

# **Fax over IP recommendations**

## **Swisscom Enterprise Customers**

December 2016

# Introduction

---

## The development of fixed-network telephony

As has already been communicated to the public, Swisscom is planning to convert all telephone connections (analogue and ISDN) to the modern IP technology by the end of 2017. With this, Swisscom is pursuing the goal of moving all services to this future-oriented technology. In the future, this will allow conventional services (images, music, documents) as well as voice services and new, high-quality products to be made available to Swisscom customers. The development towards IP fixed-network telephony is a global trend and does not just apply to fixed-network telephony customers in Switzerland.

## What does this mean for the fax?

Since e-mail has become established, the fax has been declared obsolete time and again. Nevertheless, countless analogue fax machines are still in use worldwide today. In Switzerland alone, the figure is still 500,000. In principle, these can continue being used with IP telephony connections – however, as a result of the technology, sending and receiving faxes via IP is more susceptible to errors (see “Technological background” for further information on this). Thus, under certain circumstances, the connection may be interrupted, meaning the document does not reach the recipient.

This decrease in the fax connection quality is unavoidable, as all providers worldwide are currently working on the “All IP” conversion and are all confronted with the same technological obstacles. Customers with international operations above all must therefore be prepared for increased difficulties independent of developments in Switzerland.

## Universal service obligations

Since the market liberalisation of telecommunications in 1998, the regular award of a universal service licence by the Federal State has ensured a sufficient and affordable universal service for the Swiss population. The current universal service licence expires at the end of 2017 and will be renewed for 2018 and the subsequent years. Until now, fax had been a component of the universal service. However, the new Ordinance on Telecommunications Services, which the Federal Council adopted in December 2016, no longer includes fax, as it is the Federal State’s opinion that sufficient substitution options are available. Nonetheless, Swisscom will support the transmission of fax messages via the IP network according to its best effort.

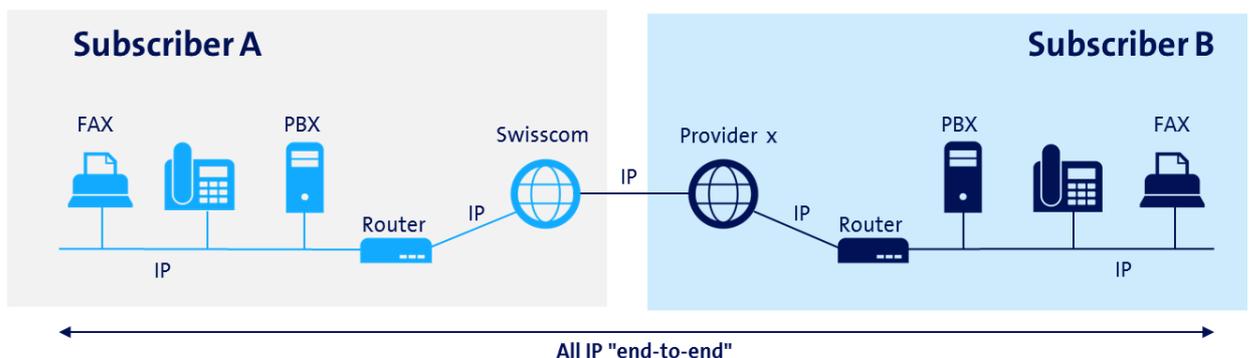
# Technological background

## How is a fax signal transmitted?

From a technological perspective, a fax terminal is an analogue modem that scans information (text, graphics, etc.), converts it to sounds and transmits it on a voice band via a circuit-switched telephone network. The protocol has been optimised for this. If a fax is connected to an IP gateway, these sounds are converted to digital data packages and then transmitted. Technologically, the data transmission in the IP network is always implemented in individual packages. In this process, unexpected package losses can occur for technological reasons. With telephone communications, the impact of these losses is usually minor, as the voice quality simply decreases and the human brain can compensate for this loss of information to a certain degree. However, fax machines are much more sensitive to such disruptions. Missing data packages can result in the transmitted fax document being displayed in an incomplete form or the fax transmission being cancelled entirely. Thus, problems frequently occur when transmitting faxes via IP.

## Influencing factors

Various components play a role on the route between the sender and the recipient:



- Fax machines, fax servers, software-based fax emulations, etc.
- Routers and networks such as LAN (Local Area Network) or WAN (Wide Area Network)
- PBX (telephone switching systems) and gateways (ATA boxes, etc.)
- Connections and telephony or data networks of the telephone provider in question (Switzerland and international)
- Transitions between networks (e.g. from analogue to IP-based or vice-versa)

To ensure successful fax transmission, all of these components must be correctly configured and optimally coordinated with one another – at both the sender's and the recipient's end.

In addition to the components, there are other influencing factors:

### G.711 vs. T.38

As well as the type and configuration of the fax machine, the fax protocol plays a key role for data exchange. Of course, a fax server or software-based fax emulation can also be used instead of a fax machine. In most cases, either the T.38 or G.711 protocol is used. The end points negotiate between themselves which protocol is used. However, not all devices and providers support T.38 and, in practice, compatibility problems frequently occur in the interaction. In such cases, the G.711 protocol is used. With this, the fax signal is transmitted like a voice signal without being compressed and is supported by all devices. However, there is a risk of loss of quality due to IP packages being lost or arriving too late. The more pages a fax has and the longer the transmission takes, the greater the effects of this factor.

### End-to-end QoS

In theory, implementing QoS (Quality of Service) could be useful here. With QoS, data packages can be categorised and prioritised accordingly within an IP network. However, for this it must be possible to implement QoS across the entire transmission route. In practice, this can be ensured only if the faxes are sent within the same company, i.e. if it is possible to monitor the sender as well as the recipient of the fax and the entire route between them. Unfortunately, this is very rarely the case.

### Voiceband Data Mode

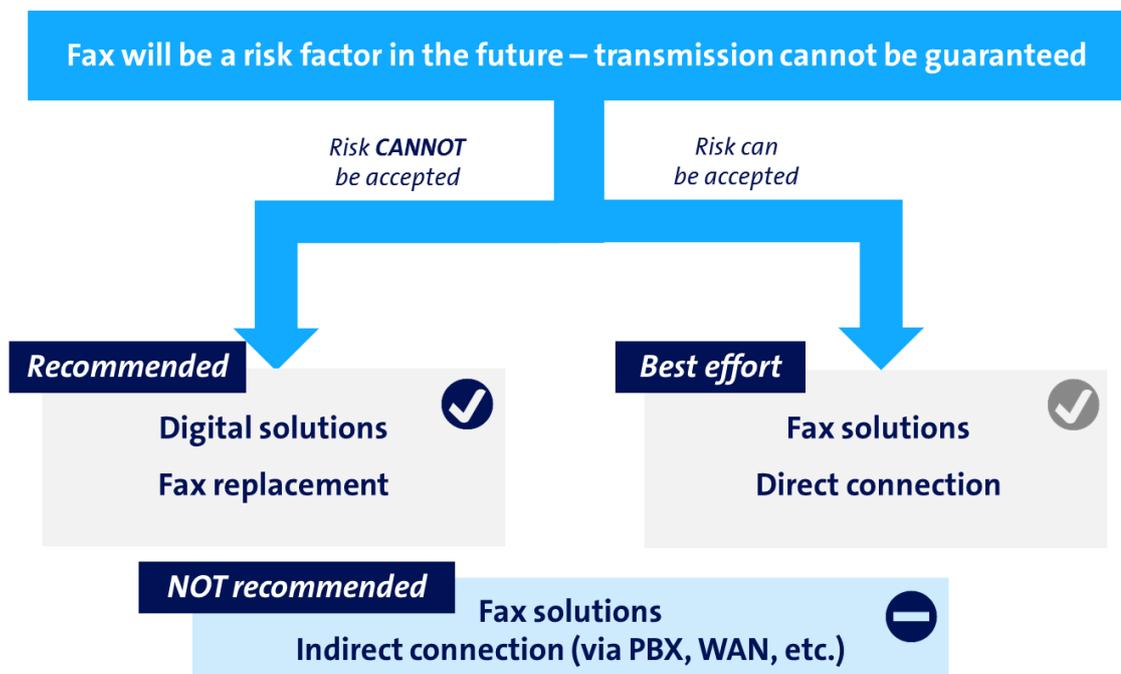
Fax and modem transmission over IP can be improved significantly using what is known as “Voiceband Data Mode (VBD)”. Voiceband Data Mode optimises the properties of a voice channel to the benefit of analogue data transmission. While transmission is generally also possible without VBD, the failure rates are considerably higher. It is therefore important that the components used (routers, gateways, PBX) support VBD; however, this is unfortunately not the case for all telephone switching systems (PBX).

# Swisscom recommendations

## Fax is a risk

Using fax over IP is risky. Changes along the route between the sender and the recipient occur on a daily, and sometimes even hourly, basis. This happens even if customers or their business partners have not made any changes to the devices they are responsible for or to their firmware or software statuses. Practical use shows that, even with successfully tested constellations, following adjustment of a single component (e.g. new ATA box, new software release, re-configuration of the fax on the opposite end), problems with the fax transmission can arise again. Furthermore, the susceptibility to errors increases with the complexity of the customer solution, i.e. the greater the number of components involved in the transmission route. The risk of connection problems will also rise continuously with the increasing global distribution of All IP, entirely independently of developments in Switzerland. Persevering with the current analogue telephony is therefore not a solution in the long term.

Neither Swisscom nor any other provider has the ability to control or monitor all influencing factors from end to end and for this reason no transmission guarantee can be provided across the entire route from the sender to the recipient. As, in many cases, customers can only monitor/optimize half of the route themselves, fax over IP always involves risks. Swisscom therefore clearly recommends that customers no longer rely on data transmission via fax protocol for company processes, where possible, and switch to alternative solutions. This applies to business-critical processes in particular.



## Digital solutions: fax replacement

For business customers, there are now numerous alternatives to conventional fax transmission. In many cases, it is worth taking a critical look at the precise reasons why fax is even still in use, and whether optimisation potential is being overlooked. For example, e-mail could be a valid alternative for sending non-confidential information, while a one or two-page document could be photographed using a mobile phone camera and then sent as an MMS. The spectrum ranges from simple process adjustments (agreeing with a supplier that e-mail will also be recognised in the place of a fax) to solutions with similar features to fax (receipt confirmation, confidentiality, guaranteed transmission, etc.) right up to fully integrated digitisation solutions that are usually extremely industry-specific (e.g. electronic patient record in healthcare).

Can “conventional” communication methods be used instead of fax?	Communication methods with fax-like properties (guaranteed transmission, legal certainty)		Integrated end-to-end solutions (usually industry-specific)
 <p>E-mail</p>  <p>Photo by e-mail/MMS</p>	 <p>Docsafe</p>  <p>All-in Signing Services</p>	 <p>Swiss Trust Room</p>  <p>Secure E-Mail</p>	 <p>Swisscom Health Connect for example</p>

A few solutions are listed here and briefly explained by way of example. Further information can be found under the supplied links:

### [Docsafe](#)

Docsafe is intended for digital storage of documents. As with fax, there is a sender and a recipient. However, in contrast to fax, document transmission is guaranteed. The transmission can be seamlessly traced. If required, Docsafe can also be used to define and restrict access to the transmitted documents. Docsafe is generally electronic and therefore paper-free (documents can, of course, be printed). Access to Docsafe is by means of secure authentication. Transmitted documents can be forwarded with ease as well as conveniently retained and managed. The Docsafe account is free of charge. Costs are incurred for the sender per document sent. The service is intended for business customers to send documents to their business partners (business to business) as well as to their private customers (business to consumer).

*Link to [Docsafe](#)*

### Swiss Trust Room

Swiss Trust Room was developed for members of management teams, administrative boards and other committees who want to exchange confidential, sensitive information among themselves and process it efficiently. The service has multiple security and authorisation levels and prevents unauthorised parties from viewing, changing or accidentally forwarding corporate information. Thanks to logging of all actions, compliance requirements are fully met. Documents can be electronically signed in a secure and legally valid manner – with no need to install signature components. The personal signature can be easily triggered using Mobile ID. The solution can be used via a web browser without installing any additional software and can be activated at any time.

*Link to [Swiss Trust Room](#)*

### All-in-Signing

The All-in Signing Service is a cloud service for legally valid signatures and timestamps for documents and files. User interaction (triggering a signature securely) takes place via Mobile ID, thus ensuring maximum user acceptance. With the All-in Signing Service, documents can be signed online in a legally valid manner, from anywhere and at any time, using a smartphone, tablet or computer. The All-in Signing Service optimises business processes, protects documents against manipulation and clearly identifies business partners. It can be embedded in applications and websites, and thus allows processes to be mapped digitally from end to end.

*Link to [All-in-Signing](#)*

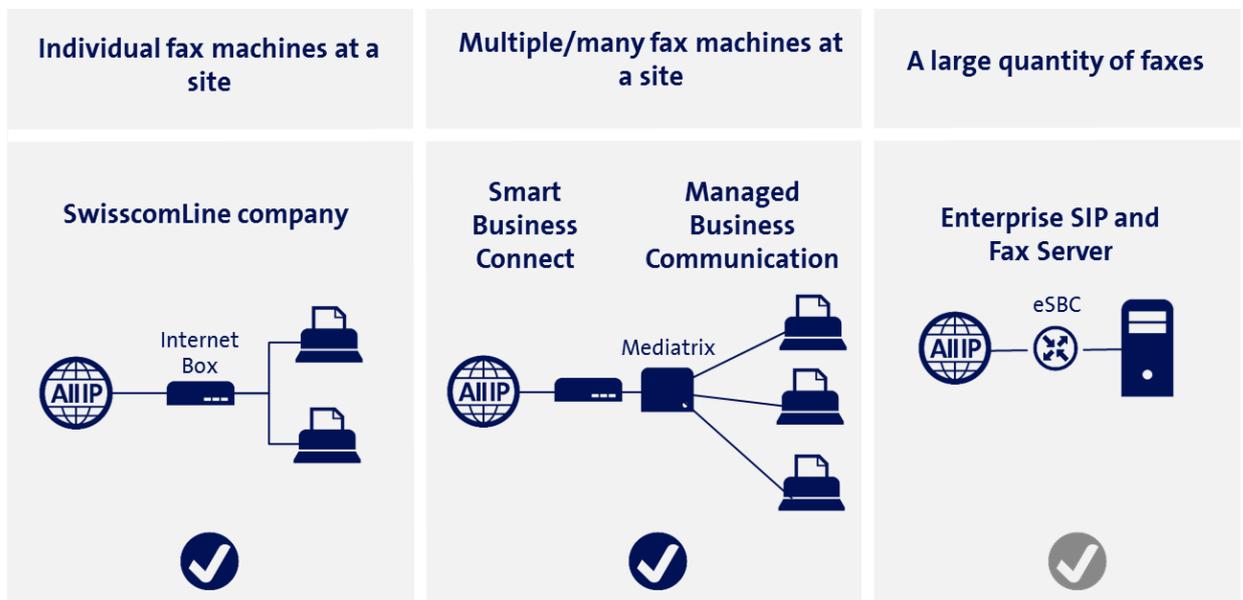
### Secure E-Mail

The Secure E-Mail Service primarily enables secure transmission of all required e-mails, allows identification of the respective senders, guarantees the non-repudiation of messages and allows message content to be protected (content integrity). The service integrates cryptographic processes (encryption/decryption, signature, verification) at a central point. As with fax, there is a sender and a recipient. However, in contrast to fax, document transmission is guaranteed. This product is recommended if e-mail communication between customers and their communication partners needs to be secure. E-mail security is an integral component of Outsourcing Messaging or MCC Exchange.

## Fax solutions: direct connection

Swisscom is aware that, in many industries in Switzerland, fax is still deeply anchored in the business processes and finding a replacement at short notice is not an option in all cases. However, the following recommendations should be taken into account here:

- The complexity and number of components involved should be kept as low as possible; in other words, we recommend direct connection of the fax machine to a router, where possible.
- It is essential that the router used supports Voiceband Data Mode.
- Swisscom cannot provide any functional guarantee due to the technological framework conditions previously described.



Swisscom provides many products that meet these framework conditions:

- SwisscomLine company
- Managed Business Communication
- Smart Business Connect

Use of a dedicated fax server that is directly connected to a SIP trunk is another option, provided the solution in use is homologated for the SIP trunk. Good results can also usually be achieved with cloud-based fax services.

However, it should be noted that even with this connection version, successful fax transmission depends on the correct configuration of the opposite terminal and is therefore subject to risk.

## Fax solutions: indirect connection

If an analogue fax machine is connected indirectly via a telephone switching system (PBX), practical experience shows that there is a major risk of disrupted or incorrect fax transmission. Very few PBXs support Voiceband Data Mode and such solutions are extremely complex, and thus susceptible to errors. While functional constellations can be found with a corresponding level of effort, following adjustment of a single component (e.g. new ATA box, new software release, re-configuration of the fax on the opposite end), problems with the fax transmission can arise again at any time.

Swisscom therefore clearly recommends that you avoid such installations and connect fax machines directly.

# Frequent sources of problems

---

## T.38 vs. G.711

Errors often occur when using the T.38 protocol. T.38 is an IP-based protocol that is used only on VoIP routes and is not used in analogue telephony (TDM). If the VoIP terminals (sender and recipient terminal devices) do not understand T.38, G.711 is used. However, even if the terminal devices understand T.38, compatibility problems mean the function is not guaranteed.

## QoS

No or insufficient QoS: If the data packages are not or only insufficiently prioritised, this can have a disastrous effect for the fax transmission, namely data packages being delivered too late and therefore a latent risk of the fax transmission being terminated. QoS is often the cause of fax transmission problems, particularly when it comes to detached units at external locations that are connected via WAN, for example.

## Incorrect configuration of the fax machine

We recommend making the following settings on the fax machine:

- a. Reduce the transmission speed:  
e.g. from 14,400 bps to 9,600 bps (this parameter is known as “TX Start Speed” and “RX Start Speed”, for example).  
*Reducing the speed can be beneficial for short faxes. However, for faxes with multiple pages this could also be counterproductive, as the transmission duration is longer and thus, statistically, an increased number of package losses may occur.*
- b. Deactivate error correction:  
Switch ECM (Error Correction Mode) to “Off”.
- c. If the fax machine is not from the official Swisscom portfolio, you should check the parameters of the analogue output on the fax machine. You can find these in your fax machine’s documentation/specification:
  - Country settings must be set to Switzerland.
  - Impedance: Should be “complex impedance” and not 600 Ohm
  - Dialling method: Your fax must be set to touch-tone, which is also known as DTMF.
  - Pulse dialling, or decadic dialling, is no longer supported.

## Fax behind a telephone switching system

If you use fax behind a PBX, the risk of fax transmission problems is increased. One reason for this is that PBXs frequently do not support Voice Band Data (VBD).

## Length of transmission duration

The transmission time should be kept as short as possible. In this respect, sending long documents in parts can help. We recommend sending faxes with a maximum of five pages.

## Glossary

---

Term	Description
ATA	Analogue telephony adapter. Device that establishes a connection with one or more analogue standard telephones via the Voice over IP network.
ECM	Error Correction Mode (configuration parameter for fax transmission)
FoIP	Fax over IP (Fax via VoIP)
G.711	Compression-free fax protocol for digitising analogue audio signals by means of pulse code manipulation (PCM). The fields of application for this codex are conventional fixed-network telephony as well as IP telephony.
IP	Internet Protocol
ISDN	Integrated services digital network
LAN	Local area network
MBC	Managed Business Communication (Swisscom product)
PBX	Private Branch Exchange (telephone switching system)
SIP	Session Initiation Protocol
T.38	Fax over IP protocol in which the information is not transmitted with sounds as in the normal telephone network, but in digital form using the network protocol. T.38 requires a real-time connection between the two opposite terminals. In contrast to IP fax devices, an analogue fax machine cannot support the T.38 protocol.
TDM	Time Division Multiplex (current, non-IP-based, telephone network)
VBD	Voice Band Data (mode for optimising the fax and modem channel)
VoIP	Voice over IP (Internet protocol-based telephony)
QoS	Quality of Service
WAN	Wide area network