



## Initial Paper

What is PLC

About Opera

Participants

Objectives and Executives Impacts

Project Structure

Technical Approach

Technical Approach

## Business Paper

Chapter 1

Chapter 2

Chapter 3

## Technical Paper

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Theme 1

Theme 2

## Final Results

Chapter 1

Chapter 2

Theme 2

Chapter 3

Chapter 4

Chapter 5

Theme 1

Theme 2



# Initial Paper

What is PLC

About Opera

Participants

Objectives  
and Executives  
Impacts

Project Structure

Technical  
Approach

Business  
Approach



- 1. What is PLC
- 2. About Opera
- 3. Objectives and Executives Impacts
- 4. Project Structure

#### 4.1 Technical Approach

##### *4.1.1 Improvement of the PLC System*

- 4.1.1.1 Couplers, Filters and Line Conditioning Devices
- 4.1.1.2 Model the PLC channel
- 4.1.1.3 Develop a PLC provisioning system
- 4.1.1.4 Characterise electromagnetic interactions of PLC
- 4.1.1.5 Access and in-house PLC equipment
- 4.1.1.6 Improve PLC Components
- 4.1.1.7 Improve functions of PLC equipment

##### *4.1.2 Backbone Network concepts and adjustments*

- 4.1.2.1 Interconnect PLC with backbone network
- 4.1.2.2 Optimize the Interconnection of the PLC access network to the backbone network
- 4.1.2.3 Obtain improvements with Satellite Links

##### *4.1.3 Development a Network Management System (NMS) and a Service Management System (SMS) suitable for PLC*

##### *4.1.4 Standardisation*

#### 4.2 Business Approach

- 4.2.1 Objectives related to commercial deployment
- 4.2.2 Dissemination of Opera



# What is PLC?

The Powerline Communication Technology provides broadband Data and Voice transmission on existing Power Networks.



## ■ What is PLC?

The Powerline Communication Technology provides broadband Data and Voice transmission on existing Power Networks.

Powerline Communications can provide:

- Fast and secure surfing on the Internet, e-commerce, e-mail and e-banking
  - Powerful telephone connection using the internet that offers security and good speech quality. Send and receive fax messages is also possible.
  - Smart Home Applications with remote maintenance and in-house control of internet enabled household appliances like refrigerators, heating systems, smoke and fire alarm systems.
  - Surveillance systems with both visual and motion detectors that can be monitored by you and a security service.
  - Health Care Services
  - Online reading of utility meters for flexible and easy up-to-date billing

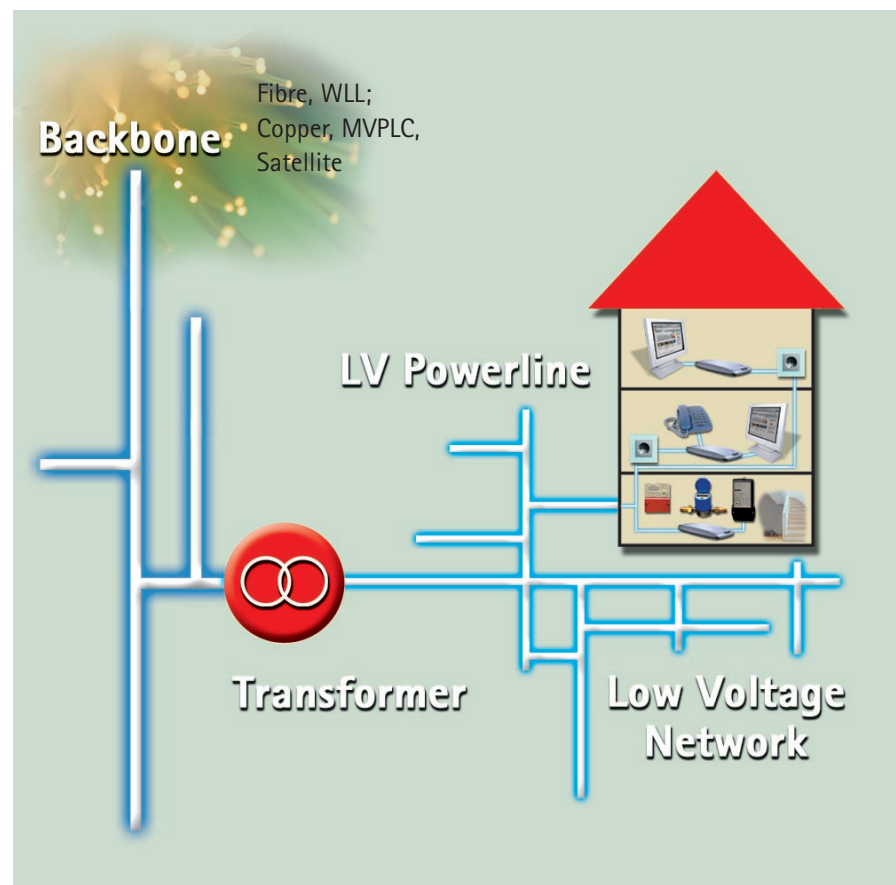
PLC is easy to install and use - no more wires are needed - just plug in. Share your internet connection and move computers and other appliances where you want. High transmission rates, multiple Megabits per second (Mbps), right now available and more than 100 Mbps possible. Together with secure data-encryption you can utilize your existing power source for all your communications needs, including TV quality video, streaming audio and broadband multimedia.

Utilities offering PLC services face interesting business cases together with added values like making power network maintenance more efficient and enhancing customer relationship. It is also a unique opportunity to build up a sustainable telecommunications business unit.



## ■ System Concept

*Fig 1: System concept of Powerline Communication access and inhouse system*



## ■ Example topology of PLC-Access

Digital information gets to the homes through modems that connect it to the home wiring. Each of the wall plugs is then online. Computers, stereos, digital TV's, appliances and game units will be plugged in for electricity and internet connection.

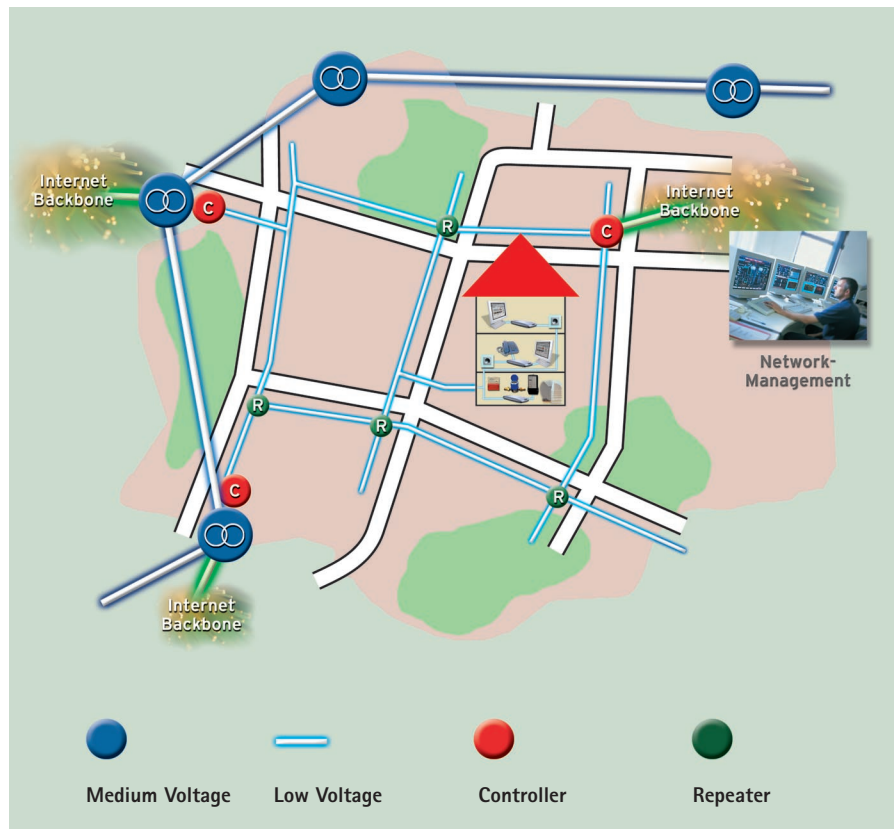


Besides the modem at the home the PLC Internet service provider installs controllers, usually at the secondary substations now feeding the LV-distribution networks in the streets not only with power but also with digital information. Repeaters between controllers and modems make the system reliable and efficient.

Controllers are connected to fibre backbones and internet via distribution networks consisting of a flexible mix of technologies, i.e. radio or copper lines, optical fibre, satellite or Medium Voltage (MV) PLC.

Every PLC-device is connected to the power line via couplers. Customer modems usually integrate them into the modem box. For controllers, repeaters and MV-devices flexible external solutions are available and subject of further enhancements.

Fig. 2: Example topology of PLC-Access

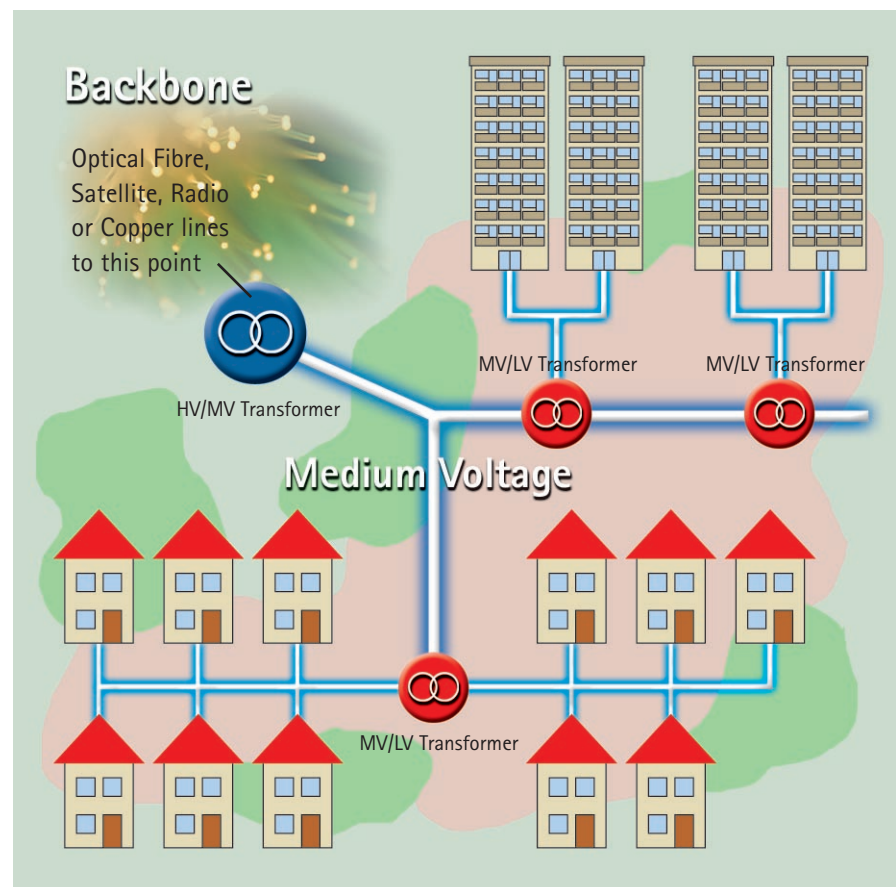




### ■ Example topology of Medium Voltage PLC

This technology has been developed in the last few years with impressive results. However there are some difficulties to beat on the road to an operator friendly system with sufficient flexibility for service development and excellence.

Fig. 3: Example topology of Medium Voltage PLC





# About Opera

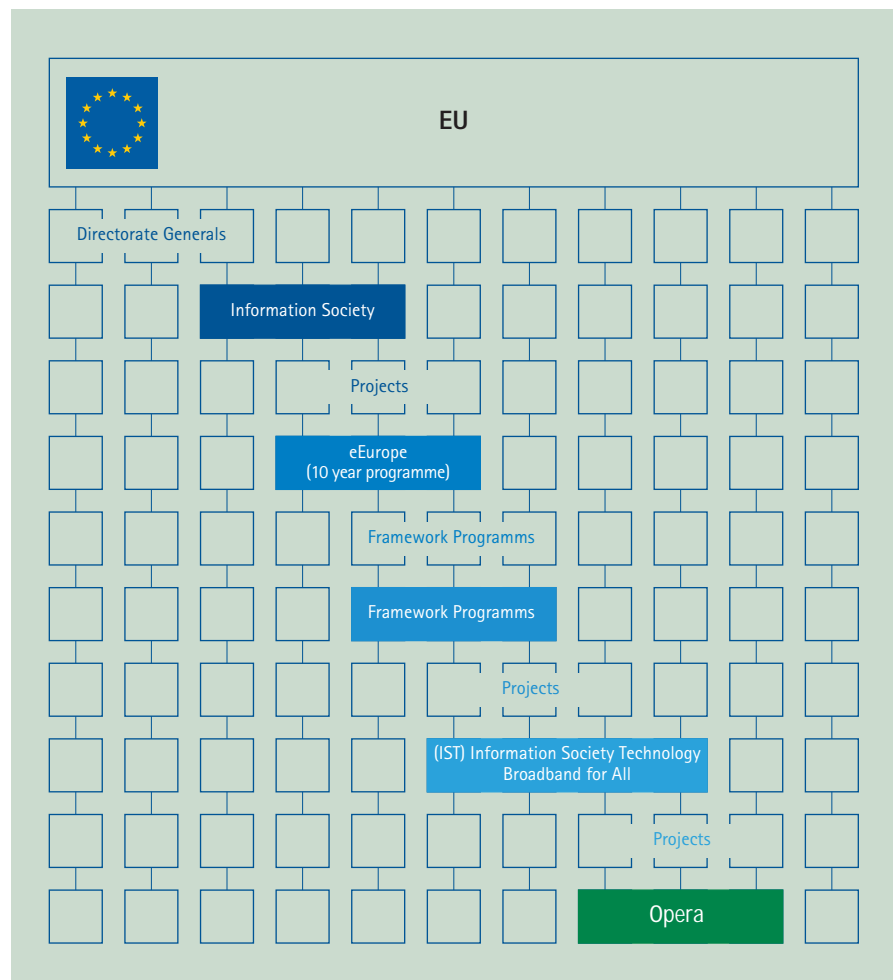
**OPERA** is the **Open PLC European Research Alliance** for new generation PLC integrated network – A R+D project with a budget of about 20 Million Euros, funded with about 9 Million Euros by the European Commission.

Participants

## About Opera

European research activities are structured around consecutive four-year programmes, or so-called Framework Programmes. The Sixth Framework Programme (FP6) sets out the priorities - including those of the Information Society Technologies (IST) - for the period 2002-2006. The Opera project will make a significant contribution within the IST area "Broadband for All"

*Fig.4: Opera is one component of a variety of EU projects. The graphic shows its positioning inside the EU hierarchy.*





The core of the project is to develop a new generation PLC technology as an alternative for access in the local loop. This standardised and standard technology will enable low cost broadband access for all European citizens with outstanding performance.

Accompanying actions are about the concept for the whole telecommunications system enabling the operator to design, offer and manage interesting, reliable and well-priced services.

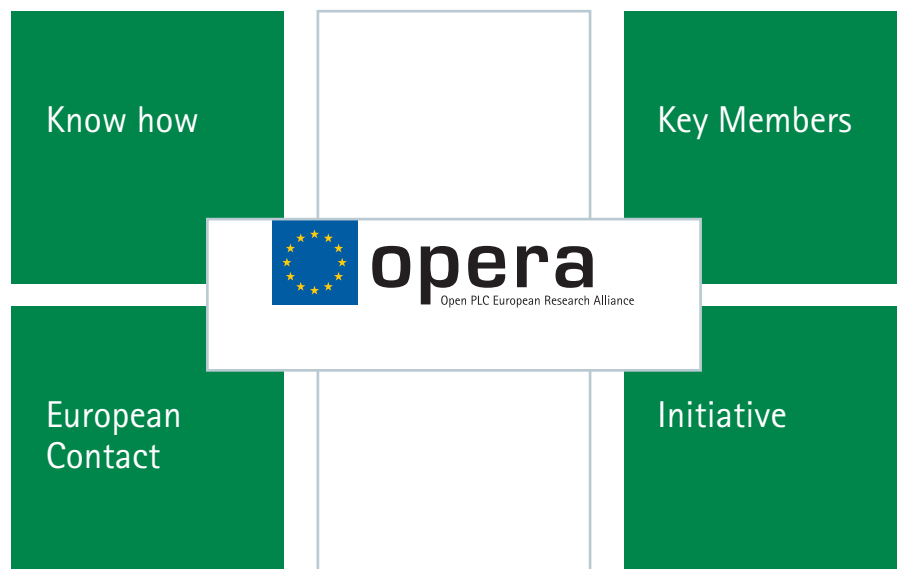
Furthermore service and business aspects are investigated.

36 participants form the consortium to achieve the project's goals. All main stakeholders in PLC are involved, not only from many European countries, but also from Israel. All types of organisation involved with PLC technology are included: utilities, developers and manufactures, universities, technology providers, engineering and consultancy companies as well as telecom operators.

The Opera project has an estimated timeframe of 48 months. The project is divided into two phases. Each phase lasts 24 months. This proposal only asks for funding for the first phase of the project, 24 months.

*35 participants form the consortium to achieve the project's goals. All main stakeholders in PLC are involved, not only from many European countries, but also from Israel*

*Fig.5: Elements insuring success of Opera*





# Participants






# Objectives and Executive Impacts



## ■ Main Objective

The main objective of the present project is to perform the necessary research and development on a European scale to overcome any remaining obstacles, allowing PLC operators to provide competitive, PLC-based broadband services for European citizens to enjoy.

## ■ Strategic Objective

The strategic objective is to offer low-cost broadband access service to ALL European citizens using the most ubiquitous infrastructure - Power Lines. Potential PLC-operators will be provided with a mass-market commercial technology requiring relatively low investment costs and minimum maintenance effort combined with full EMC-compliance. This will enable competitive PLC-based broadband services.

*The strategic objective of Opera is, to offer low-cost broadband access service to ALL European citizens using the most ubiquitous infrastructure, Power Lines*

## ■ Potential Impact

Opera will produce impacts in the European society aligned to the objectives of the action plan eEurope 2005:

- "Stimulating the deployment of a secure broadband infrastructure, creating a positive environment for private investment"
- "Promoting services, applications and content in key areas such as e-government, e-learning, e-health and e-business"



## ■ Opera Impacts

- PLC will contribute to the fast development of the European broadband market as a result of the increase of competition in access network (ADSL, cable modem, satellite, fixed wireless, fibre optic, 3G mobile and power line) especially in populated areas.
- Opera also focuses on the ability of PLC technology to complement other technologies. PLC will be able to integrate with different kinds of networks. This feature of PLC systems will facilitate finding the most suitable broadband solution in low-density and less developed areas. This will allow broadband coverage throughout any territory: "Broadband for All".

*Fig.6: Potential Impact and Benefits of PLC technology*

Potential Impact	Benefit
Increase of Competition in Access Network	Lower prices, higher quality and new services
Services in Low-Density and Less Developed Areas	Broadband for all
Leadership of European Industry	Employment, competitiveness and Investment
Foster Widescale Service Adoption	Promoting useful services for the Citizens
Gender Issues	Reduction of the housework Higher opportunities of job for Women in rural areas
New applications/Services not Imaginable yet	Quality of life



*PLC technology will definitively foster the uptake of innovative services*

- PLC represents an extraordinary opportunity for European industry since the know-how is based in Europe. Its development and subsequent commercialisation will ensure Europe's long-term competitiveness in the broadband industry contributing to the creation of both direct and indirect employment.
- PLC technology will definitively foster the uptake of innovative services such as internet for all, telephony, e-health, home automation (smart home), tele-surveillance, video streaming, etc.
- PLC will contribute positively to gender issues:
  - PLC technology promotes smart home services which facilitate the reduction of housework. Housework is still mainly carried out by women.
  - Opera opens a real possibility to create Information Technology based SME's in rural areas. This would especially benefit women who have less opportunities for jobs in these areas.
- PLC will generate new applications/services which are not imaginable yet. These new services would be oriented to improve the quality of life.

*Islands of PLC applications will accumulate into 100% PLC coverage. Scenarios will be realised where access to the internet will be available from every socket at every location*

## ■ Long Term Vision

The Opera project seeks to develop self-sustaining PLC solutions which will blossom over the next 10 years. This long term vision covers the following aspects:

- multiple PLC solutions, applications, and business scenarios will converge into an integrated PLC world
- Islands of PLC applications will accumulate into 100% PLC coverage. Scenarios will be realised where access to the internet will be available from every socket at every location.
- Roaming agreements between PLC operators country /Europe-wide will enable PLC services to end-users in a similar way as mobile services are offered nowadays.
- Collaboration agreements between PLC systems and WiFi systems will take advantage of the respective strengths of each technology and increase the coverage of one mixed system.



*PLC modems will achieve a level of integration so that they can be physically incorporated into every PC and laptop like today Ethernet cards*

- PLC modems will achieve a level of integration so that they can be physically incorporated into every PC and laptop like today Ethernet cards.
- With the development of PLC hot spots in airports, railway stations, hotels and fairs and the technical integration into laptops, PLC becomes interesting for business applications during business trips.
- The global introduction of PLC solutions will open up opportunities for new players throughout the value chain and will therefore offer widespread economic benefits.
- PLC technology will become a common way to transmit control signals between electrical components.

PLC will be completely integrated into converging telecommunications, broadcasting and IT business scenarios.

*Improved bandwidth, reach, ease of operation, network management, channel modelling*

## ■ Objectives

The **scientific and technological objectives** of the project are summarised below:

- Improved current Power Line Communication (PLC) systems -covering low voltage (LV) as well as medium voltage (MV) PLC system and looking at bandwidth, reach, ease of operation, EMC (electromagnetic compatibility), network management, channel modelling. Objectives relate to conditioning the power grid (using couplers and filters) and improving PLC equipment.
- Develop optimal solutions for connection of the PLC access networks to the backbone networks. The objective in this area is to create well-adapted backbone solutions (LMDS, satellite, MV PLC, etc.).

The main aim is to reach all end users independently of where they are.

- Develop "ready to sell services" over PLC technology and design or improve low cost user terminals.

*Standardisation of PLC systems.*

Furthermore the project presents the following objectives:

- Standardisation of PLC systems.
- Definition of the business plan and procedures for network maintenance and service provisioning, along with market research to know the requirements of end users.
- Dissemination of the project results, respecting the intellectual property rights



*Fig.7: The present state of the art and the objectives are represented in the right table*

Concept	Today	Opera Goals
Speed	Up to 45 Mbps	Up to 200 Mbps
Frequency Reuse	x 1	x 4
System	Proprietary solutions	Standard plug & play multi-vendor
Standards	Not existing	International
LV Installation	Complex and expensive	Easy and low-cost
MV Coupling	Capacitive	Inductive
End-user coverage	80% - 90%	100%
Mass deployment	Not ready	Ready
EMC Standard & Compliance	National level	European level
Audiovisual Services over PLC	Initially tested	Ready to sell
Terminals	Not user friendly	User friendly
Inhome compatibility	Not guaranteed	Guaranteed
Degree of Backbone Integration	Inefficient	Efficient

Achieving these objectives will lead to the strategic objective of the project: to have a really convenient operative PLC Integrated Network suitable for commercialisation, where all current requirements for PLC improvements will be properly satisfied and where interconnection to the most important technologies is possible, in order to reach all end users wherever they are.



# Project Structure

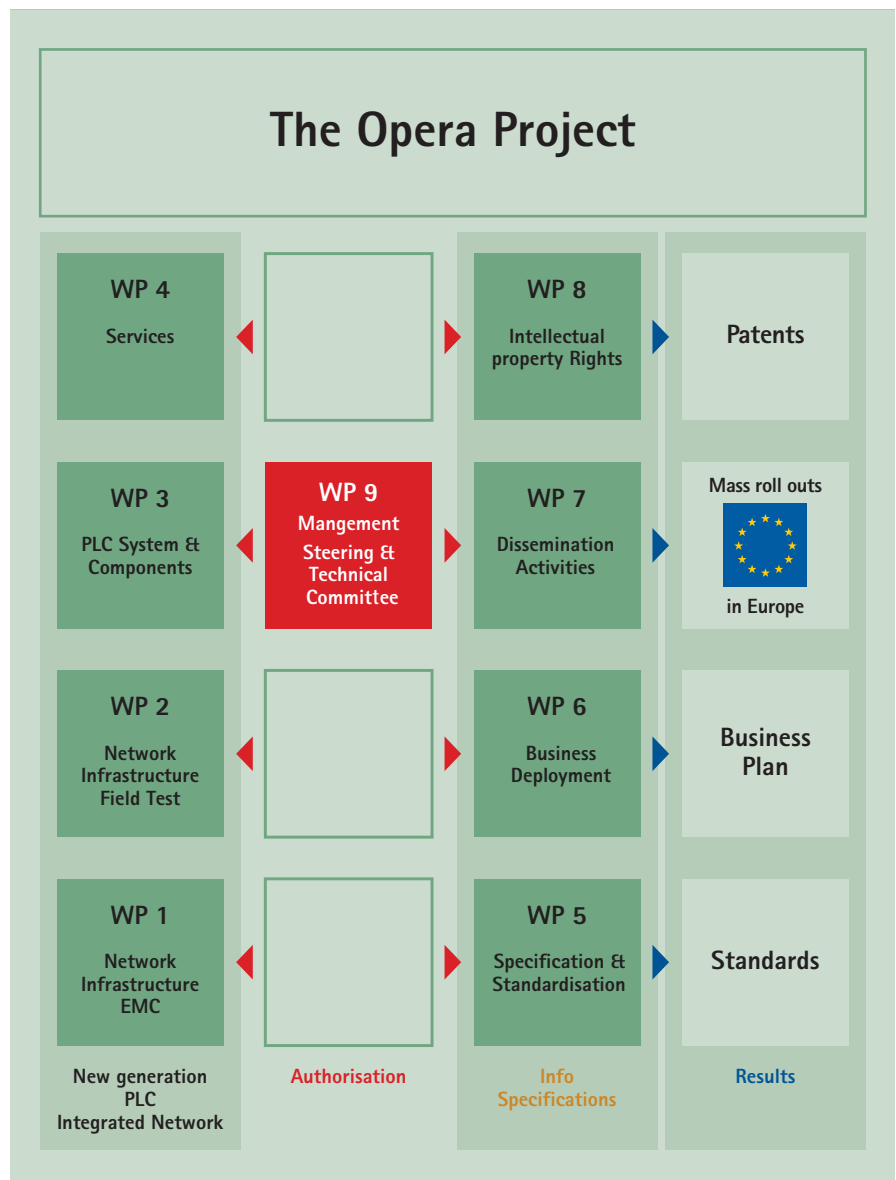
Technical  
Approach

Business  
Approach



## 4.1. Technical Approach

Fig.8: The workflow represents the management interrelation among all the workpackages





## ■ 4.1.1 Improvement of the PLC System

### 4.1.1.1 COUPLERS, FILTERS AND LINE CONDITIONING DEVICES (FOR LOW VOLTAGE AND MEDIUM VOLTAGE)

The Opera Project aims to use the existing power grid (nowadays available for every European citizen) as the communication medium for broadband services, regardless of the location of the end user. To use the power grid for communication, sometimes it is helpful to adjust it by installing couplers, filters and line conditioning devices. The key partners in the area of filtering and coupling (PLC technology providers, developers and manufactures, Electrical Utilities and some Academic Institutions) are working on an improvement in such elements. This will assure the suitability of the power line as the communication medium for broadband when combined with convenient planning and installation for operators.

The objective is to provide specific and suitable low and medium voltage PLC conditioning components (couplers, filters and line conditioning devices) which will have higher performance (increased bandwidth, longer distances reached, reduction of interference and signal losses), reduced size and an easy installation procedure without cutting power.

Furthermore, current couplers do not adapt automatically to changes in channel characteristics, so another objective is for LV couplers to adapt to channel characteristics.

During the project prototypes will be provided together with an installation procedure and validated in field tests. After the first phase of the project and as a result of this research, into the mass commercial deployment, the LV installation will be easy and low cost, the MV coupling will be inductive, the use of LV filters in the busbars will allow frequency reuse and all the improvements in couplers, filters and conditioning devices will contribute to reach an end user coverage of 100%.

### 4.1.1.2 MODEL PLC CHANNEL

Besides the aim to develop standard PLC equipment, the acquired knowledge throughout the project should be used as a basis for further research in the PLC arena.

The availability of simulators will be very useful for testing equipment in the laboratory in the process of further research. The intention is to make a valuable impact on the scientific community.

*The objective is to provide specific and suitable low and medium voltage PLC conditioning components which will have higher performance, reduced size and an easy installation procedure without cutting power*

*The availability of simulators will be very useful for testing equipment in the laboratory in the process of further research. The intention is to make a valuable impact on the scientific community*



Different PLC models - PLC channel, noise in PLC channel, coupling units, filters and conditioning devices - will be created and they will be used to simulate the PLC channel. The process of measurement, followed by the modelling and the development of a simulator will be worked out by different key partners from electrical utilities, technology providers, manufactures, engineering companies and universities.

Currently, research on channel and noise models have been done (reported by University of Karlsruhe and supported by ABB and RWE, University Politécnica Madrid etc.), using results of measurements campaigns. The results have been used to develop power line channel emulators. A channel emulator must be able to reproduce typical channels and realistic noise scenarios, including asynchronous impulsive noise. However, up till now, only very unsatisfactory and inadequate solutions like cable drums, notch filters and signal generators are available to perform these tasks. Thus, integrated and easy to operate hardware has to be developed which implements reference channels and different noise scenarios.

Also, models of couplers and filters have been developed. However more research has to be done in order to consider different materials and topologies of power line networks.

During 2004 a report with the results of measurement campaigns will be available and in the First Half of 2005 there will be a theoretical postulation of PLC channel model, along with models for filters, couplers and conditioning devices. A report of path loss as a function of frequency, distance and network topology for various LV/MV European power line networks will be submitted. Mid 2005 a software channel simulator will be provided.

As a result of this research, technology providers, universities and other organisations interested in continuing PLC research will have a useful tool for test and comparison of PLC equipment in laboratory.

*During 2004 a report with the results of measurement campaigns will be available and in the First Half of 2005 there will be a theoretical postulation of PLC channel model, along with models for filters, couplers and conditioning devices*

#### **4.1.1.3 DEVELOP A SERVICE PROVISIONING SYSTEM**

Opera aims to optimise operational costs in the commercialisation phase. The cost of previous field studies can be avoided with a system able to predict if it is possible to provide a certain service over a given PLC network to its clients. Such a service provisioning system will be developed in the second phase (2006/2007) of the project by PLC technology providers, developers and manufactures, engineering companies and universities.



*Implement a system able to estimate the quality of service the customer will receive*

Nowadays, in a PLC network there is no way to determine the quality of service provided to a customer until equipment installation is performed. This is an unsatisfactory process, based on trial and error until the best conditions are achieved. The objective is to implement a system able to estimate the quality of service the customer will receive. This system will be useful for commercialisation because it will allow the operators to respond rapidly to customers' requests, without the need for a field study.

#### *4.1.1.4 CHARACTERISE ELECTROMAGNETIC INTERACTIONS OF PLC*

It is intended that PLC becomes an alternative broadband access method for all European users; however communication over the power line should neither interfere with other established communication systems (e.g. radio) nor be interfered by noise over the PLC channel.

*Electromagnetic interactions of PLC will be investigated*

These electromagnetic interactions of PLC will be investigated in close collaboration with PLC technology providers and academic organisations. The electromagnetic interactions of short wave radio with PLC technology as well as those of noise and interference signals with PLC will be characterised. The established mechanisms and requirements to control these interactions will be fixed in a standard.

Although some measurement campaigns of conducted and radiated emissions, have been carried out, there is not sufficient research available to unambiguously characterise the electromagnetic interaction between short wave radio and PLC. Furthermore, impulsive noise is a strong impairment for Power Line Circuits. E.g. motors, light dimmers, television receivers, fluorescent and halogen lights, induction motors and certain switching power supplies produce interference on the 20 MHz band. Very little work on such noise has been done (Vines, Chan and Dostert produced some results).

Therefore the objectives are to find out:

- Disturbance voltage from PLC technology
- Radiation from PLC networks
- Immunity of PLC equipment against noise and interference

For these purposes, measurement campaigns in a wide variety of access and in-home areas will be performed in order to create a database that allows us to model the distribution of emissions. In addition, specific studies will be carried out.

The EMC reports will be ready by Autumn 2005.



*Coexistence between the two  
separate fields for PLC*

#### **4.1.1.5 ACCESS AND IN-HOUSE PLC EQUIPMENT**

Even though the project focuses on PLC access networks, the coexistence between the two separate fields for PLC has to be taken into account: inside the customer house for private communication networking ("In-house") and mainly outside the house as a local loop application to provide Internet based services access to customers on the medium and low voltage electrical network ("Access"). PLC technology providers, developers, manufactures and universities will combine their efforts to obtain a coexistence solution.

Many organisations tried to address the coexistence issues, e.g. PLC Forum with notable links to the CENELEC and ETSI committees, HomePlug and CEA R7.3 Working Groups in US. Up to now, no organisation succeeded in creating a unified coexistence mechanism.

So the objective is to provide the specification for a coexistence mechanism early in 2005 together with a report of cost estimation for the hardware necessary to implement the coexistence access/in-home PLC solution.

Additionally a full simulation of the proposed coexistence mechanism solution will be made during 2005.

#### **4.1.1.6 IMPROVE PLC COMPONENTS**

One approach to satisfy the future broadband user requirements for Internet-related services is to improve the PLC components with a resultant increase in usable bandwidth. PLC technology providers and manufactures will work on these improvements of PLC performance.

The objective is to allow utilities as operators to launch broadband services over power lines with commercial guaranties by improving features of current PLC equipment in the low and medium voltage.

The specific features to be improved are the following:

- **Bandwidth.**  
The objective is to reach enough transmission speed to support the services offered by operators. Today the speed is up to 45 Mbps and the objective is up to 200 Mbps.
- **Reliability & Stability**  
The objective is to design an enhanced mechanism on the PHY and MAC layer that ensures high reliability and stability.

*Allow operators to launch  
broadband services over  
power lines with commercial  
guaranties*



#### *Compliant with EMC standards*

- EMC

The goal is the development of a PLC product compliant with EMC standards that will be defined by CISPR.

A report of the detailed design of PHY, MAC & DLC layer will be available in Autumn 2004, along with the report of detailed design of PLC MIB. In spring 2005 a FPGA prototype will be developed and tested in small-scale field trials. As a result of this FPGA, by the end of 2005 ASIC prototypes will be tested in large-scale field trials.

#### *4.1.1.7 IMPROVE FUNCTIONS OF PLC EQUIPMENT*

#### *Enhanced intelligence and functionality in the access network*

Improving PLC functions to provide enhanced intelligence and functionality in the access network for delivery of new broadband services is another important aim of the project.

PLC technology providers and manufactures will work on:

- Automatic configuration

The goal is to develop an automatic configuration solution based on the location in the network and also a dynamic reconfiguration if there are changes at the location or the environment. This will avoid configurations by technicians in the field as well as reduce installation and maintenance time and cost

- Support of applications that require QoS mechanism

Applications that require QoS mechanisms like VoIP, video on demand or video streaming will be supported by the developed PLC technology. The aim is to implement standard and easy to configure solutions

- Remote maintenance abilities.

The objective is to provide standard remote maintenance facilities based on standard SNMP protocol that will allow remote identification of alarms, obtaining information on remote components and upgrading software. The employed standards should be internationally agreed by all stakeholders in Europe

Early in 2005 there will be a detailed design of the Automatic Configuration System and QoS solution. By mid 2005 a PLC prototype with automatic configuration protocols and QoS features will be provided along with a detailed design of remote maintenance and upgrade capability.



*Interconnection with the backbone network by reducing the necessary equipment for the interconnection*

## ■ 4.1.2 Backbone Network Concepts and Adjustments

### 4.1.2.1 INTERCONNECT PLC WITH BACKBONE NETWORK - AVOIDING THE USE OF MEDIA CONVERTERS

Optimisation of the operational costs can not only be achieved in the PLC access network, but also in its interconnection with the backbone network by reducing the necessary equipment for the interconnection.

Therefore PLC technology providers in conjunction with manufactures will develop PLC equipment with direct connections to the backbone networks. Especially direct interfaces to optical fibre backbone network will avoid the use of media converters.

The objective is to develop PLC medium and low voltage equipment with 100BaseF interfaces to connect directly PLC equipment to an optical fibre backbone network without an additional transceiver.

A prototype PLC gateway with a 100BaseF direct interface to optical fibre backbone will be ready by the end of 2005.

### 4.1.2.2 OPTIMISE THE INTERCONNECTION OF THE PLC ACCESS NETWORK TO THE BACKBONE NETWORK

The development of network technologies and architectures that allow a generalised availability of broadband access to European users is not restricted to improvements in the access network. The optimisation of its interconnection to the backbone network, to give end-to-end network connectivity, also has to be considered.

*Optimise this interconnection with regard to robust behaviour, easy handling and cost-effectiveness*

So the objective is to optimise this interconnection with regard to robust behaviour, easy handling and cost-effectiveness. This will also improve competitiveness of PLC to other broadband access technologies

During the project different backbone technologies will be studied and the requirements of PLC and backbone equipment interfaces will be specified.

Corresponding reference documents on planning and optimisation of the PLC access and distribution network as well as on implementation, installation, management and operation of PLC distribution networks will be provided in autumn 2005. By the end of 2005 an additional report on medium voltage back-bone systems will be ready as well as another one about requirements and specifications for the integrated communications system, i.e. PLC medium voltage and LAN as well as PLC medium voltage and PLC low voltage.

In Spring 2005 a reference guide for the selection of PLC distribution network technology and for the optimisation of PLC access networks and their connection to the backbone network will be available together with one for cost estimation of PLC distribution networks.

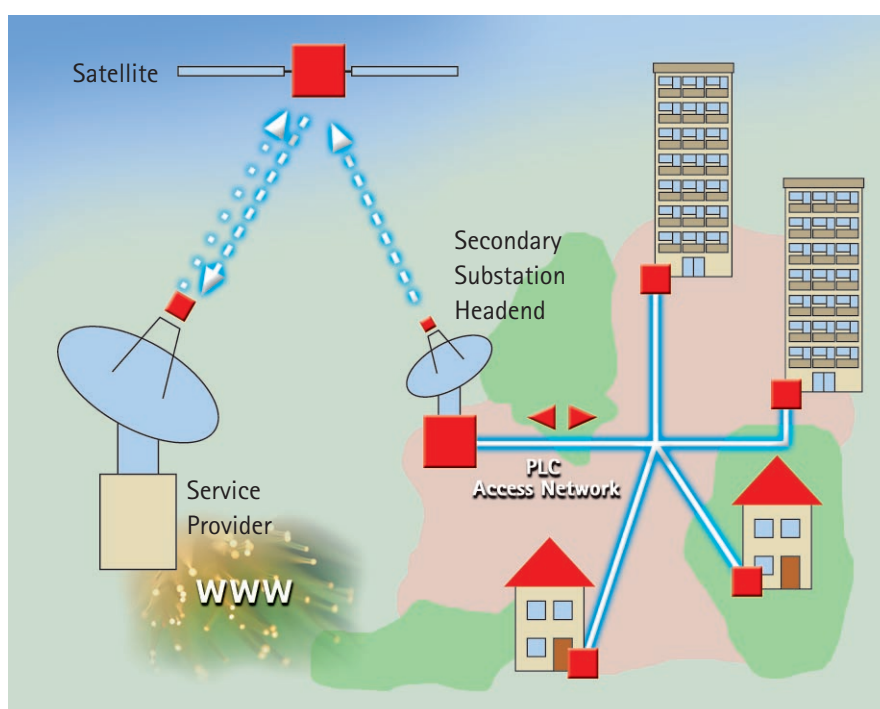
Also at that time, the interface specification for PLC access and distribution network equipment will be presented. Subsequent prototypes will be tested in the field.

These backbone integration guidelines will be valuable references during the selection of the optimal backbone technology in mass deployments.

#### 4.1.2.3 OBTAIN IMPROVEMENTS IN THE INTERCONNECTION OF PLC ACCESS NETWORK WITH SATELLITE LINKS

A telecommunications broadband service architecture aiming to serve all European users must integrate the best available backbone technology with regard to the target area. Satellite links represent a backbone technology allowing

*fig.9: In isolated areas satellite links are suitable for providing fast Internet connection*



*Satellite links represent a backbone technology allowing telecom operators to reach places that they would never have reached*

telecom operators to reach places that they would never have reached due to the large expense required for additional infrastructure.

In isolated areas satellite links are suitable for providing fast Internet connection. However, it is not reasonable that each individual customer uses a bidirectional satellite link access. The interconnection between PLC access networks and satellite links will allow traffic concentration of multiple users over the same link, limiting the number of antennas and optimising the cost.

In the project certain developers very specialised in the area of satellite communication, telecom operators and electric utilities will work together to overcome some obstacles that arise since these two technologies were not originally designed to work together:

- Remote management  
Mechanisms must be provided making possible the remote management of PLC devices interconnected to the satellite system.
- Access multiplexing  
Current maximal bit rate in satellite links is 2 Mbps (DVB- RCS). Scalable bandwidth solutions by inverse multiplexing with more than one terminal for increasing the access capability need to be investigated.
- Service priority  
Services over PLC access networks integrated with satellite links must adapt to the weakest QoS-provisioning

As a result of research and following field tests in mid 2005 recommendations will be ready for the implementation of satellite access into a PLC system.

In the second phase of Opera 2006/2007 a transparent remote management system will be developed as well as an access link multiplexing solution.

Traffic profiles in rural and isolated areas will be analysed as the basis for QoS-investigations.

The results will push satellite links to be the solution in rural and isolated areas through the commercialisation phase.



*Standard MIB*

**4.1.3 DEVELOP A NETWORK MANAGEMENT SYSTEM (NMS) AND A SERVICE MANAGEMENT SYSTEM (SMS) SUITABLE FOR PLC**

The basis of a new standardised network management system for PLC networks will be developed using new concepts for network management and with a view to reducing operational costs. A broad range of know-how will be incorporated through the collaboration of developers, manufacturers, electric utilities, telecom operators and PLC technology providers.

The objective is to validate a standard MIB for the "Opera PLC system". This will be the basis for the development of NMS and SMS capable of integrating standardised PLC access network equipment with the elements of the backbone network in a transparent way. Service provisioning and operational end-to-end quality of service (QoS) monitoring will also be included. The aim is to provide a system that can be used for planning and operational purposes.

In spring 2005 the network management system/service management system (NMS/SMS) prototype implementation will be presented together with the documentation covering:

- specifications
- model
- architecture
- design
- specification of the interface to a geographic information system (GIS)

**■ 4.1.3.1 "Ready to sell" Services and low cost user's terminals**

**4.1.3.1.1 TO SPECIFY TECHNICAL AND OPERATIVE COMPONENTS FOR SERVICES OVER PLC (VOIP, TELE-SURVEILLANCE, AUTOMATIC METER READING, e-HEALTH)**

To provide maximum benefit to the end customers and value to the operator a PLC system has to be able to deliver multiple services at a low cost.

The requirements for that will be identified by studying a number of services and parameters.



*An "adapter" connecting a TV terminal with the PLC network will allow the use of TV as an Internet and video terminal*

#### 4.1.3.1.2 TV TERMINAL

Nowadays, TV has a high penetration rate and is user friendly. So TV could be a perfect apparatus for people to enjoy broadband services.

An "adapter" connecting a TV terminal with the PLC network will allow the use of TV as an Internet and video terminal.

Currently the set top boxes available in the market which are ready for supporting Internet over TV have usually a telephone connection and/or a 10 Mbps Ethernet connection, some recent versions support cable modem, 100 Mbps Ethernet and ADSL. The objective is to have a set top box connecting the PLC network in order to enable TVs for broadband based PLC services. The approach is to adapt existing models.

In the second phase of Opera project, a set top box adapted to PLC networks will be ready. This will be a major step to enhance the market penetration of PLC services in its deployment areas.

*Multi-vendor plug and play solutions  
Cost and price reduction*

### 4.1.4 Standardization

TO SPECIFY THE REQUIREMENTS OF THE NEW PLC INTEGRATED NETWORK AND TO DRIVE THE PLC STANDARDISATION IN THE COMPETENT ORGANISATION

To achieve the appropriate acceptance, awareness and finally penetration of PLC in the mass market an important requirement is an accepted standard for access PLC, which is not in sight yet. Besides the cost and price reductions such a standard will provide confidence to the operators. The standard should enable multi-vendor plug and play solutions.

The approach is to reach an agreement among all interested parties, i.e. PLC technology providers, electric utilities, telecom operators, developers and manufacturers, with support from Universities providing their technological experience.

It is organized to specify a standard for the following issues of PLC:

- Functional requirements
- Topologies of PLC networks and system requirements, e.g. performance,



### *Specifications*

QoS, network management requirements, electrical safety specifications, dimensions, target costs

- Access system specification  
PHY layer, MAC layer, co-existence indoor-access, MIB for NMS, PLC network and services interfaces.
- PLC equipment specification
- EMC  
The objective is to provide enough information to achieve a reasonable agreement at European level.
- Interface with narrow band PLC Systems.

In the Spring 2004 the following results will be available:

- Specification of PLC system requirements
- General specification of PLC PHY layer.
- General specification of PLC MAC layer
- Specification of common MIB for all PLC equipment.
- Specification for the EMC measurements to be performed

In the Summer 2004

- An interface specification between PLC and narrow band services systems (This affects the services home automation and Automatic Meter Reading)
- The requirements for PLC equipment, particularly access/indoor coexistence
- Specification of standard interfaces according to the services intended to be provided will be presented

Those specifications will be taken to standardization bodies and will be the reference for the manufacturers of standard compliant, new generation PLC systems.



# Business Approach

Objectives related  
to commercial  
deployment

Dissemination  
of Opera



## ■ Business Approach

Participant	Contribution
Participants of WP	Business plan and market research
Telecom Operators	To provide services over PLC networks
Utilities	To provide services over PLC networks
Utilities	To provide the electricity network and PLC network maintenance
Technology Providers	To provide the technology: chips, operative system...
Manufacturers	To provide PLC equipment
Universities	To use the knowledge PLC equipment
Universities	To use the knowledge of the project for further research

### ■ 4.2.1 Commercial Deployment

#### *4.2.1.1 TO IDENTIFY THE MARKET NEEDS AND TO DEFINE PROCESS FOR OPERATORS TO DEVELOP THE BUSINESS PLANS*

*Business plans will also take into account new business models*

Key elements for commercialisation of PLC are the identification of the end users' needs and appropriate business plans. PLC operators need this for preparation of their deployments and service offers.

By using market research, the end users' needs will be identified and transferred into technical and functional requirements for the PLC system. Setting up the business plans will also take into account new business models.



One challenge to face is that there is not a common business plan, rather a series of specific configurations for each distinct company. The approach is to establish a common business plan framework which can be individually adapted. The competence of consultancy and engineering companies, telecom operators and power utilities will be incorporated.

In Autumn 2004 a report of new business models will be finished, along with a report of technical requirements specification to implement new business models.

By the end of 2004 the report on business plans will be available and in Spring 2005 a common business planning tool for new business models will be ready.

In Autumn 2004 a report on the market research will be ready and, as a subsequent result a report of technical requirements specifications and a marketing white paper will be presented by the end of 2004. The white paper contains chapters on channel sales, market access tools and methods etc.

#### *4.2.1.2 IMPROVE PROCEDURES FOR NETWORK OPERATION, MAINTENANCE AND SERVICE PROVISIONING*

For mass commercial deployment, it is necessary to specify and implement the processes and tools to ensure efficient commercial operation and maintenance of the network and to deliver broadband telecommunication services.

Power utilities, telecom operators, consultancy companies and developers will develop together the network operation and maintenance procedures as well as the permanent surveillance of the network, for the optimisation of the business processes and finally the cost efficiency of large PLC networks. Additionally the procedures for service provisioning will be optimised.

By the beginning of 2005 reports on network operation and maintenance standard procedures will be finished and by mid 2005 the following deliverables will be ready:

- Software tool for permanent and remote maintenance supervision
- Software tool to create a data base with statistical traffic observations
- Software tool to support hotline procedures concerning customer relationship management
- System solution for mobile work force management

*Optimisation of the business processes*



*Commercial deployment needs  
to be efficient and at appropriate  
operational effort*

- System solution for convergence between network maintenance, operation system and geographic information system.
- System solution for convergence of network roll-out planning support software and the network maintenance system.

Once the services over PLC have been specified and implemented technically, the scale of commercial deployment needs to be efficient and at appropriate operational effort. So, this objective consists of providing simplified procedures for service provisioning, including fair and transparent billing, in order to facilitate the commercial mass deployment of service over the new generation PLC network.

By the end of 2005 a number of reports related to improvements in service provisioning procedures will be ready:

- Report of procedures for service provisioning
- Report on legal and regulatory requirements on specific services.  
Report of different options for billing
- Report on lawful interception methods. Test specification for end user trials

*Reach the mass market*

## ■ 4.2.2 Dissemination

Dissemination is the instrument to transfer and exploit the knowledge gained throughout the project. To reach the mass market every dissemination activity for the project will be checked if it is suitable for communication to the consumer market.

Different tools will be used for disseminating information, such as electronic communication means, a website, newsletters, technical visits, road shows, publications, conferences, workshops, training and education etc.

Competitiveness of participating companies, institutes and organisations is also an important element. Dissemination will therefore be oriented towards creating and increasing awareness and transfer of knowledge, while still respecting intellectual property rights.

To take care of the intentions of the Commission a process for regular information exchange is established.



Special dissemination activities related to regulatory issues will be carried out to inform the stakeholders and especially the Commission.

Objectives:

- win new players in the PLC area in all related domains:  
Chip-designers, system manufacturers, operators, service providers, consultants, venture capitalists, system houses and so forth
- Attract attention within other business areas to enable the discovery of links between PLC and other businesses capable of creating new promising products
- Get visibility towards the end-customers
- Continuous information of the Commission and transfer of their feedback into the project
- Fast and widespread distribution of the consolidated findings related to regulatory issues

Tasks:

- Web site, Creation of a small-scale web site, providing information as well as access to internal and external sources. The presence of the site will be communicated to the important search engines
- Newsletters  
A regular newsletter in electronic form for pushing actual information to interested parties and individuals will be managed
- Publications  
Initial papers on the project and plans, technical and business papers on the progress as well as a final results report
- Road Shows  
Presentation of the prototypes of the developed PLC-system and Services in conjunction with the results of the business and marketing research
- Technical Visits  
Organisation of field trial visits for the demonstration of the developed PLC-system and services
- Participation in fairs with major relevance for the project's objectives to present the intermediate and final results and get feedback from a wider user audience



- Participation in conferences with major relevance for the project's objectives to present the intermediate and final result and get feedback from a wider user audience. Participation without physical presence at suitable conferences (e.g. Poster) to take into account after the constraints of the budget.
- Organisation of a final conference at the end of the project to present the results and the roadmap for further PLC-products and services
- Workshops  
Organisation of workshops to gather all experts in the different business and technological fields to discuss the requirements of the sector under consideration and provide recommendations for future action - research covered or not covered by the project - tailored for the specific sector
- Organisation of theme parties, cocktail receptions etc. in conjunction with corresponding events to attract decision makers
- Training programmes will be set up to address the informational needs of established and new players in the PLC-area. They need to be informed in depth about the outcome of the project related to their special business cases.