does your value proposition require?</b>
<b>24. What activities are important the most in distribution channels, customer relationships, revenue stream?</b>

Key partners
<b>25. Who are your key partners/suppliers?</b>
<b>26. Are your suppliers or employees are enough to support for future extension in market?</b>
<b>27. What are the motivations for the partnerships that will not be potential customers but just partners like Universities' campus areas?</b>
<b>28. How the expansion in Enterprise WLAN will effect on other businesses? Will the capacity of company be enough to answer in case of a big demand?</b>
<b>In your selling strategy are you generally going for the main sell or cross selling?</b>

## SOHO WLAN MARKET ANALYSIS QUESTIONNAIRE

**Tarkoitus:** Tämän kyselyn tarkoitus on antaa yrityksille tietoa Wi-Fi verkkovierailusta (Wi-Fi roaming) koti- ja pientoimistoissa . Kerätyn tiedon avulla analysoidaan koti- ja pientoimistojen langattoman lähiverkon (WLAN) käyttötarpeista ja kiinnostuksesta verkkovierailupalveluun.

**Purpose:** *This questionnaire is prepared to inform SOHO (Small Office Home Office) customers about Wi-Fi Roaming and to collect data based on SOHO Enterprise WLAN market in order to perform market analyzes. The collected data is going to be used for the development of Enterprise WLAN business models.*

**Wi-Fi Roaming:** Wi-Fi tarkoittaa langatonta lähiverkkoa (WLAN). Wi-Fi -reititin toimii langattomana liityntäpisteenä tietoverkkoon. Roaming (verkkovierailu) tarkoittaa toisen yhteistyössä toimivan Wi-Fi -liityntäpisteen käyttämistä omien tunnistustietojen avulla. Verkkovierailu yhteistyön tekijät voivat jakaa Wi-Fi -yhteydensä käyttäen erillistä SSID:tä (Service Set Identifier – Wi-Fi-verkon yhteyden nimi), jonka avulla he voivat automaattisesti käyttää toistensa WLAN-liityntäpisteitä internetyhteytenä. Näin jäsenet laajentavat Wi-Fi -peittoaluetta ja voivat nauttia nopeasta ja turvallisesta internetyhteydestä lukuisissa eri paikoissa ympäri Suomen.

**Wi-Fi Roaming:** *Wi-Fi Roaming stands for the navigation of Wi-Fi users among the partner's Wi-Fi hotspots without reentering the user credentials (Username and password). Enterprise WLAN users may share their Wi-Fi connection over a second SSID (Service Set Identifier – Wi-Fi network connection name) that provides them to automatically connect to internet over other members' WLAN connections. By doing this members extend their Wi-Fi coverage and, enjoy fast and secure Internet connection at many hotspots in different cities in Finland.*

*Wi-Fi -verkkovierailun ominaisuuksia:ks erillinen kalvosarja*

- Laajennettu Wi-Fi -peittoalue Suomessa yhteistyö tahojen liityntäpisteissä
- Nopea, hallittu ja suojattu Internetyhteys
- automaattinen kirjautuminen ensimmäisen kirjautumisen jälkeen(käyttäjätunnus ja salasana kysytään vain ensimmäisellä kerralla)
- 

*Features of Wi-Fi roaming;*

- *Extended Wi-Fi coverage in Finland at available partner's Wi-Fi hotspots.*
- *Fast, controlled and secure Internet connection.*
- *No user intervention (Username and password).*

*Wi-Fi –verkkovierailuyhteisön jäsenyyden etuja*

- Verkkovierailu on ilmaista
- Verkkovierailu ominaisuus kaikille yrityksen työntekijöille
- Tarjoaa nopean ja turvallisen yhteyden yrityksen asiakkaille
- Vieraileva käyttäjä ohjataan yrityksen verkkosivuille internetkäytön aluksi (Etusivun uudelleenohjaus)

*Benefits of being a member of Wi-Fi Roaming;*

- *Free of Charge.*
- *All the employees of the enterprise will gain from Wi-Fi roaming features.*
- *Providing a fast and secure internet connection to enterprise's customers.*
- *Users will be redirected to website of the enterprise when they start a browser over your Wi-Fi connection (URL redirection).*

**YRITYKSEN TIEDOT**

Nimi :  
 Työntekijöitä :  
 Toimiala :

**VASTAAJAN TIEDOT**

Nimike :  
 Koko nimi :  
 Sähköposti :  
 Puhelin :

**\*Mitä mieltä olet Wi-Fi -verkkovierailusta (alueellisesta, kansallisesta tai kansainvälisestä näkökulmasta)? Käyttäisitkö itse verkkovierailua ja missä eniten?**

*What do you think about Wi-Fi roaming (In terms of Regional, National and Global usage)? Would you use Wi-Fi roaming, and where would you use it the most?*

**\*Asteikolla 1-5, jossa 1 = huono asia, 5 = erinomainen asia;**

	1	2	3	4	5
Alueellinen verkkovierailu					
Kansallinen verkkovierailu					
Kansainvälinen					

**\*Onko sinulla WLAN-yhteys?**

*Do you have a WLAN connection?*

Kyllä  Ei

**\*Jos käytössäsi ei ole WLAN yhteyttä, miksi ei?**

*If you don't have a WLAN-connection, why not?*

**\*Miten itse hyödynnät WLAN yhteyttä tällä hetkellä?**

*How do you take advantage of the WLAN connection at the moment? (eg, surfing, payment terminals and cashiers, customer contact, other)*

- Surffaus*  
 *Maksupäätteet ja kassat*  
 *Asiakasyhteys*  
 *Muita:*

---

**\*Kysyvätkö asiakkaasi WLAN -yhteyttä?**

*Does your clients ask for WLAN-connection?*

Kyllä  Ei

---

**\*Käytätkö itse WLAN yhteyttä työpaikan ulkopuolella, missä?**

*Are you using WLAN connection outside the workplace, where?*

Kyllä  Ei

---

**\*Jos sinulla olisi käytettävissä verkkovierailumahdollisuus, olisivatko asiakkaasi tyytyväisempiä?**

*If you would have roaming available, would your clients be more satisfied?*

Kyllä  Ei

---

**Oletko tyytyväinen nykyiseen langattomaan yhteyteesi?**

**Minkälaisia haittoja olet havainnut?**

**Miten ongelmat on ratkaistu?**

*Are you satisfied with your current wireless solution? What are the drawbacks? How are the problems solved?*

Kyllä  Ei

**Mitä palveluja toivoisit WLAN-palveluusi?**

*What services would you like to your WLAN service?*

- Wi-Fi -verkkovierailu  
 Etusivun uudelleenohjaus  
 Muita:

---

**Voisitko ajatella maksavasi tarpeitasi vastaavista palveluista ylimääräistä?**

Kyllä  Ei

*Do you consider paying extra for the service offering that satisfy your needs?*

---

**Mitä odotuksia sinulla on palveluntarjoajalle? Minkälaisia palveluita haluaisit saada?**

*What is your expectation from your service provider? What kind of services would you like to receive?*

---

**Vaihtaisitko palveluntarjoajaa, jos kilpailija tarjoaisi parempia palveluita?**

Kyllä  Ei

*Would you consider switching your operator if another service provider offered a better service?*

---

**Mikä pitää sinut nykyisen palveluntarjoajan asiakkaana?**

*What would keep you not switching your operator?*

---

**Olisitko valmis jakamaan internet-yhteyttäsi WLAN yhteisön muodostamiseksi, kun palvelu järjestetään niin, että vierailijoiden käyttö ei häiritse omaa internetliikennettäsi?**

Kyllä  Ei

*Would you be willing to share your Internet connection WiFi in the form in which the service is arranged so that visitors use does not interfere with your own use?*

---

**Olisiko 5 €/kk sopiva hinta WLAN roaming-palvelun toteuttamisesta yrityksessäsi (kiinteän laajakaistapalvelun lisäksi)?**

Kyllä  Ei

*Would 5€/month be an appropriate price for implementing the WLAN roaming-services in your company, in addition to the broadband connection?*

---

**Arvioi seuraavia ominaisuuksien tärkeyttä valitessasi WLAN palvelun toimittajaa**

*Evaluate the importance of the following features while choosing your WLAN service provider*

**1 = ei tärkeä ja 5 = erittäin tärkeä**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Luotettavuus <i>Reliability</i>					
Turvallisuus <i>Security</i>					
<u>Verkkovierailumahdollisuus Vaasassa ja Pohjanmaalla</u> <i>Option for roaming service in vaasa and ostrobothnia</i>					
Kansainvälinen verkkovierailu <i>Global Roaming</i>					
Lisäpalvelut <ul style="list-style-type: none"> <li>• Etusivun uudelleenohjaus</li> </ul> <i>URL redirection</i>					
Hinta <i>Price</i>					
Yhteyden nopeus <i>Connection Speed</i>					
Helppo käyttöönotto <i>Ease of deployment</i>					
Toimittajan maine <i>Reputation of vendors</i>					
Käyttäjien suositukset <i>Recommendations of peers</i>					

---

**Kuka on palveluntoimittajasi? Millainen on kuukausierä? Millainen palvelu?**

*Who is your supplier? What is the total monthly cost? What is the service offering?*

## Appendix C.

ENTERPRISE WLAN ANALYSIS
<p><b>Purpose:</b> This interview is arranged to inform SMEs and Large businesses about national and international Wi-Fi Roaming and to collect data based on Wi-Fi Roaming services and Enterprise WLAN market in order to perform market analyzes. Through these analyzes it is aimed to determine Enterprises' WLAN point of view to enhance Anvia's service offerings in order to provide a better service to its customers.</p> <p><b>Wi-Fi Roaming:</b> Wi-Fi Roaming stands for the navigation of Wi-Fi users among the partner's Wi-Fi hotspots without reentering the user credentials (Username and password). Enterprise WLAN users may share their Wi-Fi connection over a second SSID (Service Set Identifier – Wi-Fi network connection name) that provides them to automatically connect to internet over other members' WLAN connections. By doing this members extend their Wi-Fi coverage and, enjoy fast and secure Internet connection at many hotspots in different cities in Finland.</p> <p><b>Main features of WiFi-Anvia;</b></p> <ul style="list-style-type: none"> <li>• Extended Wi-Fi coverage in Finland at available partner's Wi-Fi hotspots.</li> <li>• Fast, controlled and secure Internet connection.</li> <li>• No user intervention (Username and password).</li> </ul> <p><b>Benefits of being a member of (WiFi-Anvia);</b></p> <ul style="list-style-type: none"> <li>• On-line connection sharing for your guests and your customers: Your business guests can safely and easily get connected to Internet resources due to your Wi-Fi roaming membership.</li> <li>• Cost savings, as reducing the need for 3G/4G SIM cards.</li> <li>• Easy to use WLAN on employees' own devices (BYOD)</li> <li>• Give secure network access to customers and business partners through your guest network.</li> <li>• Allows members of the WLAN roaming networks to facilitate business cooperation.</li> <li>• The system allows for secure wireless internal network of internal systems; payment terminals, IT systems and management systems.</li> <li>• The service adds to the attractiveness and competitiveness of company by making use of mobile technology.</li> <li>• No extra charges for this service.</li> <li>• WiFi-Anvia gives your employees the ability to a secure and easy-to-use wireless Internet connection.</li> <li>• Your employees are able to roam around without losing their connection to your Intranet and Internet from anywhere at any time.</li> <li>• Employees will have access to applications and documents on a server while on the move.</li> <li>• Internet is out of the office all the time at your fingertips. You can take advantage of working days to the fullest.</li> <li>• More efficient meetings that all the employees are conveniently online.</li> </ul>
<b>COMPANY'S DETAILS:</b>
Company's Name : Number of Employees : Business Area :
<b>PARTICIPANT'S DETAILS:</b>
Title : Full Name : E-mail : Phone :

---

**Would you need/like to have Wi-Fi roaming service, and where would you need/like to use it the most?**

- Hotels  
 Airports  
 Cafés, Restaurants  
 City centers  
 Other:

**What do you think about Wi-Fi roaming (its usage by your employees)?  
On a scale of 1 (not important) to 5 (very important);**

	1	2	3	4	5
Regional Roaming (Free)					
National Roaming (Free)					
Global Roaming					

**How would you like to be charged for global Wi-Fi roaming? What compensation do you think would be convenient for you?**

- Usage based (per minute, e.g. 5-10 cents per minute)  
 Monthly subscription (unlimited, pay only for the month that you use the service, e.g. 15-20 euros per month)  
 Other:

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**What is the current technology used in terms of data access in-building and outdoors on-site?**

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**Are you satisfied with your current wireless solution?**  YES  NO

**What makes the solution valuable and keeps you satisfied?**

- Technical support  
 Price  
 Value added services  
 Other:

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**Have you ever faced any problems? How are they solved?**

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**What limitations may be keeping WLAN from becoming your primary enterprise access network?**

- Security
  - Cost
  - Bandwidth
  - Speed of access
  - Already having a large wired network
  - Other:
- 

**Which of the following applications are you using on your wireless network? And which applications would you like to use on the network that you currently don't/can't?**

In use		Want to use
<input type="checkbox"/>	Business applications (Data)	<input type="checkbox"/>
<input type="checkbox"/>	Guest access	<input type="checkbox"/>
<input type="checkbox"/>	Digital video	<input type="checkbox"/>
<input type="checkbox"/>	Voice over WLAN	<input type="checkbox"/>
<input type="checkbox"/>	Coverage in outdoor areas	<input type="checkbox"/>
<input type="checkbox"/>	Video surveillance	<input type="checkbox"/>
<input type="checkbox"/>	Lync conference communication	<input type="checkbox"/>
Other:		

**I might/would like to have;**

- Cloud based workstation service, CPU, HDD, RAM
- Cloud based SW, monthly payment
- Immediate technical support

**I would like to see**

- Anvia providing cellular services to its customers, one-stop shop
- Filtered internet connectivity for the employees' devices

**Are there any applications/SWs that you want to have but don't want to purchase as it is expensive?**

**What do you think about employees using their own devices to connect corporate network? Do you consider outsourcing support for security related issues?**

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**Would you consider switching your solution provider if another one offered a better service?**       YES       NO

**Are there any obstacles preventing your firm from migrating to a newer or better infrastructure (operator)?**

- Management costs
- Security issues
- Reliability concerns
- Troubleshooting issues
- Ongoing Contract
- Other:
- No concerns preventing migration

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**What is the effect of WLAN usage in your business?**

- Employees/Customers Satisfaction
- Customer attraction
- Increase in Sales
- Provides competitive advantage by using wireless technologies
- Convert downtime into productive time by allowing real-time access to corporate resources
- Other:

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**In case of a bundled service package, what kind of services would you like to have along with the main service offering?**

- Firewall Service
- Mobile and Corporate Security
- Office 365, E-mail and Office programs
- Backup Service
- PBX Services
- email services
- WEB services
- Other:

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**Do you consider paying extra for the service offering that satisfy your needs?**       YES       NO

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**Which wireless access solution do you think is the best choice for the company, WLAN or Cellular? In terms of which advantages?**

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**Through which channels would you like to be reached and informed about Anvia's service offerings?**

- Key account managers, by phone, email or an appointment
- Short video clips describing a specific product or service offering
- Newspapers & Magazines:
- Seminars, being invited by Anvia
- Others:

**How do you get informed on Anvia's service offerings?**

**On a scale of 1 (not important) to 5 (very important); , rate the importance of the following factors when considering a wireless network solution**

	1	2	3	4	5
Reliability					
Security					
Additional services (e.g. URL redirection)					
Cost of deployment					
Ongoing system management costs					
Speed connection					
Ease of deployment					
Reputation of vendors					
Recommendations of peers					
Technical Service Support					
Regional Roaming					
National Roaming					
Global Roaming					
Roaming between wireless networks					

<b>Current usage of WI-FI in company</b>	
<b>Number of APs</b>	:
<b>Number of SSIDs</b>	:
<b>Reason of multiple usage</b>	:
<b>How many are inside firewall?</b>	:
<b>Supplier</b>	:
<b>Total Cost (investment and monthly cost)</b>	:
<b>Service Offering</b>	:
<b>Free words:</b>	