Ericsson W25
Fixed Wireless Terminal for WCDMA/HSPA Mobile Networks

Application Note:
Fax over IP with Ericsson W25

ERICSSON ⊜

Contents

1   Introduction

This document gives a brief description of the Fax over IP and the implementation in the Ericsson W25. It also includes a guidance of how to configure the Ericsson W25.

1.1   Background

The Ericsson W25 is intended for residential and SOHO applications. The focus for the Ericsson W25 is to enable both broadband data and voice calls using existing 3G network. Additionally support for analog Fax operation is essential when targeting business users such as SOHO users.

Fax support in GSM mobile networks is standardized, but not in 3G mobile networks. The available options in 3G mobile networks are T.37, store and forward mailbox, or T.38 Fax over IP. Since Fax communication is considered legally binding when doing business, the demand on Fax operation is that the sender of a Fax can get a receipt that the fax has been delivered to the recipient in real-time. Therefore, Ericsson has chosen Fax over IP (T.38) using packet switched connection in the Ericsson W25 to enable Fax operation in 3G mobile networks. This, since it is the only option that can guarantee that a fax has been delivered to the recipient in real-time. This can be done thanks to HS(D)PA introduced in 3G mobile networks with features such as increased data bandwidth and reduced delay.

2   System Overview

Fax over IP is based on Voice over IP. The Voice over IP system utilizes IP technology over broadband networks and uses SIP for control signaling and RTP for media. The differences between Fax and Voice are the codecs. For voice the normal voice codecs are G.711, G.729, AMR etc, but T.38 is used for fax. The voice and fax media are both sent in RTP packets.
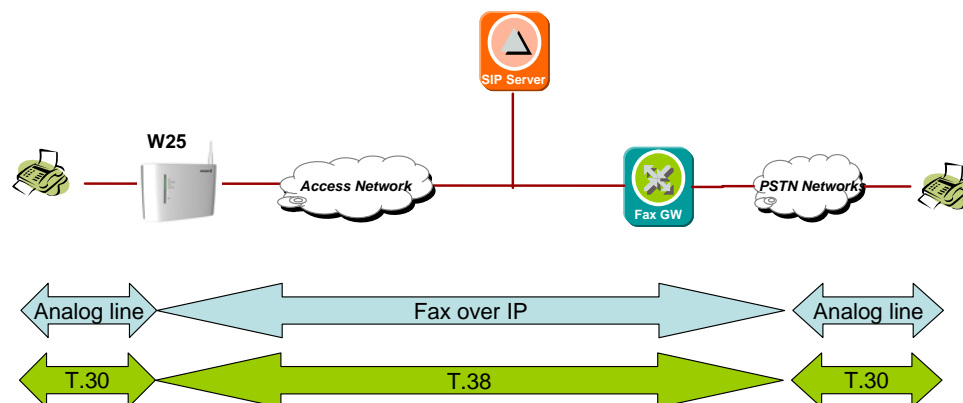

Figure 1 - Typical network for VoIP running Fax (T.38)

The fax machines still use the analog interface and the T.30 fax protocol. In the picture above one fax is connected to the dedicated fax port on the Ericsson W25 and the other fax to the PSTN.

The Ericsson W25 has a SIP User Agent associated to the fax port. The User Agent registers in the SIP server. The User Agent originates and terminates the FoIP (Fax over IP) calls and use the SIP protocol to manage and control the media streams (T.38). T.38 enables real-time facsimile communication over an IP network.

W25 does NOT support fax in clear channel i.e. G.711. This is not feasible due to, primarily, lack of phase-synchronization between the endpoints. It may be possible to transmit shorter fax messages but the method would not be proven robust enough to be useful.

2.1   The Fax over IP solution

To enable a fax call a SIP server and PSTN gateway is required. There is actually no need for extra features more than a basic call, i.e. no supplementary services are required.

The SIP server needs to support SIP according to RFC 3261 and the Fax gateway needs to support SIP and T.38. In addition to this the operator might have requirements on charging etc, which is not taken into account in this document. There are several products on the market which fulfill the basic requirements.

2.2   VoIP network

The basic building blocks for Voice and Fax over IP are a SIP server and a PSTN gateway with T.38 support. Sometimes the PSTN gateway might consist of two units; Media Controller and Media Gateway. Normally a Session Border Controller (SBC) is used to handle security.
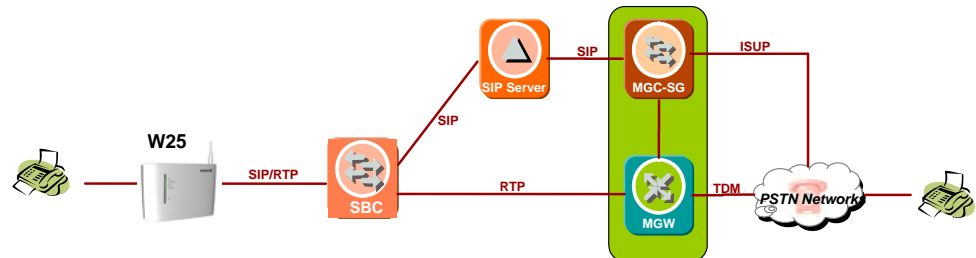
2.2.1   SIP Server

The SIP server is the heart of VoIP system. It keeps track of the location of each User Agent (UA). Calls are routed through the server. Each User Agent has to authenticate to the server.

2.2.2   PSTN Gateway

The PSTN Gateway can be one single unit or divided in a Media Gateway Controller (MGC), including the Signaling Gateway (for SS7/ISUP connectivity), and the Media Gateway (MGW). Divided or not the functionality is the same.

To be able to send fax between FWT and Fax machines on PSTN, each User Agent in a FWT has an associated E.164 number in the PSTN. The interworking between PSTN and VoIP is done in the PSTN gateway. Note that the Fax E.164 number is separate from the E.164 number associated with the SIM card in the FWT. So there is one E.164 number for fax and another for voice.

2.2.2.1   Media Gateway Controller (MGC)

The Media Gateway Controller (MGC) provides interworking between the SIP session control signaling and ISUP call control signaling to/from external PSTN/PLMN networks. Furthermore, it controls the Media Gateway resources.

The MGC normally provides the following capabilities:

- Handles multimedia session establishment, modification, and termination using the SIP protocol in the IP Multimedia domain and appropriate ISUP protocol in the circuit switched domain.

- Supports addressing and routing of multimedia sessions to and from SIP server and interconnected PSTN nodes.

- Controls one or more Media Gateways.

- Performs mapping of application level signaling (SIP/ISUP).

2.2.2.2	**Media Gateway (MGW)**

The Media Gateway (MGW) provides interworking between PSTN and IP media streams, i.e. conversion between circuit-switched TDM (Time Division Multiplexing) bearer circuits and packet-switched media streams (RTP).

2.2.3 Session Border Controller (SBC)

The SBC can also be called outbound proxy, which normally is a SIP aware proxy/stateful firewall. If an SBC is used in the network, the User Agent has to be configured to use the SBC for all SIP sessions. Usually the SBC is placed together with the firewall so the only way in to the SIP server is through the SBC. An SBC can also overcome problems with NAT in the network.

2.3 Fax Call Setup

The picture below shows the SIP signaling during a fax call.

When sending a fax from a fax-machine connected to the W25, the off-hook status as well as the called number (B-subscriber)is detected by the W25. This is included in a INVITE-message which is sent to the SIP server.

The SIP server forwards the INVITE to the appropriate fax gateway, which then calls subscriber B on the PSTN. When the B subscriber answers, a voice call is setup using the voice codec G.711. At the same time as the B Fax answers, it starts sending out CED (called station identification) tones, which is detected by the Fax gateway. Now the Fax gateway sends a re-invite to use T.38 protocol instead of voice codec G.711. The normal fax training, e.g. negotiating fax transfer speed, is done using the T.38 protocol. After the training, the pages are transferred and then the faxes go on-hook, which then results in a SIP BYE message.
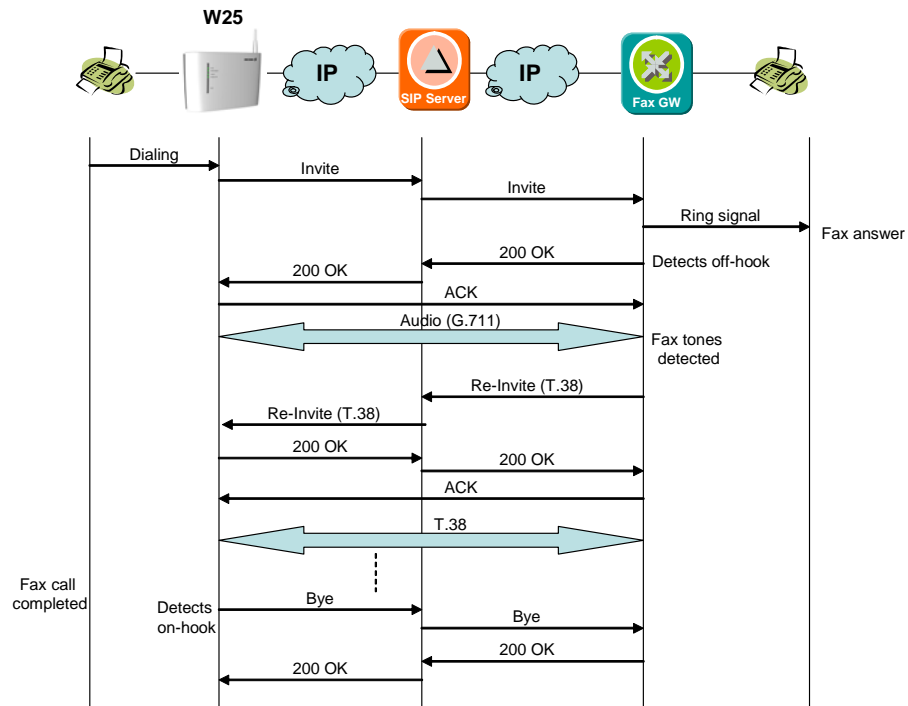
2.4 T.38 and T30 Protocol

There are two protocols used to transfer a fax over IP; T.30 [2] and T.38 [3].

T.30 is the protocol that describes the communication process between two fax machines on a circuit-switched network.

T.38 is the protocol that describes the process for sending and receiving fax in real-time over a packet network. The protocol makes adjustments for delay, jitter, and dropped packets, which comes with the characteristics of IP networks and radio networks. Since Fax devices are sensitive to timing it would not be reliable to send and receive faxes over an IP network using a normal voice codec e.g. G.711.

The gateway (MGW/MGC) receives T.30 data from the fax (PSTN-side), converts the data to IP-packets, wraps it in T.38 packets, and sends it to the destination, over the IP network.

The MGW/MGC works the other way round as well, receives the T.38 data from the IP-network, un-wraps it to T.30-data, and converts and forwards it to the PSTN-side.

Since T.30 data is encapsulated in T.38 packets, the same protocol used for faxing over traditional circuit switched networks, remains for every IP fax connection. Thus it's important to have a high level of T.30 interoperability to be able to communicate with legacy fax devices.

The normal bandwidth for the T.38 protocol is approx 30 kbps, but depending on configuration it can be up to 80 kbps.

2.5 Access Network

The access network used for transmitting fax pages to and from the Ericsson W25 is the WCDMA/HSDPA Radio access network and belonging core network.
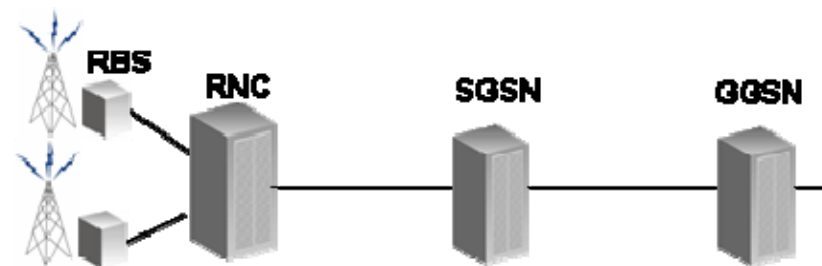
IP packets are sent in packet switch data channels over the radio network. To increase the success rate of fax calls it's important to have a connection with as little as possible latency and jitter since, despite T.38, Fax devices are sensitive to timing. WCDMA is a minimum requirement, but it's recommended to have a HSPA connection since this reduce the latency and jitter. Future radio network improvements, mainly regarding QoS, the fax transmission success rate will further improve.

3 Ericsson W25

The Ericsson W25 will work as a gateway, using T.38 protocol. The fax terminal shall be connected to the dedicated fax port on the Ericsson W25. Associated to this fax port is a SIP User Agent, which manages and controls the media streams by using the SIP protocol (RFC 3261) towards the SIP server and the PSTN Gateway.

Depending on configuration, Fax calls between two FWT on the same radio networks can be sent directly between the FWT's not using the PSTN.

3.1 Signaling

The Ericsson W25 conforms to the SIP protocol according to RFC3261.

3.1.1 Details over the SIP Implementation

The Ericsson W25 supports:

- SDP according to RFC 2327.
- SDP usage according to RFC 3264.
- Media "hold" by using destination address 0.0.0.0
- Configuration of SIP message timers T1, T2 and B as defined in RFC 3261.
- URI for fax calls, RFC 3966.
- PRACK method according to RFC 3262.
- Session timer, RFC 4028.

3.2 Security

The Ericsson W25 authenticates towards the VoIP system using the HTTP Digest Authentication mechanism.

3.3 Media Stream

Due to the procedure of setting up a fax call both G.711 and T.38 is supported by the Ericsson W25. The W25 requires that the call is first setup as a normal voice connection (using G.711) before a switchover from voice to T.38 fax is done with SIP Re-INVITE practices.

3.3.1 Jitter Buffer

One important function in the Ericsson W25 is the jitter buffer, which is necessary to have due to the latency and jitter in the IP network. The access network contributes with most of the latency and jitter, so to reduce this a HSPA connection is recommended.

3.3.2 Echo Canceller

To improve the fax transfer the Ericsson W25 also has an echo canceller in accordance with G.168.

3.3.3 QoS

The outgoing VoIP related traffic will be prioritized before other traffic from the Ericsson W25 to reduce the uplink delay and jitter.

3.4 Interoperability

The Ericsson W25 is interoperable with e.g. Broadsoft, which is included in Ericsson's IMT (IMS Multimedia Telephony). Other SIP servers and Fax gateways should also work as long as they support SIP v2 (RFC 3261) and T.38, but interoperability testing needs to be done to verify this.

For more information on Ericsson's IMT see ref [1].

4 W25 Configuration

For configuration purpose, the Ericsson W25 includes a CLI (Command Line Interface) and a WUI (web user interface) which are accessible as illustrated in the figure below.
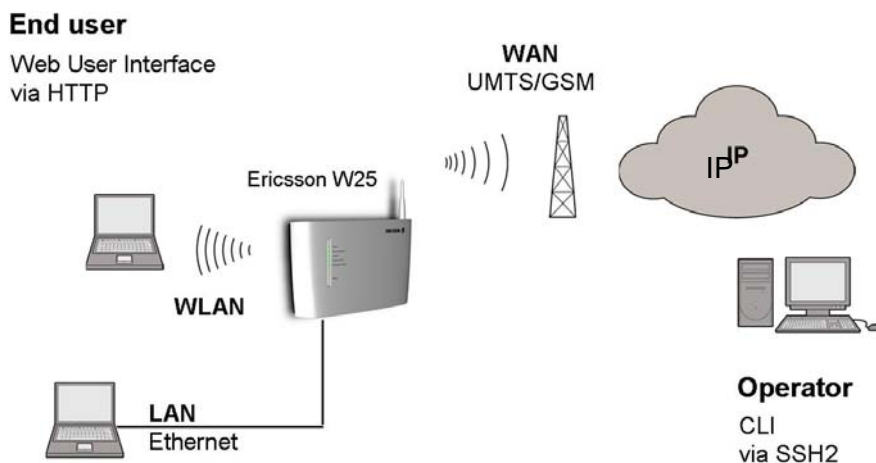
Please also see the document "Ericsson W25 Administrator's Guide" for more details on Ericsson W25 configuration.

4.1 Fax service

To configure the Fax service in the W25 the CLI is used. It can either be done remotely via SSH or via telnet locally with operator or root user access.

Normally two parts need to be configured in the W25:

- IMS User Agent (the local client credential)

- IMS Call server (remote SIP server(s))

In addition to this it also might be needed to fine tune the T.38 codec depending on the remote fax gateway. This is done in "IMS media codec".

4.1.1 IMS User Agent

The IMS (SIP) User Agent is associated to the fax port on the Ericsson W25. This integrated User Agent controls the VoIP sessions and manages and controls the media streams by using the SIP protocol towards the SIP Server and Media Gateway.

To configure the User Agent you need:

- authentication id, which is used for authentication and is usually the same as user id, but sometimes with domain name e.g. xxxxx@domainname.com

- user id , which is the public user identification e.g. the phone number xxxxx

- password, which is the password for the user id

4.1.1.1 CLI commands

The W25 has already one User Agent configured by default, so this needs to be modified. The commands to modify are:

```
cf set ims.user_agent[0].auth_id <auth_id>

cf set ims.user_agent[0].user_id <user_id>

cf set ims.user_agent[0].user_password <password>
```

The command to save the new configuration is:

```
cf commit
```

To display the entries in the user account list, use the following command:

```
cf show ims.user_agent

ims.user_agent[0].auth_id "user.grp"
               .user_id "54321"
               .user_password "mysecret"
               .ims_callserver_index 1
```

The last parameter "ims_callserver_index" is referring to the configuration of IMS Call Server, which will be described below. Normally you do not need to change this.

4.1.2 IMS Call Server

Here you configure the IMS/SIP server(s) address (IP or FQDN), and possibly an outbound proxy.

The SIP-server address configuration is mandatory while the outbound proxy is optional, depending on network configuration.

The outbound proxy is usually an SBC (Session Border Controller) e.g. IMS P-CFCS

4.1.2.1 CLI commands

The W25 has already one IMS Call Server defined with default values, but the SIP proxy and outbound proxy addresses (IP or FQDN) need to be modified. The commands for this are:

```
cf set ims.callserver.proxy[0].address <sip proxy>

cf set ims.callserver.outbound_proxy <outbound proxy>
```

The command to save the new configuration is:

```
cf commit
```

Note if the proxy[x].address is set to "localhost", the W25 will not register to any SIP server.

To display the entries in the call server, use the following command

```
cf show ims.callserver
```

```
ims.callserver[0].domain "server.com"
                .proxy[0].address "host.server.com"
                        .port 5060
                .outbound_proxy ""
                .local_ip_interface "ppp0"
```

The domain parameter is for future use. The proxy[x].port is by default 5060 (according to the SIP standard). The port number only needs to be changed in special case.

In a normal scenario the SIP server is accessible via the WAN interface, but for test and demo purposes it's possible to use a SIP server which is connected on the LAN interface. To change this you need to modify "local_ip_interface" from "ppp0" (WAN) to "br0" (LAN).

4.1.3 IMS Media Codec

The IMS Media Codec commands configure the settings for T.38.

4.1.3.1 T.38 Settings

The settings for T.38 are used for Fax. The following parameters can be configured:

Table 1   T.38 configuration parameters

Parameter	Description
`forward_error_correction`	Specifies if FEC (Forward Error Detection) should be used or otherwise Redundancy packets will be used. (True|False)
`max_bit_rate`	The max bit rate for fax transmission. Valid values are 2400, 4800, 7200, 9600, 12000 and 14400.
`local_tcf`	Defines whether the tcf (Training Check Flag) should be local i.e. only between the fax machine and the W25 T.30-client or end to end (to the terminating fax machine). If using UDP (default) this parameter should be set to false. (True|False)
`fill_bit_removal`	Capability to remove and insert fill bits in Phase C, non-ECM data to reduce bandwidth in the packet network. (True|False)
`transcoding_mmr`	Specifies whether the ability to convert to/from MMR from/to the line format for increasing the compression of the data and saving bandwidth in the packet network. (True|False)
`transcoding_`	Specifies whether the ability to convert to/from

Parameter	Description
`jbig`	JBIG should be used, (reduces bandwidth). (True|False)
`Ecm`	Specifies if ECM should be used or not. (True|False)
`extended_ roundtrip`	Enables the support of dealing with extended round trip delays (True|False)
`data_wait_time`	This parameter indicates the time for internal buffering appropriate V.21, ECM and non-ECM page data in the case if the end of line or the end of the HDLC frame is not detected. The value range is from 0 up to 100. The default value is to set to 50 which is of 500 ms buffering. One unit is of 10 ms. After the Data Wait Time T.38 starts with the modulation also if not all data is received
`low_rate_ recovery_ packets`	This parameter is used for the Redundancy and the FEC error Correction Mode on a UDP transmission for V.21. The parameter indicates the number of additional recovery data packets send during a low rate Fax transmission (control data). The value can be between 0 and 4.
`high_rate_ recovery_ packets`	This parameter is used for the Redundancy and the FEC error Correction Mode on a UDP transmission for V.17, V.29, and V.27. The parameter indicates the number of additional recovery data packets send during a high rate Fax transmission (image data). The value can be between 0 and 4.

To show the current configuration for T.38, use the following command:

```
cf show ims.media.codec.t38

ims.media.codec.t38.forward_error_correction false
                    .max_bit_rate 14400
                    .local_tcf false
                    .fill_bit_removal false
                    .transcoding_mmr false
                    .transcoding_jbig false
                    .ecm true
                    .extended_roundtrip false
                    .data_wait_time 500
                    .low_rate_recovery_packets 4
                    .high_rate_recovery_packets 1
```

Depending on radio network characteristics, there might be a need for fine tuning T.38.

ECM (Error Correction Mode) may need to be reconfigured since ECM is sensitive for packet loss, it might be necessary to disable this.

It's recommended to not enable "extended_roundtrip", since it has been shown that this cause interoperability problems.

Not all gateways support recovery packets, but then the recovery packets will be ignored. Note that at the same time as the recovery_packets is increase, the bandwidth requirement increase as well. For more details see [3].

4.1.4   VoIP timer

To avoid that the fax port is used as a telephony port using Voice over IP, it is possible to restrict for how long a voice call is allowed. If no fax tones are detected i.e. switching over to T.38, within a certain time the call is closed by the W25. The time is configurable and default value is 60000 ms (60s). If configured to "0", the timer will never expire, i.e. the call will not be closed by the FWT. The parameter name is:

telephony. pots.line_interface[0].voip_session_timeout 60000

5   References

[1] Internal System Description IMT (IMS Multimedia Telephony) 3.01551-HSC 113 03/4 Uen

[2] T.30 Procedures for document facsimile transmission in the general switched telephone network

[3] T.38 Procedures for real-time Group 3 facsimile communication over IP networks

6 Acronyms and Abbreviations

CDMA
Code Division Multiple Access

CLI
Command Line Interface

DNS
Domain Name System

E.164
International Public Telecommunication Numbering Plan as described in the ITU-T Recommendation E.164.

FoIP
Fax over IP

FWT
Fixed Wireless Terminal

GSM
Global System for Mobile Communication

HSDPA
High Speed Downlink Packet Access

HSPA
High Speed Packet Access

HTTP
Hypertext Transfer Protocol

IMT
IMS Multimedia Telephony

IP
Internet Protocol

ISUP
ISDN User Part

LAN
Local Area Network

MGC
Media Gateway Controller

MGW
Media Gateway

PDP
Packet Data Protocol

PLMN
Public Land Mobile Network

POTS
Plain Old Telephone Service

PSTN
Public Switched Telephony Network

QoS
Quality of Service

RAB
Radio Access Bearer

RAN
Radio Access Network

RFC
Request for Comments

RTP
Real-Time Transfer Protocol

SDP
Session Description Protocol

SFQ
Stochastic Fair Queuing

SIP
Session Initiation Protocol

SOHO
Small Office Home Office

SSH
Secure Shell

TDM
Time Division Multiplexing

UA
User Agent

URI
Uniform Resource Identifier

VoIP
Voice over IP

WCDMA
Wideband CDMA

WLAN
Wireless LAN

WUI
Web User Interface

7 Appendix A

This chapter describes the test results for the End-to-End T.38 interoperability tests that has been performed on the T.38 implemented in W25. The list includes all successful fax machines

(The list has the following format: Fax machine, Profile and Speed)

AT/T PPF200 MMR, ECM, 200x100 V.29 9600
Brother 6650MC MMR, ECM, 200x100 V.17 14400
Brother 7150C MMR, ECM, 200x100 V.17 14400
Brother MFC 4600 MMR, ECM, 200x100 V.17 14400
Brother MFC 4650 MMR, ECM, 200x100 V.17 14400
Brother MFC 4550 MMR, ECM, 200x100 V.17 14400
Canon Fax B340 MMR, ECM, 200x100 V.17 14400
Canon Fax TF 301 MMR, ECM, 200x100 V.29 96001
Canon L 777 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass C2500 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass C530 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass C545 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass C555 MMR, ECM, 200x100 V.17 14400
Canon Multi pass C560 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass C755 MMR, ECM, 200x100 V.17 14400
Canon Multi Pass L6000 MMR, ECM, 200x100 V.17 14400
Hewlett Packard Fax 920 MMR, ECM, 200x100 V.17 14400
Hewlett Packard Fax 200 MMR, ECM, 200x100 V.29 9600
Hewlett Packard Laser Jet 3200 MMR, ECM, 200x100 V.17 14400
Hewlett Packard Office Jet MMR, ECM, 200x100 V.29 9600
Hewlett Packard Office Jet 350 MMR, ECM, 200x100 V.29 9600
Hewlett Packard Office Jet 570 MMR, ECM, 200x100 V.17 14400
Lumina 2096 MMR, ECM, 200x100 V.29 9600
Mita LDC 750 MMR, ECM, 200x100 V.17 14400
Monroe MX 4020 MMR, ECM, 200x100 V.29 9600
Muratec F150 MMR, ECM, 200x100 V.17 14400
Muratec F 56 MMR, ECM, 200x100 V.17 14400
Muratec F 90 MMR, ECM, 200x100 V.17 14400
NEC Nefax 480 MMR, ECM, 200x100 V.17 14400
Okidata Okifax 1000 MMR, ECM, 200x100 V.29 9600
Okidata Okifax 2200 MMR, ECM, 200x100 V.29 9600
Okidata OkiOffice 84 MMR, ECM, 200x100 V.17 14400
Panasonic PX 350 MMR, ECM, 200x100 V.29 9600
Panasonic PX 5 MMR, ECM, 200x100 V.29 9600
Panasonic UF 880 MMR, ECM, 200x100 V.17 14400
Panasonic UF V60 MMR, ECM, 200x100 V.29 9600
Ricoh 180 MMR, ECM, 200x100 V.29 9600
Ricoh 3500L MMR, ECM, 200x100 V.17 14400
Ricoh Fax 240 MMR, ECM, 200x100 V.29 9600
Ricoh Fax 3000L MMR, ECM, 200x100 V.29 9600
Sharp FO 5400 MMR, ECM, 200x100 V.17 14400
Sharp UX 1400 MMR, ECM, 200x100 V.17 14400
Sharp UX 3600M MMR, ECM, 200x100 V.17 14400
Toshiba TF 421 MMR, ECM, 200x100 V.29 9600
Toshiba TF 671 MMR, ECM, 200x100 V.17 14400
US Robotics 33.6 Mdl 1172 MMR, ECM, 200x100 V.29 9600
Xerox 3004 MMR, ECM, 200x100 V.17 14400
Xerox 7033 MMR, ECM, 200x100 V.17 14400
Xerox Work Center 250 MMR, ECM, 200x100 V.29 9600
Xerox Work Center 470cx MMR, ECM, 200x100 V.17 14400
Xerox Work Center 480cx MMR, ECM, 200x100 V.17 14400
Xerox Work Center XK50cx MMR, ECM, 200x100 V.17 14400
3 COM EtherLink III LAN 33.6 MH, ECM, 200x100 V.17 14400
AT/T9015PF MH, Non-ECM, 200x100 V.29 9600
AT/T Data Port MH, Non-ECM, 200x100 V.17 14400
AT/T PPF200 MH, ECM, 200x100 V.29 9600
Boca MV34E MH, Non-ECM, 200x100 V.17 14400
Brother 6650MC MH, ECM, 200x100 V.17 14400
Brother 7150C MH, ECM, 200x100 V.17 14400

Brother Fax 190 MH, Non-ECM, 200x100 V.29 9600
Brother Fax 580 MC MH, ECM, 200x100 V.17 14400
Brother Intellifax 2500 MH, Non-ECM, 200x100 V.29 9600
Brother Intellifax 600 MH, Non-ECM, 200x100 V.29 9600
Brother Intellifax 625 MH, Non-ECM, 200x100 V.29 9600
Brother Intellifax 950M MH, Non-ECM, 200x100 V.29 9600
Brother MFC 4600 MH, ECM, 200x100 V.17 14400
Brother MFC 4650 MH, ECM, 200x100 V.17 14400
Brother MFC 4550 MH, ECM, 200x100 V.17 14400
Canon B70 MH, Non-ECM, 200x100 V.29 9600
Canon Fax 750 MH, ECM, 200x100 V.29 9600
Canon Fax B340 MH, ECM, 200x100 V.29 9600
Canon Fax TF 301 MH, ECM, 200x100 V.29 9600
Canon L777 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C2500 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C530 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C545 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C5500 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C555 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C560 MH, ECM, 200x100 V.17 14400
Canon Multi Pass C755 MH, ECM, 200x100 V.17 14400
Canon Multi Pass L6000 MH, ECM, 200x100 V.17 14400
Cardinal MH, ECM, 200x100 V.17 14400
Compaq 9600 PCMCIA MH, ECM, 200x100 V.29 9600
Eiger 14.4 PCMCIA MH, Non-ECM, 200x100 V.17 14400
Gammalink Fax Modem MH, ECM, 200x100 V.17 14400
Global Village Teleport Bronze II MH, Non-ECM, 200x100 V.27 4800
Hayes JetFax MH, Non-ECM, 200x100 V.29 9600
Hayes Optima 14.4 MH, ECM, 200x100 V.17 14400
Hewlett Packard Fax 920 MH, ECM, 200x100 V.17 14400
Hewlett Packard Fax 200 MH, ECM, 200x100 V.29 9600
Hewlett Packard LaserJet 3200 MH, ECM, 200x100 V.17 14400
Hewlett Packard OfficeJet MH, ECM, 200x100 V.29 9600
Hewlett Packard OfficeJet 350 MH, ECM, 200x100 V.29 9600
Hewlett Packard Office Jet 570 MH, ECM, 200x100 V.17 14400
Intel SatisFAXtion 400e MH, ECM, 200x100 V.29 9600
Konica 7310 MH, ECM, 200x100 V.29 9600
Lumina 2096 MH, ECM, 200x100 V.29 9600
Megahertz PCMCIA card MH, Non-ECM, 200x100 V.17 14400
Minolta 3300 MH, Non-ECM, 200x100 V.29 9600
Mita LDC 570 MH, ECM, 200x100 V.17 14400
Mita TC 750 MH, ECM, 200x100 V.17 14400
Mita TC 170 MH, ECM, 200x100 V.29 9600
Monroe MX 4020 MH, ECM, 200x100 V.29 9600
Motorola CELLect 14.4 (FaxTalk) MH, ECM, 200x100 V.17 14400
Motorola Power 14.4 (FaxTalk) MH, Non-ECM, 200x100 V.17 14400
Motorola Power 14.4 (BitFax) MH, ECM, 200x100 V.17 14400
Motorola Power 14.4 (FaxWorks) MH, Non-ECM, 200x100 V.17 14400
Motorola UDS 14.4 (FaxTalk) MH, ECM, 200x100 V.17 14400
Muratec F150 MH, ECM, 200x100 V.17 14400
Muratec F56 MH, ECM, 200x100 V.17 14400
Muratec F90 MH, ECM, 200x100 V.17 14400
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