Fax transmission
via SIP Connection

Configuration scenarios
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1 Introduction

At least two fax devices are required for a fax transmission (one sender, and one recipient).

Negotiation usually takes place in the follow order:
1) The sender initiates the call to the recipient.
2) The recipient accepts the call.
3) The sender emits the CNG tone (calling tone, 1100 Hz).
4) The recipient emits the CED tone (called terminal/station identification, 2100 Hz).
5) Fax transmission is executed.
6) The call is ended following the fax transmission.

Normally, fax transmission follows fax protocol T.30. On IP networks, by contrast, T.38, a special fax protocol, is implemented to get the transmission tough towards packet losses and delays.

Analog fax units are integrated into IP networks via IP terminal adapters. That means fax units are connected via analog IP terminal adapters, which establish connections via SIP CallControl and convert fax data from T.30 into T.38. For voice transmission on IP networks, codecs from the ITU G.7xy-series are generally used (e.g. G.711).

Fax connections on IP networks can be established with SIP as the CallControl protocol via the following methods:

Method 1)
If configuration stipulates that exclusively fax connections should be established, then a connection can be established and accepted directly with T.38. In this case, here is what the CallControl procedure will look like.

Method 2)
If neither the sender nor the recipient knows in advance whether a fax connection is intended, then a voice connection is established via an audio codec (G.711). Then, the recipient uses the CED tone emitted by the recipient device to recognize that a fax transmission is intended and therefore switches to T.38 via SIP INVITE.
Method 3)
Another option not described in the T.38 standard is where the fax sender switches to T.38 after a voice connection has been established via an audio codec (G.711). This means the IP terminal adapter to which the sending fax device is connected recognizes the sender’s CNG tone and switches the voice connection to fax via T.38 INVITE. Since this option is not described in the standard, it is not supported by all terminal devices, but can still be helpful in many scenarios.

In the methods described, only one codec is offered in the initial INVITE. However, SIP/SDP also provide the option of offering a selection of codecs in a so-called “offer.”
The recipient of the "offer" can establish its response in the 200 OK message ("answer"). That "answer" can establish exactly which one of the codecs in the "offer" will be used; however, it is also possible to answer with multiple codecs in 200 OK. However, responding with multiple codecs in 200 OK frequently creates problems, for some manufacturers can only use the answer's highest preferred codec, while others run parallel audio/fax data streams.
2 Configuration scenarios

This chapter shows concrete configuration scenarios for providing help for SwyxWare administrators, as well as sample applications from practice for the fax methods named in the introduction. All of the examples named below are based on the T.38 settings that can be configured for trunks and users separately.

Please refer to chapter 13.6 (Sending Faxes via SIP Connection) in the SwyxWare Administration Documentation.

SIP INVITE messages and fax negotiation methods can be influenced in SwyxWare administration via trunk properties (see fig. 1) and user properties (see fig. 2).

![Fig. 1: Trunk properties (SwyxWare Administration)](image-url)
If the option "Remove T.38 codec from initial invite" is activated, then SwyxServer will remove any potential T.38 codec options from the "offer" prior to transmitting an SIP INVITE to a trunk or a SwyxWare user.

**Example:**
If, due to an incoming call from the PSTN, SwyxGate sends an INVITE with an "offer" containing G.711 and T.38 to an IP terminal adapter (= SwyxWare user) via SwyxServer, then SwyxServer will remove the T.38 from the "offer" as long as the check box "Remove T.38 codec from initial invite" is activated. The INVITE delivered to the IP terminal adapter thus now only has G.711 in the "offer."

If the option "Prohibit T.38 reinvite by sender" is activated, then SwyxServer will not transmit a repeat INVITE from the sender (Method 3) to the recipient. This forces the process into Method 2).

**Example:**
A call from the PSTN is delivered to an IP terminal adapter via SwyxGate. Pursuant to Method 3), SwyxGate sends an INVITE via SwyxServer to the IP terminal adapter, and a G.711 voice connection is established.
Based on the CNG/CED tone recognition, SwyxGate then automatically attempts to switch the connection to T.38 via INVITE. If, however, the IP terminal adapter does not
support this option, then set the option "Prohibit T.38 reinvite by sender" for the SwyxWare user for whom the IP terminal adapter is signing on. Then the IP terminal adapter will not receive the INVITE from SwyxGate, because SwyxServer won’t be passing it on. This forces the process into Method 2).

For the configuration scenarios described below the following options (see also Fig.1 and Fig.2) are relevant:

- "Remove T.38 codec from initial negotiation (SIP INVITE)"
- "Prohibit T.38 reinvite by sender"

Note: The default setting after SwyxWare installation is that these two options are deactivated.

2.1. SwyxGate – SwyxFax User

If SwyxGate registers a call from the PSTN to SwyxServer via SIP INVITE, it will always have G.711 and T.38 in the "offer," because it cannot be determined in advance whether a fax device or a person (voice user) is calling.

In the standard configuration, SwyxServer will forward the INVITE to the fax server unchanged, which accepts the call directly with 200 OK and "answer" T.38; i.e., Method 1) is used.

The same applies for calls in the opposite direction.

Since the fax server can only process fax transmissions, i.e. T.38 calls, it always switches call signalization to T.38 as early as possible, or accepts calls with T.38 immediately.

No changes need to be made in the standard configuration for calls in either direction.

2.2. SwyxGate – IP Terminal Adapter

a. IP terminal adapter does not support Method 3):
   Activate the option "Prohibit T.38 reinvite by sender" in the user properties so that SwyxGate (= sender) does not forward the RE-INVITE for T.38 to the IP terminal adapter. This forces the process into Method 2).

b. IP terminal adapter supports Method 2) (e.g. AudioCodes MediaPack):
   All settings can be left in the default configuration, for both SwyxGate and AudioCodes support all methods of fax negotiation.

c. IP terminal adapter commands all fax methods and accepts "offers" with all of their codecs, but the sender fax device does not emit the CNG tone in a standard-compliant manner:
   The default setting is for AudioCodes IP terminal adapters to accept all codecs in an "offer" and to use all codecs simultaneously in the call process to follow. In practice, there may be problems here, for if the sender fax device does not emit a
clear CNG tone, then SwyxGate will not automatically switch the call to T.38 only per RE-INVITE. This means AudioCodes will initially use a G.711 voice connection, but will send the T.38 fax data to the same SwyxGate target port via fax transmission (without an additional CallControl message) upon launch, which leads to processing problems with SwyxGate.

If problems are observed on the IP terminal adapter when receiving faxes via SwyxGate and the IP terminal adapter has sent G.711 and T.38 as "answers" in its 200 OK for call acceptance, then change default configuration and activate the option "Remove T.38 codec from initial invite" in the user properties. This will force the process into Method 2) or Method 3) and unambiguous use of only one codec at every point in time.

2.3. SIP Provider – SwyxFax User

a. The SIP provider does not support Method 1):
   In trunk properties, activate the option "Remove T.38 codec from initial invite" so that outgoing INVITEs to the SIP provider always contain only one audio codec (G.711).

b. The SIP provider does not support Method 3):
   In the trunk properties for the SIP provider trunk, activate the option "Prohibit T.38 reinvite by sender" to avoid SwyxWare sending a RE-INVITE to the SIP provider for calls to the PSTN.

2.4. SwyxWare – SwyxWare Coupling via SwyxLinks

For this scenario, use Method 1) whenever possible. The advantage here is that all switches to T.38 and negotiation conflicts due to a simultaneous switch from G.711 to T.38 from sender and recipient are avoided. The fax connection can be established more quickly and reliably. This also means that SwyxLink should be configured for the voice codecs and the T.38 fax codec. Avoid linking SwyxWare installations via two separate SwyxLinks (one for voice and another for fax/T.38). Limitations that made this concept necessary for older SwyxWare installations have now been removed.
3 Summary

The great majority of SwyxWare installations work immediately with the default fax settings. Please only make changes in the event a problem is incurred. If it does become necessary to make changes, always be sure to configure limitations only for the side on which the technical limitation is incurred.

If, for example, an IP terminal adapter is integrated that cannot handle Method 3), then please set the option "Prohibit T.38 reinvite by sender" only for the SwyxWare user for whom the IP terminal adapter registers. If, for example, an SIP provider does not support certain functions, then limitations should only be configured on that provider's trunk.

Following this approach guarantees that all further components will continue to use the optimum methods.