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WLAN point to point Wireless Bridges

An Experimental Investigation

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1 INTRODUCTION

Cabling is the most common method used for the networking of computers and peripheral devices, but frequently it is not the cheapest or flexible option. This is especially true if offices spread over several building. In this case, the operation of wired networks is very time-consuming and therefore not reasonable from an economic viewpoint.

WLAN technology permits the cost-effective and simple implementation of point-to-point connections. Using the well-known technology 802.11abg, a maximum gross throughput of 54 Mbps can be achieved at the bridge links.

The new 802.11n technology makes the advantages of higher data transmission rates or distances also available for bridge links. This is achieved by the transmission of two separate data streams. Beside the n access point, a dual polarization antenna enables to transmit two separate partial streams from one location to another. Compared to the previously applied technology, the gross data rates are nearly increased by a factor of 6, now achieving up to 300 Mbps.

The advantages supplied by the 802.11n technology are particularly relevant at distances of up to 5 km. In a practical application, it was possible to achieve a net throughput rate (TCP/IP) of 75 Mbps at a distance of 900 m. Bintec access points permit the encryption of the transmitted data via IPSec. The accelerator chip is a standard component of the device and permits data transmission rates of up to 90 Mbps.

The Equipment is provided with a Quick Installation Manual and DVD necessary to install and run the experiment. The most important features that needs to be studied with regards to installation and configuring the experiment are detailed.

1.1 Project Outline

The project has been documented in two chapters. Chapter 2 deals with the basic installation and configuration from guide book. Chapter 3 deals with advanced software configurations using Interactive Lab Assistant DVD for formation of a WLAN bridge.

The Project hardware needs to be setup to run the experiment according to the instruction manual for setting up the stands till fixing the access points on top of it which are attached to the dual polarized antennas.

2 QUICK INSTALL GUIDE BOOK CONFIGURATION

2.1 Introduction

This section details briefly about the safety instructions, login credentials, softwares used for monitoring and locating the access points.

2.1.1 Safety Notices

The safety precautions brochure tells the necessary things to consider while using access point.

2.1.2 Credentials

In order to login to the access points after configuring the hardware setup and installing the needed software, use the predefined login credentials defined by funkwerk which are as follows:

Username: Admin

Password: funkwerk

The credentials need to be changed as soon as possible to prevent unauthorized access as all devices have same credentials.

2.1.3 WLAN Management

WiLMA Wireless LAN Management is a software applications in a client/server architecture that allows to centrally monitor, control and maintain funkwerk access points in medium and large wireless LAN's.

2.1.4 Dime Manager

Dime Manager is a .Net based application that is supported by funkwerk devices, and offers easy to use functions and an overview of the devices in the network, their parameters and files. SNMP multicast is used to locate the devices in the network irrespective of the IP address assigned by the DHCP server. A new configuration can be initiated over HTTP or TELNET.

The Dime Manager tool allows you to do the following operations:

- ✓ Locate Funkwerk Devices
- ✓ Assign new IP Addresses
- ✓ Logs into devices on behalf of user while using HTTP

2.2 Installation

The device can be fitted with various antenna systems. External, screw-on standard antennas can be used. The access points of the bintec WI series can be mounted on a mast (indoor and outdoor environments) or DIN rail (indoor environment). When setting up and connecting, carry out the steps in the following sequence:

- ✓ Antennas

External standard antennas must be positioned and screwed up on the connections provided. If two antennas are connected there must be atleast 6cm or 12cm apart.

- ✓ Installation

The access points needs to be fitted to the wall using brackets on the housing or can be used as a table-top device.

In our experiment the Antennas are attached to the access points which are placed on stands on both the transmitter and receiver in LOS. They are mounted based on the instruction manual which is included in the equipment manual.

- ✓ LAN

The device can be configured via Ethernet ports. If the LAN wire is connected to port ETH1 or ETH2, the device automatically detects the port it is connected to and a LED is set on the device for that port respectively. If one port is used for connection the other port can be used for cascading purpose to create a bigger network.

- ✓ Power Connection

Connect the devices to the mains socket using the main adaptor supplied. Plug the device into a 100-240V socket and when connected the LEDs signal the power connection status on the device. When the device is connected to LAN

via ETH1 or ETH0, device automatically detects the LAN/Switch and is shown on the LED status.

✓ **Configuring via Console**

The serial interface of the gateway (console) can be connected to the serial interface of your PC (COM1 or COM2) as an alternative option for configuring the device.

2.3 Basic Configuration

The device basic configuration can be done with the usage of Dime Manager (IP Address assignment) and the Funkwerk Configuration Interface.

Basic configurations required based on the availability of DHCP server are shown below. In the experiment done, the college has a DHCP server and assigns an IP address when it is connected to an access point via a switch.

Note: The netgear switch used in the experiment doesn't have a DHCP server.

Funkwerk switches that were needed for the experiment had inbuilt DHCP server in the switch.

2.3.1 Pre-Configured Data

There are three ways of accessing the device in the network to perform configuration tasks which are described as follows:

✓ **Dynamic IP**

If DHCP Server is available then the device by default is set to DHCP Client Mode, i.e. the device is automatically assigned an address by the DHCP server which is used to access the device.

✓ **Fallback IP**

If there is no DHCP server, connect the device to the configuration PC directly and then it can be reached by using the predefined fallback IP configuration:

IP Address: 192.168.0.252

Net Mask: 255.255.255.0

✓ **Assigning Fixed IP (Using Dime Manager)**

Dime Manager enables to assign new IP Address to the device.

Note: If Fallback address is assigned, it is overridden and a new IP address can be assigned. If DHCP address is assigned, it cannot be overridden.

2.3.2 Software Update

The software needed for operation can be updated in software and configuration settings as the device contains the software available at production time. Open Funkwerk Configuration Interface using the Maintenance ->Software and Configuration menu.

2.3.3 System Requirements

System Requirements for running the software are as follows.

- ✓ Microsoft Windows operating system Windows 2000 or higher
- ✓ Internet Explorer 6 or 7, Mozilla Firefox Version 1.2 or higher
- ✓ Installed network card (Ethernet)
- ✓ CD ROM drive
- ✓ Installed TCP/IP log
- ✓ High colour display (more than 256 colours) for correct representation of the graphics

2.3.4 Preparations

The necessary steps for configuration involve:

- ✓ Obtaining the data required for the basic configuration
- ✓ Checking the system requirements of the configuration PC

Gathering Data

The data required for the basic configuration can be gathered and is needed for the following purposes:

- ✓ IP configuration (mandatory)
- ✓ Optional: Configuration of a wireless network connection in Access Point mode
- ✓ Optional: Configuration of client links in Client Links mode
- ✓ Optional: Configuration of bridge links in Bridge mode

Basic Configuration

It involves the IP Configuration of Access Point that includes

- ✓ IP Address of the access point and Net Mask of the access point

In order to configure a new network you can use the following values:

Table 2-1 IP configuration of access point

Access data	Example value
IP address of access point	192.168.0.252
Netmask of access point	255.255.255.0

2.3.4.1 Optional Configuration

a) Access Point Mode

If the device is run in Access Point mode use the following configuration:

Table 2-2 Configuration of a wireless network

Access data	Example value
Network Name (SSID)	Funkwerk-ec
Netmask of access point	WPA-PSK
Preshared Key	supersecret

b) Access Client Mode

If the device is run in Access Client mode, required client links can be set up using the following configuration:

Table 2-3 IP configuration of access client

Access data	Example value
Network Name (SSID)	Funkwerk-ec
Netmask of access point	WPA-PSK
Preshared Key	supersecret

c) Bridge Link Mode (Configuring Bridge Link)

The bridges in Bridge mode can be configured in two ways either manually or by using bridge link autoconfiguration function. The manual configuration of a bridge link uses the following data:

Table 2-4 Configuration of bridge link

Access data	Example value
Preshared key	bridgesecret
MAC address of remote bridge	00:a0:f9:5a:42:53

The autoconfiguration function can be selected by selecting the Bridge Link Auto Configuration workshop -> Wireless LAN -> WLANx -> Bridge Links -> Add

2.3.4.2 Configuring PC

The necessary configuration of the PC which is required to reach the device via network are detailed below:

- ✓ Make Sure that PC and the device are in the same LAN
- ✓ Make sure that the TCP/IP protocol is installed on the PC.
Go to Control panel->Network and Internet Connections. Select LAN, then right click properties and look for Internet Protocol (TCP/IP) entry in the list.
- ✓ Select the suitable IP configuration for your configuration PC.
If the TCP/IP protocol is not installed, you can install it by clicking Properties, Install in the status window of the LAN Connection. Select the Protocol entry, Add -> Internet Protocol (TCP/IP) and click OK. Follow the on-screen instruction and restart the PC to finish.
- ✓ If connected to a DHCP server, select obtain IP address automatically and obtain DNS server automatically.

2.3.5 IP Configuration

- ✓ When connected to a DHCP server (switch), the device is running a DHCP Client mode and the device acquires the IP address automatically. If not, the device is connected to PC and configured using fallback IP address 192.168.0.252
- ✓ Alternatively, Dime Manager can be used to assign required IP address.

2.3.5.1 Dime Manager

The Dime Manager is used to configure the IP manually.

- ✓ Detects device automatically, if it is in the same LAN up to a certain range.
- ✓ Open Dime Manager, select the device needed to be configured
- ✓ Successively, select Device and Configure to change device configuration.

2.3.5.2 Funkwerk Configuration Interface

Log on to the device using device IP in the browser.

- ✓ If DHCP Server, enter the IP address that is automatically assigned.
- ✓ No DHCP Server, Connect to the PC directly and use the fallback IP 192.168.0.252.
- ✓ Enter the login credentials User: admin and Password: funkwerk

2.3.6 Modify System Password

As all devices are provided with the same password, it is essential to change the password for security purposes which can be configured as follows:

- ✓ Go to System Management -> Global Settings-> Passwords
- ✓ Enter a new password under System Admin Password
- ✓ Enter the new password again under Confirm Admin Password
- ✓ Click OK and save the configuration

2.3.7 Setting up Wireless Network

A wireless network needs to be setup if the device is run in an Access Point mode which is detailed as follows:

- ✓ Go to Wireless LAN -> WLANx -> Radio Settings -> Screw symbol
- ✓ In Operating Mode, select Access Point
- ✓ Keep the default settings and OK
- ✓ Go to Wireless LAN -> WLANx -> Virtual Service Sets -> Screw symbol
- ✓ In Network name (SSID) enter, for example, Funkwerk-ec
- ✓ In Preshared Key enter, for example, supersecret
- ✓ Keep the default setting and click OK

2.3.8 Setting up Bridge Link

When the device is run in Bridge mode, a bridge link is needed to be established.

Bridge Link Auto configuration can be done by the following:

- ✓ Go to Wireless LAN -> WLANx -> Radio Settings -> Screw symbol
- ✓ Select Bridge in Operation mode
- ✓ Keep the default settings and select OK
- ✓ Go to Wireless LAN -> WLANx -> Bridge Links -> New
- ✓ In Preshared Key enter, for example, bridgesecret
- ✓ Keep the default settings and click OK
- ✓ Configure a bridge link in the same way

- ✓ In the PC selected the option in the list in Wireless LAN -> WLANx
->Bridge Links
- ✓ Click Scan under Actions which will result a list.
- ✓ Click on select for the desired entry.

In order to use the bridge link autoconfiguration function, proceed as described in the Automatic Configuration of a Bridge Link workshop and read the Wireless LAN chapter of the user's guide under WLAN1 -> Bridge Links -> Add.

Manual configuration can be done by the following procedure:

- ✓ Go to Wireless LAN -> WLANx -> Wireless Module Settings -> Edit.
- ✓ In Operation Mode, select Bridge
- ✓ Keep the default settings and click OK
- ✓ Go to Wireless LAN -> WLANx -> Bridge Links -> screw symbol
- ✓ In Preshared Key enter, for example, bridgesecret
- ✓ For Remote MAC address, enter the MAC address of the bridge to which your bridge is to set up a connection, e.g. 00:a0:f9:5a:42:53
- ✓ Keep the default settings and click OK
- ✓ Configure the bridge link in the remote device in the same way

2.3.9 Software Update

The software needed for operation can be updated in software and configuration settings as the device contains the software available at production time. Open Funkwerk Configuration Interface using the Maintenance ->Software and Configuration menu.

2.4 Reset

The device can be configured to its default settings by pressing the RESET button which is located at the bottom of the device by proceeding as follows:

- ✓ Switch off the device and press the Reset Button
- ✓ Keep the Reset button on your device pressed down and switch the device back on
- ✓ Look at the LEDs:
- ✓ The Power and Status LEDs come on first.

- ✓ The LEDs Eth 1 Eth 2 and SFP then flash if these exist for the ports that are connected.
- ✓ The device runs through the boot sequence.
- ✓ After the Status LED has flashed five times, release the Reset button.
- ✓ On devices of the WI series, the red Failure LED comes on first. Hold in the Reset button until the red LED goes out and the green Status LED starts to flash.

2.5 Technical Data

Technical Specifications of various components are described. Most importantly are LED's and Antenna connectors which needs to be studied before progressing with the project.

2.5.1 LEDs

The device is provided with a LED indicator which is use to depict radio status, radio activity Ethernet activity and LED states of the device:

Table 2-5 LED status display

LED	State	Information
State	off	The power supply is not connected. If other LEDs are on, also Error.
	on (static)	Error
	on (flashing)	Ready
WLAN (1/2)	on (flashing slowly)	Free
	on (static)	At least one client is registered.
	on (flickering)	At least one client is registered and there is data traffic.
	on (flashing fast)	BLD (Broken Link Detection) active
	on (flashing fast)	5 GHz scan active
ETH 1/2	off	No cable or no Ethernet link

2.5.2 Antenna Connectors

There are three antennas attached to the device. – Ant1, Ant2 and Ant3.

- ✓ Ant1 and Ant2 have transceiver capability which can be used for transmission and reception.
- ✓ Ant3 is only a receiver antenna.

3 LUCAS – NULLE LABSOFT

WLAN Bridgelink Radio Trainer is the software that has details concerning equipment details, fundamentals, planning, installation of network components, configuring of WLAN routers, use of standard tools and measuring instruments for installation.

3.1 Equipment

The equipment necessary for the experimentation process are detailed as below:

- ✓ 2 Dual Polarized Antenna
- ✓ 4 x Connecting leads
- ✓ 2 * 802.11n access points
- ✓ 2 * Stands
- ✓ 2 * Switches with POE (Power over Ethernet)

3.2 Fundamentals

Need for WLAN has been discussed along with the technology and specifications of various WLAN Technologies. Fundamentals about the following have been discussed in brief:

- ✓ IEEE 802.11 Protocols
- ✓ EIRP (Equivalent Isotropic Radiated Power)
- ✓ Fresnel Zones

3.3 High Performance wireless (WLAN) bridge

The experiment uses Dual-polarized antenna. While Surge suppression and Low-loss antenna cables are used when the equipment is installed outdoors.

A brief description about them is detailed below:

3.3.1 Dual Polarized Antenna

- ✓ 5GHz, suitable for Directional Links.
- ✓ IEEE 802.1n equipment compatibility.
- ✓ 20dBi Gain.
- ✓ Output has beam width of 10 degree.

- ✓ Gross Data Rate is 300 Mbits/s for a distance of 800m and 150 Mbits/s for distance of 2km.

3.3.2 Surge Suppression

A surge protector (or surge suppressor or surge diverter) is an appliance or device designed to protect electrical devices from voltage spikes. A surge protector attempts to limit the voltage supplied to an electric device by either blocking or shorting to ground any unwanted voltages above a safe threshold. Surge suppressors are used to suppress peak voltages from external sources like lightning.

- ✓ Preferable to install surge suppressors at a point when cable enters the building.

3.3.3 Low Loss Antenna Cables

Low Loss Antennas cables have more performance and are used for operating installations in outdoor environment.

3.4 Ethernet switch with PoE capability

The supplied Fast Ethernet PoE switch is a multi-port switch, which can be used to set up high-performance, switched workgroup networks. The switch allows for store-and-forward switching and short latency times for high-speed networks. The equipment detects which devices are connected to which port thereby enabling fast data transmission and preventing duplicate data transmission.

- ✓ If the device is connected to a POE port on the switch, then there is no need of external power connection.

3.5 DHCP

- ✓ Dynamic Host Configuration Protocol (DHCP) is a client/server protocol that automatically provides an Internet Protocol (IP) host with its IP address and other related configuration information such as the subnet mask and default gateway.

- ✓ The intelligent Ethernet switch supplied has its own integrated DHCP server, which is disabled by default.
- ✓ In the experiment done, the college network has a DHCP server located and once connected to the internet, the devices are automatically assigned IP addresses.

3.5.1 Configuration of DHCP server

Steps to configure the switch's integrated DHCP server are described:

- ✓ Connect switch to PC
- ✓ Check LED status on device to check for proper connection

3.5.1.1 Configuration of Switch via web page

- ✓ Connect one port from switch to the internet and two port to each of the access point. This creates a LAN between the access points and the PC via switch.
- ✓ There is a console located at the bottom of the access point which is used to login to it.
- ✓ Once we login to the device i.e. access point console, we can configure it to the necessary settings. Repeat on the other access point.

3.6 Measurement and Analysis

- ✓ Calculate the distance between the radio links by using the tool computed using excel.
- ✓ Once the network is established, there are signals that can be transmitted over the established radio link.
- ✓ The detection software installed on the PC detects the amount of radiation received on the receiver to the transmitted signals.
- ✓ The software does a comparative analysis of the received signal to those transmitted in terms of various parameters and displays the output as a graph.
- ✓ Further analysis can be computed based on the results obtained.

4 PROBLEMS

Problems encountered during the course of the project are detailed below:

- ✓ Missing Hardware – Cables, Switches
- ✓ The experiment needs to switches which is used to create a two networks and then transmission from one to another. Due to non-availability of equipment, everything was set into a single network.
- ✓ Lack of availability of cable to login to device console.
- ✓ Project meetings scheduled with the availability of both mine and professor availability.
- ✓ Internet connectivity and help from IT help desk was not as quick as it was needed for project progress because of Christmas time.