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INTERNET-DRAFT   Siemens Roke Manor Research Ltd.
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A proposal for the provisioning of PSTN
initiated services running on the Internet

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Abstract

This Internet Draft has arisen out of work concentrating on the
interconnection of IP and the Public Switched Telephone Network
(PSTN) undertaken within the PINT working group. Efforts within this
group have, to date, concentrated on the initiation of PSTN services
from the Internet.

This Internet Draft aims to describe a possible architecture for the
implementation of services initiated from the PSTN such as, but not
limited to, Internet Call Waiting (ICW). It also identifies the

possibility of using this class of service, in conjunction with the
PINT work already undertaken, in order to provide a third flavour of
service.

This Internet Draft deliberately does not to define the protocols for
these kinds of services, although descriptions contained within it do
use Session Initiation Protocol (SIP) terminology.

The purpose of this Internet Draft is to ascertain the level of
interest in pursuing this area of work. It is submitted with the goal
of forming the basis of an Informational RFC and thereby further work
on the standardisation of the provision of these kinds of services.

Contents

The contents of the rest of this document is as follows:

2. **Introduction**

In its charter, the description of the PINT working group states that
it aims to address connection arrangements through which Internet

applications can request and enrich PSTN services.

   Work to date has produced a proposal based on the use of the Session

Initiation Protocol (SIP) [2] and Session Description Protocol (SDP)
[3] to achieve these objectives in respect of Internet initiation of
PSTN services (as shown in Figure 1).

```
            ...........................
            : PINT area of interest    :
            :                          :
            :               PINT       :
            : +----------+   REQUEST   :+----------+
            : | Internet |------------>:|   PSTN   |
            : +----------+             :| Services |
            :                          :+----------+
            :..........................:
```
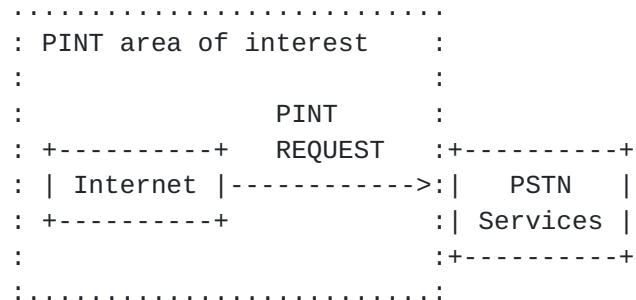
                    Figure 1.

As a result of this work the group has identified a need, and has
begun discussions on, the possibility of using SIP and SDP in a
similar manner in order to perform the reverse of this function i.e.
initiating Internet services from the PSTN using some yet to be
defined protocol (initially called TNIP, it being the reverse of PINT
[4]) as shown in Figure 2.

```
            ...........................
            :                          :
            : +----------+   REQUEST   :+----------+
            : | Internet |<------------:|   PSTN   |
            : +----------+    TNIP     :| Services |
            :                          :+----------+
            :..........................:
```
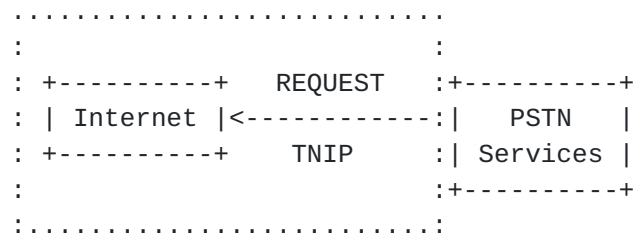
                    Figure 2.

The service initially identified for this scenario is the Internet
Call Waiting (ICW) Service, also known as Call Completion Internet
Busy (CCIB). In this service, a PSTN user attempts to make a Plain
Old Telephone Service (POTS) call in a traditional manner to another
number. This second number is engaged, possibly because the person is
presently connected to the Internet. The service should identify if
this user is indeed connected, and if so, a message is sent over the
Internet to inform this person about the call attempt. The user may
then decide what action to take, dependent on what service options
are provided by the service provider. This might be to drop the
current Internet connection and take the call in the normal way, take
the call as a Voice Over IP (VOIP) call, decline and give the calling
party the option to leave a voice message or simply decline the call.

Of course this is not the only service which could be deployed, other
services, such as :

o Remote Activation
  Using a telephone a user could request actions to be performed
  at some remote location.

     o Remote Data Setting
       Using a telephone a user could create or modify information held
       on a remote machine.

     o Paging
       A paging service could send a text message to the user logged on
       to the Internet using voice to text conversion software.

     o Voice Messaging
       A voice message service, whereby a voice message could be taken
       and converted to an audio format which could be played on the
       users machine.

     o Voice to Email.

  could also be deployed.

  However, the real benefits of this class of service (PSTN activation)
  will be in its use, in conjunction with the work already undertaken
  within the PINT group, to provide a further completely new class of
  Intelligent Network (IN) 'like' services. This scenario is depicted
  in Figure 3 :

```
                       .............................
                       :                           :
                       : +----------+   REQUEST   :+----------+
                       : |          |<------------:|          |
                       : | Internet |             :|   PSTN   |
                       : | services |             :| Services |
                       : |          |------------>:|          |
                       : +----------+    PINT     :+----------+
                       :                 REQUEST   :
                       :...........................:
```
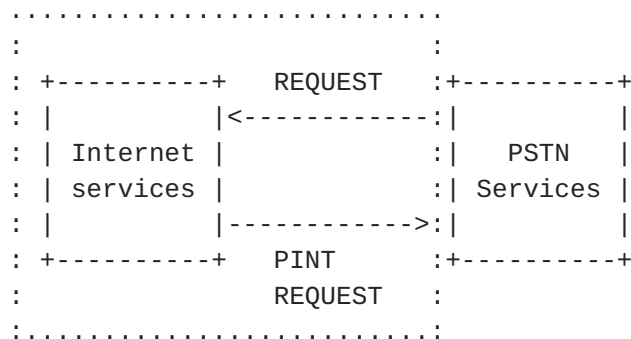
                           Figure 3.

  The scenario of these kinds of services would be that a user uses the
  PSTN to initiate an Internet service. This Internet service could
  then either :

      Store information which could be used during an initation of an
      Internet Service at a some later time.
  or
      Initiate a PSTN service directly.

  A simple example of a service using both of these facets might be a
  number portability service. A user could use a telephone to specify
  the telephone number at their current location (perhaps using Calling
  Line Identity CLI) this is sent over the Internet (using the protocol
  which would come out of any future work) to a repository. Another
  user could then attempt to telephone the first user. This call is

intercepted and the number called checked against the current known
location by a request (using the protocol or profile which would come
out of any future work) to ascertain the number registered by the
first user. If the number is different, a PINT request could be

   issued back to the PSTN to connect the call to the new number.

   For the purposes of this Internet Draft and identifying what kind of
   services are being disussed this Internet Draft identifies three
   groups of service which could be provided :

     1. PINT   Internet initiation of PSTN servives.

     2. TNIP   The reverse of PINT i.e. PSTN Initiation of Internet
                 services and the protocol or profile which could provide
                 these services.

     3. SAINT   Service Activation and the INTernet. An all encompassing
                 classification which contains services provided by the
                 previous two groups, plus any combination of these
                 services, used to provide further services.

   Figure 4. provides a schematic of the different kinds of service.

```
                         SAINT
                Service Activation on the INTernet
                            |
             +----------------+----------------+
             |                                 |
            PINT                              TNIP
         PSTN INTernet                 Telephony iNitiation
         Interworking                    of IP services
```
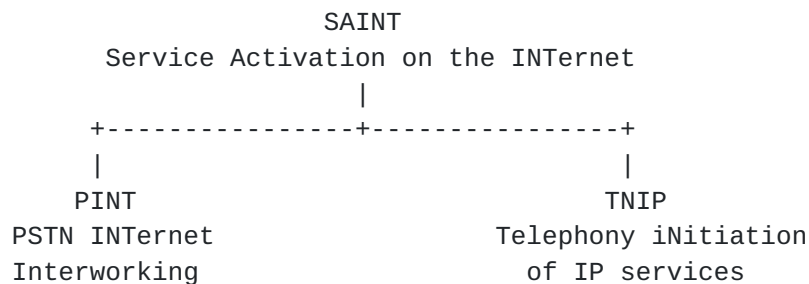
                         Figure 4.

   So, in the number portability serice described above, the service
   components would break down as follows :

     o The ability to call and set current location (telephone number)
       would be a TNIP flavour of SAINT which could be used in multiple
       services.

     o Similarly, the ability to look up the present location would also
       be a TNIP flavour of SAINT, as this would have been initiated via
       the PSTN. This also could be used in multiple services.

     o The ability to forward the call would be a PINT flavour of SAINT
       because this would be initiated from the Internet. Again, this
       functionality could be used in multiple services.

     o The whole combination of the above would be a SAINT service.

   Eventually, if further work in this area is undertaken, what is
   presently considered to be independent services within the PINT and
   TNIP class of service, might be seen more as functional components

within a SAINT architecture of service provision.

This Internet Draft will not consider the potential for PINT and TNIP
combination kinds of SAINT services further. The mechanism for

   providing these should 'fall out' of any work undertaken in the
   standardisation of PSTN initiated or TNIP services.

3. General Requirements For PSTN Initiation Of Internet Services

   This section aims to specify an initial set of requirements for any
   future work in the specification of a protocol, or implementation of,
   the group of PSTN initiated services identified in Section 2.

     o The profile should provide the service in a secure manner.

     o Any profile defined for PSTN initiation of services should reuse
       where possible existing IETF protocols. In particular, a profile
       for the PSTN initiation of services should be aligned with the
       PINT profile work undertaken to date.

     o The identification of any equipment (external to the Internet)
       within the specification of the protocol, or, service defined
       using this protocol SHOULD NOT be required. This would be in
       accordance with the PINT approach to date which places no
       requirements and identifies no specific equipment beyond the PINT
       gateway.

     o Provide the possibility for a service to be activated in a manner
       which is independent in both location of service and user.
       Section 5 describes one possible ICW implementation which allows
       a user to use the ICW service in a portable manner without that
       service being tied to a specific telephone number (and thereby
       service location). User (the caller) location can be considered
       to be location independent for this service.

4. Proposed Architecture

   The proposed architecture contains three main elements :

     1) The user's machine.
        This contains a TNIP Server to receive INVITE and/ or NOTIFY
        messages. What action occurs next can be either predetermined
        by the service provider or dictated by the user themselves.

     2) Information/ Service Repository.
        This could contain the service provider's services, service
        related information, subscriber related information or indeed
        accounting information. In Figure 5 this element is indicated as
        a single entity, where in fact, it may be comprised of several
        servers working together to provide the overall service.

        These functions receive INVITEs from the TNIP client, check
        where to send the message and perform any other service
        functionality. Next, the INVITE is forwarded to the TNIP server

on the user's machine. These functions also receive REGISTRATION
messages sent from the TNIP Server on the user's machine and
maintain/store any relevent information contained in these
messages.

   3) TNIP Gateway.
      This 'could' receive service requests from the PSTN and
      formulates TNIP messages to be forwarded to the Information/
      Service Repository or directly to the TNIP Server on the users
      machine. In so doing it acts as a TNIP client.

   A simplistic schematic of these elements is shown in Figure 5 below.


```
        ...............................................
        : Scope of interest                          :
        :                                            :
        : +-----------------+                        :
        : | Users Machine   |                        :
        : |                 |                        :
        : | +-------------+ |                        :
        : | | TNIP Client/ | |                       :
        : | | Server      | |                        :
        : | +-------------+ |                        :
        : +--------:--------+                        :
        :         |            +-----------------+ :
        :         :            | Information/    | :
        :         |            | Service         | :
        :         :            | Repository      | :
        :         |            | +-------------+ | :
        :         :-..-..-..-..-..-..| TNIP Server  | | :
        :         |            | +-------------+ | :
        :         :            |                 | :
        :         |            +-----------------+ :
        :         :                                :
        :         |                                :
        :   +-------------+                        :
        :   |    TNIP     |    -..-..- TNIP Protocol  :
        :...|   Gateway   |...............................:
            |             |
            +-------------+
                  |
                  o
                  |
            +-------------+
            |    PSTN     |
            +-------------+
```
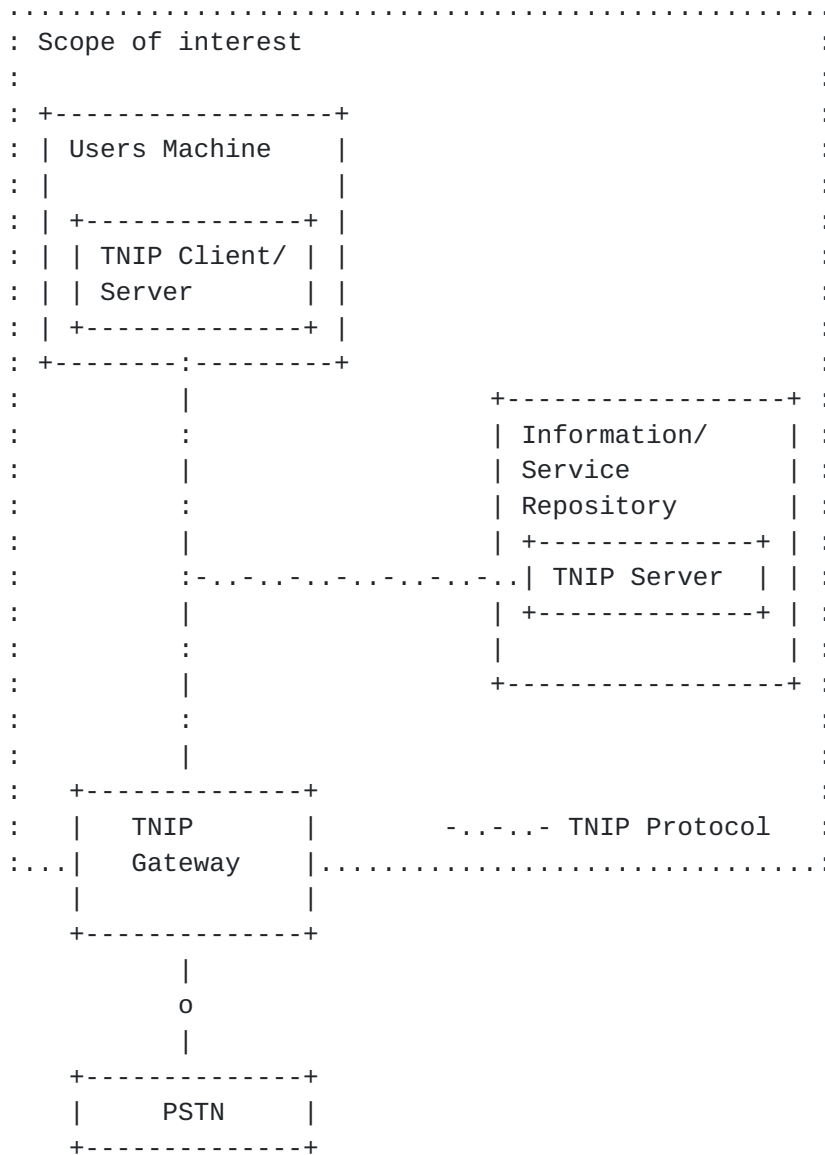
                         Figure 5.

   One thing to note about this architecture is that the Information/
   Service Repository is not necessarily required. A User machine could
   handle a service itself if the TNIP client were to issue INVITEs and
   NOTIFYs to it directly.

The function of the information/service repository itself could exist
outside of the scope of interest demarcation indicated, as proposed
in [5].

Maintaining the information/ service repository within the Internet

   as indicated however, would permit interoperability with the work
   presently being undertaken within the IP Telephony (IPTEL) working
   group, specifically the proposed Call Processing Language [6].

   Another point of note is that the TNIP boxes on the user machine and
   connected to the Gateway Function are indicated as Client/ Server.
   This is because the description of the implementation falls into two
   parts (see Section 5) and the behaviour of these TNIP boxes is more
   client or server like in each phase.

5. Implementation Scenarios

   This section describes how services might be implemented within the
   architecture described in the previous section. The order of flows is
   identified though the specific contents is not. As has been stated
   previously, this draft aims to ascertain the level of interest in
   this architecture and the services it could provide, prior to work
   on any actual specification of a protocol which will be required to
   support them.

   To reduce complexity the description is in two parts. First the user
   registers for the service. Secondly, a call attempt is made.

5.1. Service Registration Phase

```
                    User Machine
                +--------------+
                | TNIP Client  |
                +--------------+
                   |      ^
                   |      |
                   |      |
              1 |      3 |
                   |      |                +--------------+
                   |      |                | Information  |
                   v      |                | Service      | 2
                 .........                 | Repository   |
              .../         \...            |              |
            ../               \..     1    |  +--------+  |
           /                    \---------->| TNIP   |  |
           |          Internet        |     |  | Server |  |
            \..                    ../<----------|        |  |
             \...              .../     3    |  +--------+  |
               \........../                  +--------------+


                    Figure 6.
```
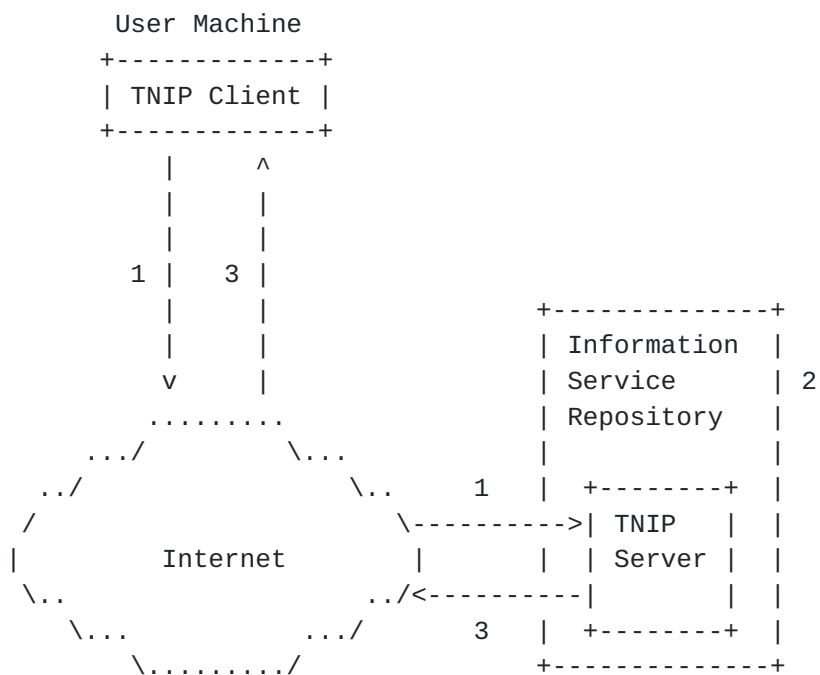
   1. User submits a Registration message containing IP Address and any

other information, such as in the case of ICW (if CLI is not
available), their telephone number.
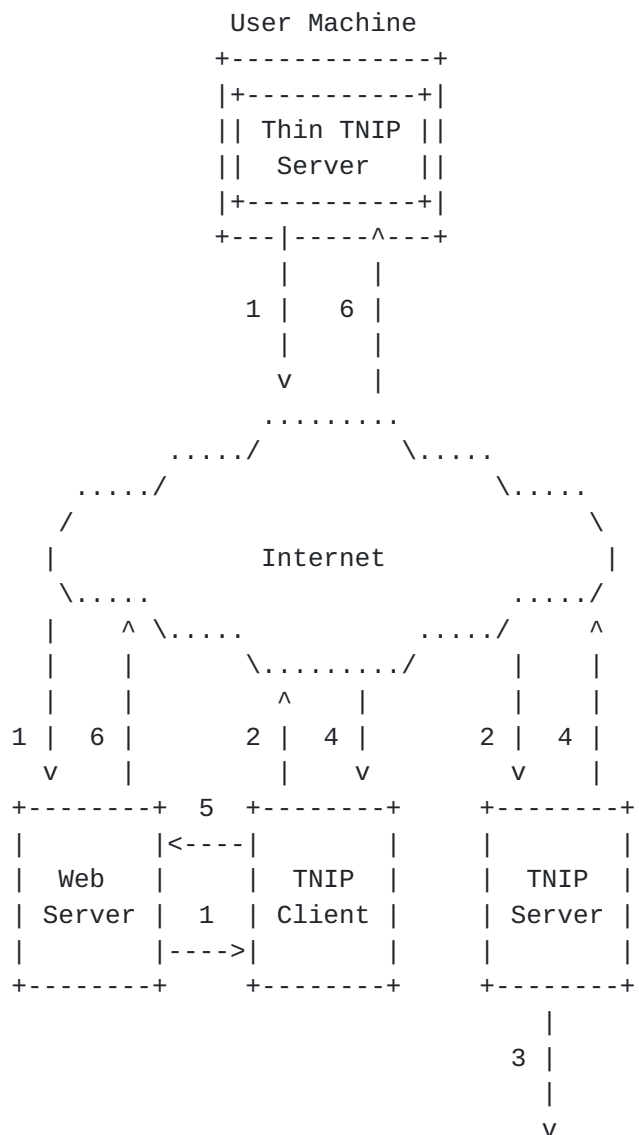
2. User details provided are registered.

     3. Response message constructed and returned to registering Client.

Other issues

  As previously stated messages 1 and 3, and the function performed by 2
  do not need to be located in what is called in this description the
  Information/ Service repository. These flows and the registration may
  be undertaken within the telephony network using IN [5].

  The implemenation scenario described assumes that TNIP functionality
  has at some previous time been downloaded to the user's machine. This
  need not be the case. If it were required that a user could gain
  access to the Internet using any machine and still have access to
  these services, an implementation similar to that identified in Figure
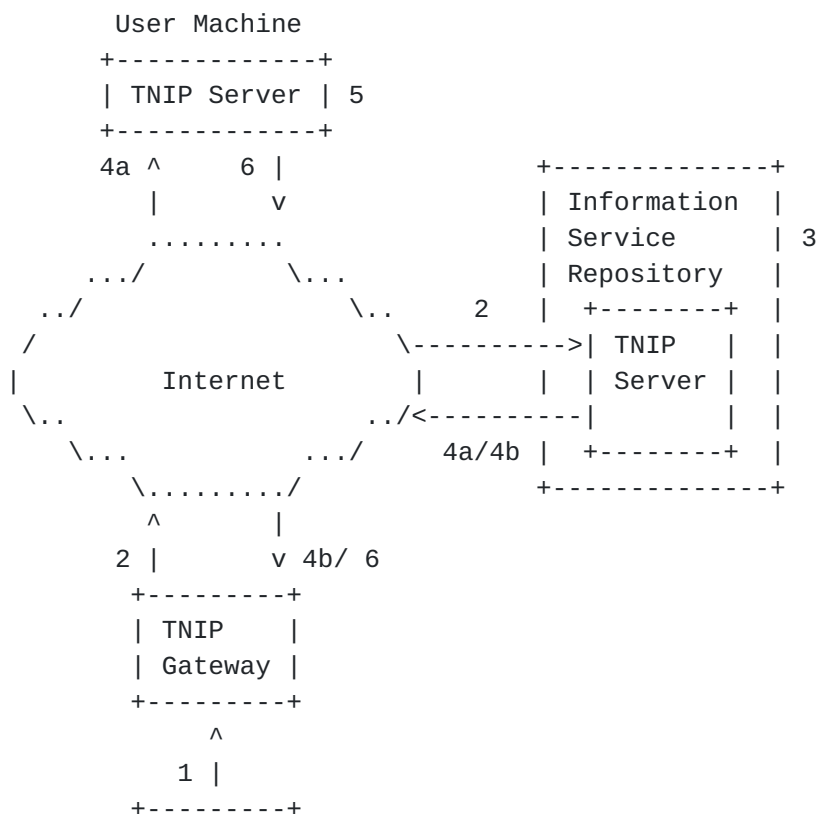 7. and the following paragraph could be employed.

```
                          User Machine
                      +-------------+
                      |+-----------+|
                      || Thin TNIP ||
                      ||  Server   ||
                      |+-----------+|
                      +---|-----^---+
                          |     |
                       1  |   6 |
                          |     |
                          v     |
                        .........
                  ...../         \.....
               ...../                 \.....
              /                             \
              |           Internet          |
              \.....                   ...../
              |    ^ \.....       ...../    ^
              |    |      \......../     |   |
              |    |       ^    |        |   |
          1 | 6 |       2 | 4 |       2 | 4 |
            v   |         |   v         v   |
         +--------+  5  +--------+   +--------+
         |        |<----|        |   |        |
         |  Web   |     |  TNIP  |   |  TNIP  |
         | Server | 1   | Client |   | Server |
         |        |---->|        |   |        |
         +--------+     +--------+   +--------+
                                         |
                                       3 |
                                         |
                                         v
```

```
                                    +----------+
                                    | Database |
                                    +----------+

                      Figure 7.
```

1. The user goes to a service providers URL using a browser and
   specifies the information requested such as, in the case of ICW,
   telephone number.

2. The service provider constructs and issues a SIP registration
   message on behalf of the user.

3. User details provided are registered.

4. A response message is constructed and returned to registering
   Client.

5. Response message returned to service provider's Web Server.

6. A 'thin' TNIP User Server Agent is sent to the user machine. This
   can then be used in the service activation phase.

   The term 'thin' means that a full implementation of a TNIP server
   need not be required in order to handle specific requests. This
   is because of two main reasons. Firstly, the exact format of
   messages which may be sent by the service provider to offer this
   service is known. Secondly, only a subset of the full protocol
   need be required to provide the service.

5.2. Service Activation Phase

```
               User Machine
              +-------------+
              | TNIP Server | 5
              +-------------+
              4a ^      6 |            +--------------+
                 |        v            | Information  |
                 .........             | Service      | 3
              .../        \...         | Repository   |
            ../               \..   2  |  +--------+   |
           /                    \---------->| TNIP   |   |
           |         Internet        |    |  | Server |   |
          \..                    ../<----------|        |   |
           \...           .../    4a/4b |  +--------+   |
            \........../               +--------------+
               ^        |
             2 |        v 4b/ 6
             +---------+
             | TNIP    |
             | Gateway |
             +---------+
                 ^
               1 |
             +---------+
```

```
                         | PSTN    |
                         |Equipment|
                         +---------+

                           Figure 8.
```

1. A service activation request. For example an ICW service request
    is made after a call has been attempted and the PSTN has
    recognised that the number is engaged.   An announcement could
    be played and a request sent from the Gateway to establish if
    the user is currently registered as wanting to receive INVITEs
    for a particular service. This will not be discussed further as
    it is outside the scope of this Internet Draft.

2. A TNIP invitation message is constructed and sent to the TNIP
    Server on the information/ service handler.

3. The TNIP server in the information/ service repository looks up
    the registration details of the user. Two things may then occur.
    If the user has registered details a TNIP invitation could be
    forwarded to the TNIP server on the user's machine (see 4a). In
    this case the information/ service repository performs as a
    redirection server or proxy. If the user has no registration
    information in the database (either because they have not
    registered or the registration has expired) a failure response
    is sent to the requesting TNIP client (see 4b).

4a. A TNIP invitation message is sent by the TNIP Server on the
    information/ service repository. This invitation contains a
    combination of information contained within the repository and
    information contained in the original request.

4b. A TNIP failure response is returned to the requesting TNIP
    client as no current regration information could be found.

5. User or service action to dictate what should happen as a
    result of the receipt the TNIP request. In ICW this might be to
    provide the user with the following options :

        Take telephony call
        Take VOIP call
        Send to voice mail
        Refuse connection

6. The user sends a response to the INVITE, a final timeout occurs
    or the client gives up.

5.2.1 Other issues

As with the Service Registration Phase the flows to and from the
information/ service repository and the actions it performs could be
undertaken within the telephony network using IN [5]. The only flows
in this scenario would be the invite 4a and the response 6.

6. Security Considerations

Security issues are still an open issue within the PINT Internet
Draft itself. It is expected that much of the security arrangements
finally proposed by the PINT Internet Draft will be replicated within

   any further work undertaken to provide the services identified in
   this Internet Draft.

   However, due to the nature of implementation of these services there
   are a number of security issues that need to be addressed. These are:

      o De-registration.

      o Claiming another number (somebody else's) by accident or design.

6.1. **De-registration**
   The de-registration problem would arise if a user did not de-register
   themselves before they finished using the Internet, likely to be a
   common occurrence e.g. users turning off their machines or modems
   without de-registering. It is expected that any implementation builds
   in a mechanism to handle this scenario. Authenticators could be used
   and passed in responses to the REGISTER messages sent to the TNIP
   service on the users machine. Alternatively, these authenticators
   could be placed directly in the TNIP server when it is initially
   downloaded.

   When the user logs off the Internet, without de-registering, there
   are three scenarios which could happen when an attempt is made to
   place a call to the number the user specified as their location :

     1) The line is not busy, therefore place the call and remove any
        previously held registrations.

     2) The line is busy on a voice call. An attempt to send a INVITE
        message from the Information/ Service Repository fails (as there
        would be no receiving client). Any previously held registration
        for this number is removed.

     3) Another user (or the same user on a different Internet session)
        has registered for receipt of calls on this number. There are
        two solution possibilities :

          a) When the new registration is made the old is replaced
             immediately.

        or

          b) The new registration is kept until an Authenticator fails
             on the TNIP server of the new registrand when a call
             attempt is made. When the Authenticator fails the INVITE
             fails and the original registration can be removed and
             replaced with the new. The INVITE is then resent to the new
             registrand.

6.2. **Claiming another number by accident or design.**

In this scenario a user may attempt to use ICW to claim notification
on a line they have no right to, and possibly handle that call using
VoIP, if the actual line is engaged. Consider the potential criminal

   activities of claiming the telephone number of a Bank. This security
   issue is much more complex. The following options are suggested as
   possible solutions :

      1) Only allow this kind of access from the user's own phone.

      2) Provide functionality at the ISP to get the CLI and implement a
         SIP based mechanism to request this from the ISP.

      3) Good accounting to track down offenders.

      4) Only provide the option to drop the Internet connection and
         establish a POTS call on untrusted (e.g. not home) numbers.
         Normal Bank authentication procedeures could then be used.

7. Conclusions

   There is a perceived requirement for the provision of services which,
   whilst running over the Internet, would be initiated from the PSTN.
   This Internet Draft has proposed an initial attempt at defining an
   architecture for the provision of such services.

   This Internet Draft has also identified that these services may be
   used in conjunction with PINT services in order to provide a new kind
   of IN 'like' services with their logic operating within the Internet
   domain.

   It has also been identified that the architecture outlined in this
   Internet Draft permits service users to specify data which can then
   be used by services during execution. An extension to this approach,
   and a possible area of further work would be to investigate how the
   ability of users to define their services as proposed in [6] could be
   integrated with the initiation of a service from the PSTN.

   Much further work would be required in defining a TNIP style protocol
   or profile and identifying possible services for this protocol or
   profile. Identfying and specifying candidate services which use both
   the TNIP and PINT protocols, such as the portability service
   described earlier, would also require further work.

   Finally, neither PINT nor this proposal for a TNIP protocol address
   the issue of generalised/spontaneous notifications between the PSTN
   and IP domains. These notifications may be in the form service data
   or status information. Further work is required to identify how these
   notifications are sent, what handles these messages and how they are
   handled. It may be that PINT can be used to forward these messages to
   a TNIP server and vice versa.

8. References

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[2] Handley, M., Schulzrinne, H., Schooler, E., Rosenberg, J.,
    "SIP Session Initiation Protocol", RFC 2543, March 1999.

   [3] Handley, M., Jacobson, V., "SDP Session Description Protocol"
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   [4] Petrack, S., Conroy, L., "The PINT profile of SIP and SDP: a
       Protocol for IP access to Telephone Call Services", Internet
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   [5] Brusilowsky, A. et al, "A proposal for Internet Call Waiting
       Service using SIP. An implementation Report", Internet Draft,
       January 1999.

   [6] Lennox, J., Schulzrinne, H., "Call Processing Language
       Requirements", Internet Draft, July 1998.

   Glossary

   CCIB   Call Completion Internet Busy
   ICW   Internet Call Waiting
   IN   Intelligent Network
   IP   Intelligent Peripheral
   POTS   Plain Old Telephone Service
   PSTN   Public Switched Telephone Network
   SDP   Session Description Protocol
   SIP   Session Initiation Protocol
   VoIP   Voice over IP (Internet Protocol)

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