1 Introduction //>

> 1.1 Goal

The IP Telephony Cookbook is a reference document addressing technical issues for the setup of IP Telephony solutions. Its goal is to provide the user community with guidelines and information about the IP Telephony world and everything related to it. Since the Cookbook is intended to be a technical document, the main target audience are the network engineers and system administrators at universities and national research and education networks (NREN); however, university students and researchers may find it useful, both for enriching their technological background as well as for finding information about advanced research topics and projects in the European community.

> 1.2 Reasons for writing this document

Members of the NREN community asked TERENA to start an investigation into IP Telephony in September 2001. The response was very positive and suggestions were made to co-ordinate the creation of a cookbook with recommendations for setting up IP Telephony solutions at university- and national-level, with information about protocols and the interoperability of equipment as well as about integration with the existing international hierarchies for IP videoconferencing. For this reason, a number of people in the TERENA community with significant expertise in the area of IP Telephony decided to undertake this task and to compose this document, The IP Telephony Cookbook.

> 1.3 Contents

The IP Telephony Cookbook is divided into chapters, which guide the reader through increasing levels of knowledge of the IP Telephony world. This first chapter contains introductory information and gives details of the contents of the Cookbook, useful tips on how to read this document and techno-economic considerations. Chapter 2 explains the technological background needed in order to understand the topics addressed in the rest of the Cookbook. This chapter describes the basic IP Telephony components and gives an overview of the IP Telephony protocols. Chapter 2 ends with additional considerations on call routing and perspectives about the future. Chapter 3 gives a high-level overview of scenarios a user may face when building an IP Telephony environment. Details are given to explain what a particular scenario is about, what is needed in order to deploy it and what needs it is serving. The next three chapters (Chapter 4, Chapter 5 and Chapter 6) detail how to set up IP Telephony services; those chapters give the reader the chance to learn how to set up basic services, advanced services (still telephony-centric) and value-added services (with respect to classic telephony service). Chapter 7 is about the

integration of global telephony, describing the technological solutions available for the integration of global IP Telephony and the successful replacement of classic telephony. Chapter 7 reports on today's situation, as well as migration and future trends. The last chapter contains the regulatory/legal considerations users have to be aware of when moving from classic telephony to IP Telephony. The topics here relate to the regulation of IP Telephony in Europe and in other countries outside the European Union. A large number of legal issues for classic telephony are detailed, from licensing to unbundling, and their mapping to the IP world. Finally, the IP Telephony Cookbook contains two annexes. Annex A lists and describes current and future IP Telephony Projects in Europe. Annex B gives the reader useful information about IP Telephony hardware and software, reporting 'hands on' experience (i.e., how the devices performed, how good tech-support was, what were the workarounds for some of the problems faced, etc).

> 1.4 How to read this document

Since the IP Telephony Cookbook is a technical reference document, it must include guidelines for users who do not want to read the whole document, so that they can find the information they need. In this section, we give the reader tips on how to read the document in order to retrieve the information needed as fast as possible; for a detailed overview of the contents of the Cookbook, please refer to the previous section. To speed up the information retrieval process, each reader should identify himself as belonging to one of the following three groups:

- readers who have no knowledge of IP Telephony;
- readers who have basic knowledge of IP Telephony;
- readers who have advanced knowledge of IP Telephony.

Readers belonging to the first group should, first of all, refer to Chapter 2 to acquire the necessary background to understand the rest of the cookbook. Readers who are interested in setting up an IP Telephony service should read Chapter 3 to have a clear picture of the possible scenarios offered by IP Telephony and target the one best-suited to the needs of their environment. The second group of readers may skip the previously-mentioned chapters, but Chapter 3 may be of some interest to them; the main focus of this group of users is more likely to be in Chapter 4 and Chapter 5 which give tips and help in setting up an operative service. The third group of users is likely to be more interested in the 'value added' services available nowadays with IP Telephony (Chapter 6) or in the integration problems of an IP Telephony architecture that is widely distributed across multiple sites and organisations (Chapter 7). All three groups of users may find useful information in Chapter 8 and European project information in Annex A. Last but not least, the list of products and testing experience reported in Annex B is a must for all users who do not want to risk making the wrong choices in a buying decision.

> 1.5 Techno-economic aspect of moving from classic telephony to VoIP

Many institutions are facing investment decisions with respect to replacing or expanding their existing telephony infrastructure, which currently consists mainly of large PBXs with proprietary phones and interfaces. As is there such a clear trend to replace old-style (TDM) PBXs with IP Telephony ones, it is important that there is a guide on how to attach such an IP Telephony solution to the existing network. IP connectivity can be used as the basis for establishing good

communication between scientists that might not use traditional, still relatively expensive, long-distance calls as extensively as they could use IP Telephony. Even where financial constraints are not the driving force, the potential for enhancing IP Telephony with additional services that support scientific co-operation makes IP Telephony an attractive solution.

IP Telephony can provide a number of benefits beyond replacing existing PBX/PSTN telephony:

Enhanced speech quality
The PSTN (and most PBXs) are limited to 3.1 kHz, 8-bit/sample audio. It is likely that future IP phones can provide CD quality and possibly even stereo audio. Even where the additional bandwidth required for this extreme level of quality cannot be provided; modest codecs such as G.722 (7 kHz speech bandwidth) can be used to provide better quality than conventional telephony;

Improved availability
There are many aspects of availability. Lowering the cost can make telephony more available to low-budget activities. Redundancy can provide as good as (or even better) reliability than traditional telephony. Integrating telephony with location-based computing and group-awareness systems can make the communication partners much more 'available', or provide the means to transfer communication to a point in time where it is more appropriate than the usual interrupt-driven telephone call;

Improved coverage
In a similar argument, IP Telephony can be made available in places where traditional phones are often not available in a university, e.g., lab settings (in particular, student labs). Also, many universities still consider the cost of phone installations high enough to force their employees to share phones in a common office, again, not necessary when workstation-based IP Telephony is used;

Improved mobility
It is very easy to move an IP phone to another room. There is no need to deal with ports on the PBX and change dial numbers. Simply plugging it into an ethernet socket in a new room makes it available;

Improved media integration
IP phones can be enabled to add media to an ongoing call as required, e.g., viewing a picture or drawing on a whiteboard. Using workstations themselves as IP phones can facilitate providing this function, whereas the standards are not yet there for coupling traditional phones and workstations;

New services
As IP Telephony evolves, it can be used to provide new services (like user-defined call processing) or to integrate existing concepts, e.g., Presence, Location Awareness or Instant Messaging. Because of the open standards available for these services, they need not to be limited to vendor-specific solutions. In other words, it can be much easier to deal with issues such as CTI (Computer Telephony Integration) and so pave the way to a completely new way of understanding telephony;

Research
As mentioned before, the protocols and standards used for IP Telephony are open and publicly available. This allows research institutions to work on their own services and solutions.

It is important to point out that before introducing IP Telephony into the network of an organisation; several issues unknown to the old telephone system have to be taken into account. A rough, non-exhaustive list may include addressing (special subnet/VLAN for phones), Quality of Service (QoS), security, positioning of gateways, interfacing of firewalls and, last but not least, maintenance of the system (backups, spares, etc., - something not very common in the legacy PBX world).

With regard to the economic aspects, the 'packetisation' of voice using Voice over IP has given rise to new international telecommunications carriers. These carriers have distributed network architectures using the Internet as a platform. VoIP networks have an architecture offering the most efficient way to implement multilateral telecommunications agreements, thus eliminating the need for carriers to engage in hundreds of bilateral traffic agreements as are required between traditional circuit-switched PSTN carriers. Moreover, since packet networks are software driven, they can be configured more dynamically than traditional PSTN networks. For example, with a global voice over packet network, new destinations are available to all users on the network, without the need for constant additional investment.

IP Telephony telecommunications companies may expand the availability of services to a wider audience. IP Telephony technologies can be used to build voice networks more rapidly and at a lower cost than legacy PSTN systems. Easier deployment of Voice over IP networks can bring the benefits of telecommunications to more people in a much shorter timeframe than would be possible with conventional PSTN networks. At the same time, not having to build extensive infrastructure provides the motivation for many companies to migrate to IP Telephony architectures.