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"Network of the Future"

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Socio-Economic Studies Report-1
Summary Report

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Abstract:
This document describes the initial work done in EFIPSANS towards *Socio-Economic Studies*. The document summarizes what was done in the first year of EFIPSANS and goes on further to describe the Future Plans towards carrying out the *Socio-Economic Studies.*

Keywords: WP6, *Socio-Economic Studies*.

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1. Introduction

The findings of D.6.3 indicate that the area of autonomics and IPv6 is in its early stages of development and there is little information and knowledge available to demonstrate the socio-economic impacts. Therefore, there is a lot of work to be done in this area to produce some meaningful outcome for the autonomic environment primarily due to the constraints outlined in section 3 of this document.

These findings puts Task 6.4 Socio-Economics Studies of the EFIPSANS project at ground zero to resource itself differently and play a pioneering role in engaging industry to create a serious path to real solutions such as building industry standards to generate a mass market with genuine value and new business opportunities.

In order to address these challenges, a concise description of the future work plan for Task 6.4 is presented in this report in light of the Deliverable 6.6 (D.6.6) and Deliverable 6.8 (D.6.8) due month 24 and month 36 respectively. It also takes into consideration the feedback received from the review of the existing socio-economic Deliverable 6.3 (D.6.3) and clearly identifies the objectives achievable for the remaining period of the project. This report also includes a summary of the major findings from D.6.3.

2. Objectives being addressed

Task 6.4 concerns the expected socio-economic impact of EFIPSANS project. The research objectives and priorities for impact assessment of IPv6 Autonomic Networks as per the original proposal are:

- Evaluation of the effects of widespread use of Autonomic Networks and Services.
- Analysis of policy & measures on global IP version six protocols with autonomic characteristics.
- Elucidation of social aspects of a user's quality of experience (QoE), which reflects its degree of satisfaction in accordance to the quality of service (QoS) provided by the network.
- Mapping and adapting requirements of societal communities to communication services and infrastructure.
- Clarification of future economic trends in communication services and infrastructure
- Support for business strategy.

At this stage it appears that the advancements driven by EFIPSANS will follow a techno-economic evolutionary path leading to social implications. Therefore, the future work will present an analysis that incorporates:

- Socio-economic impacts due to technological advancement of EFIPSANS
- Socio-economic impacts due to better Quality of Experience (QoE) for users
- Socio-economic impacts due to creation of new services, practices, etc, as a result of EFIPSANS research and technology development.

D6.6 will address the technological impacts of autonomics on the current network management practices, which are known to involve a great deal of human intervention in the commissioning and maintenance of network operations. Savings on operating cost and superior quality of experience will be the key focus areas for this deliverable. Quality of Experience aspects will be investigated in further detail in D6.8 along with the socio-economic impacts of new services, practices, etc. As Task 6.4 (T6.4) is an evolution of the work, D6.8 will also put together the most important results from D6.3, D6.6 and D6.8 and present a summary of the socio-economic findings for the entire duration of the project.

3. Summary of findings from D6.3

The findings of D6.3 demonstrate that a lot needs to be accomplished in the autonomic environment area to produce some meaningful outcome. In order to make a detailed and broad Socio-economic study than what we can achieve in the current EFIPSANS project, the following requirements would need to be considered:

- Requirement for industry standards for autonomicity at ETSI or the IETF
- Need for industrial experience.
- Need for IPv6 production-grade autonomic solutions.
- Need for user experience and awareness of autonomicity.
- Need for industry-based research in this area.
- Need for large-scale IPv6 production networks interested to look into IPv6++ features.
- Need for a proper Industry Forum for autonomicity to design standards.

In general, there is an abundance of research by the academia in the field of Autonomics. However the lack of contributions to standards and industry scale exploitation makes their research work difficult to exploit. This is the reason why EFIPSANS took the initiative to establish an Industry Specification Group (ISG) within a well established standardization body (ETSI).

3.1 EU Market & Survey Results

EFIPSANS has undertaken a review of available data in advance of undertaking its own research work. A recent market study done solely for IPv6 features by another EU-funded project has shown following first results that need to be taken into account in our next study when combining IPv6 with autonomicity. This study described the **new needs** for IPv6 addresses by analyzing 15 vertical sectors and the potential application of IPv6. The results from this study will be used as background for the work in task 6.4. They have been studied carefully.

In this survey, a SWOT analysis has been devised over fifteen sectors to describe their Strengths, Weaknesses, Opportunities and Threats to integrate IPv6. These sectors have been chosen, from early results of the consultation process, based on the potential impact they may suffer or benefit if a wider IPv6 adoption were to happen.

Table 1: List of 15 sectors analysed through a SWOT analysis

1. Central Government	8. Collective Transportation
2. Education	9. Health
3. Defence	10. Buildings
4. Media/Entertainment: Gaming	11. Public safety
5. Media/Entertainment: Television	12. Finance
6. Tourism	13. Logistics
7. Automotive Transportation	14. Service operators

By 2012, about 17 billion devices will be connected to the Internet, estimates IDC. However, only 30% of the Internet Service Provider networks will support IPv6 by 2010, and 30% of user networks by 2012, according to a study by the National Institute of Standards and Technology (NIST) and the RTI International on IPv6 migration (2006). Furthermore, InfoPro reports that only 5% of the interviewed US organizations have IPv6 in use today. Research also reveals that additional 18% have expressed some interest in adopting IPv6 for their infrastructure in the next 12 to 18 months (2006).

1. **What are the Strengths for these sectors to integrate IPv6**

The main advantage of IP version 6 over IP version 4 is the larger address scope. The large majority of actors share this belief. For example, an adoption of IPv6 in automation and control industry would require a lot of IP addresses that IPv4 cannot deliver. The fact that IPv6 is an open standard could make the development of solutions in the long run less expensive than proprietary ones.
In a world becoming more and more mobile, the IPv6 mobility feature is of great interest in some sectors (automotive, transportation, public safety). Even if IP version 4 supports that kind of mobility, IP version 6 makes it easier to use and to develop.

2. **What are the Weaknesses for these sectors to integrate IPv6**

The main weakness is the fact that everything works with IPv4 and technical solutions are proposed to make it evolve. Business solutions are thus developed using the existing standard, IPv4. Convincing industries to move to a new standard which implies staff training and technical support without having a strong and clear competitive advantage compared to version 4 is difficult. Solutions are still implemented using proprietary standards or IPv4. Despite the complexity of NAT, Voice Over IP (VoIP) uses IPv4. A lot of research is still carried out using IPv4.

IPv6 competes with other standards in some sectors, but has to face the fact that there is not a pull demand. Markets have to be created. Upfront investments should be made and ROI is difficult to see in a short-term view. For instance, IP cards are technically feasible but the banking sector has not asked for such solutions yet. This could be due to a lack of awareness and false beliefs concerning this protocol. In a lot of sectors, it is believed that IP equals the Internet and as everybody uses the net, applications could be visible to every single Internet user.

Finally, even if “all IP” transition can be observed, IPv6 cannot satisfy all technical requirements. In the Air Traffic Management or for critical time response applications (car to car communication), going through all the OSI layers is not as efficient as other specially designed solutions.

3. What are the Opportunities for these sectors to integrate IPv6

IPv6 can benefit from the development of new networks and new products. Indeed, in some sectors, the solutions launched in 2007-2008 will have to last for 10 to 15 years. As it is estimated that IPv6 will be more widely deployed at that time, today solutions have to be IPv6 compliant.

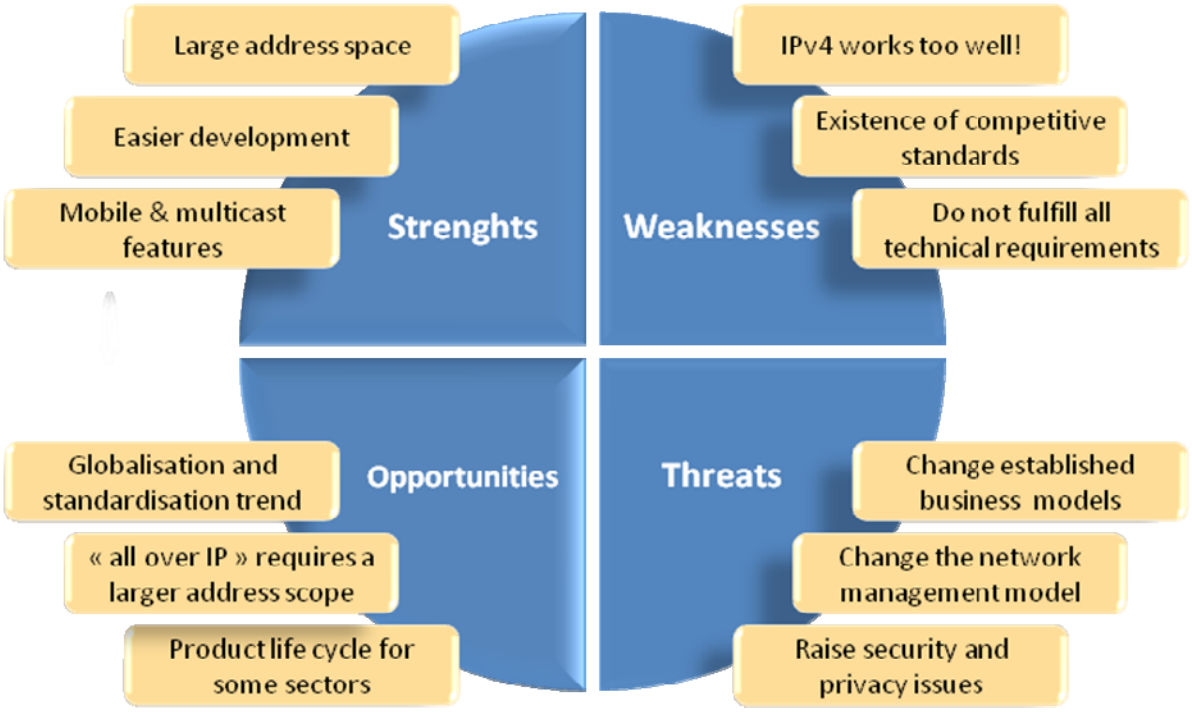
Globalisation at all levels can also push IPv6. Some relatively new countries to the IP world are starting with IPv6. The case of French universities having to integrate IPv6 to continue cooperating with its African counterpart has been mentioned. It is also part of homogenisation process in Europe. Europe thinks about adopting single standards in public safety for example.

4. What are the Threats for these sectors to integrate IPv6

"All IP" transition scares some companies. Companies that were developing in-house proprietary protocols and that were making money on it can fear the integration of IP. Indeed, IP code developers are numerous and new business models can attract IP specialized players.

The main issue across all sectors remains the security level that is brought by NAT. With IPv4 and NAT, a huge part of the networks is hidden to the public Internet, which is often mentioned as being a necessary security level. Removing NAT is a concern for the privacy of these sub-networks whereas this mechanism can be implemented within firewalls using standard IP capabilities. Introducing IP products raises questions in highly secured sectors such as banking whereas IPv6 has been selected in other secured sectors such as defence.

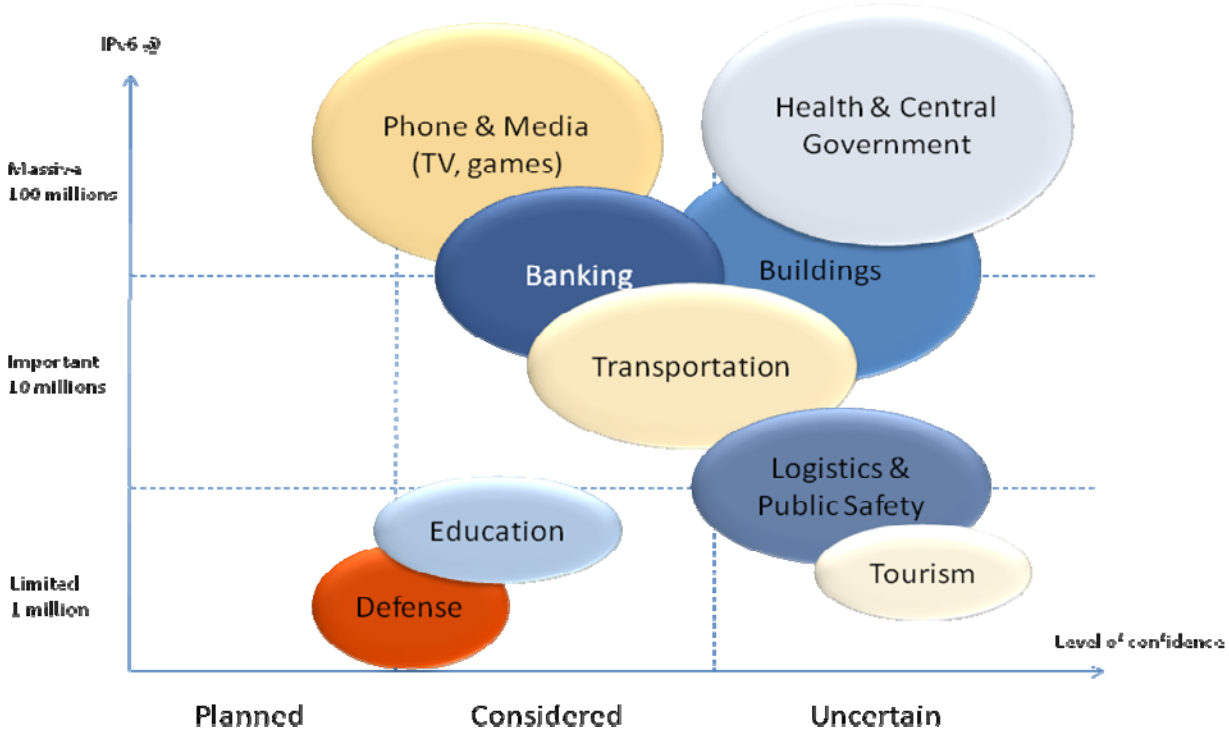
Figure 1: SWOT Analysis of IPv6



5. Adoption Scenario

The majority of stakeholders in the 14 sectors are in a position that one can qualify as “wait & see situation”. Industries are aware of IPv6 but do not expect a significant move before 2010-2012, mentioning that networks are not sufficiently ready to support their applications. Most of the sectors, while recognising the advantages of IPv6 also prepare alternative solutions in case IPv6 would take too long to be deployed, at a risk of limited interoperability between applications.
Based on the SWOT analysis, sectors have been classified upon their potential need for IP addresses and IPv6 adoption roadmap in Figure 2.

Figure 2: Need versus adoption roadmap for IPv6



3.2 Socio-economic impact of autonomic Networking

Autonomic computing and other self-managing system initiatives, many strongly based on biological metaphors, are emerging as a significant new vision for the design and development of complex computer systems. They offer the promise of controlling complexity through the achievement of self governance and self management. We consider how complexity is exhibited in the computer industry as a whole, and how the situation is deteriorating, rather than improving. We consider how autonomous and autonomic systems, with their biological inspiration, can provide a framework for tackling complexity and overcoming the problems of its (unavoidable) inherent existence in certain classes of systems.

NASA increasingly relies on autonomous systems concepts, not only in the mission control centres on the ground, but also on spacecraft, on rovers and other assets on extraterrestrial bodies. Space missions lacking autonomy will be unable to achieve the full range of advanced mission objectives, given that human control under dynamic environmental conditions will

not be feasible, due in part, to the unavoidably high signal propagation latency and constrained data rates of mission communications links. While autonomy cost-effectively supports mission goals, autonomicity supports survivability of remote missions, especially when human tending is not feasible. As such, not only are Autonomous concepts but also Autonomicity concepts require to be brought to bear on future space missions - self-governance and self-management.

3.3 FISE – Socio-Economics Report

The WP6 leader is part of the FISE team (EFIPSANS being a project contributing to FISE) since its creation and contributed to the debate and drafting of the FISE paper. This is a relevant position of the EFIPSANS statement:

The Social Challenge of a Universal and Trustworthy Internet

Besides the economic dimension, the Internet faces an important social challenge. The current Internet penetration has reached 20% worldwide and should reach 30% by 2015 and 50% by 2020. Broadband access to telecommunication network capacity and services must be guaranteed "anywhere-anytime" to universally exploit the Internet – present and future – which is becoming a fundamental service that communities use and rely upon. As such, the Future Internet shall be able – among others – to support daily life in developed countries as well as within developing countries. Telecommunication infrastructures must be conceived to guarantee access to the Future Internet also where currently it is poor.

However, the IP address space is depleting fast with only 11% left and expected to be exhausted by 2010. This may not only be the end of the E2E model, but also the end of the Internet itself. To fix this problem of the current Internet is a big and large-scale task and challenge. With virtually unlimited address space, the new Internet Protocol IPv6 has been designed to cater for the many deployment scenarios, starting with an extension of the packet technology and, therefore, supporting IPv4 with transition models to keep IPv4 working even for ever, and then to cater for new uses and new models that require a combination of features that were not tightly designed or scalable in IPv4 like IP mobility, E2E connectivity, E2E services, and ad hoc services; to the extreme scenario where IP becomes a commodity service enabling lowest cost deployment of large-scale sensor networks, RFID, IP in the car, to any imaginable scenario where networking adds value to commodity.

3.4 Elucidation of User Benefits & Socio-economic impact of IPv6

The first impact expected from deployment of IPv6 is the reduction in cost of maintenance and sustainability in large-scale implementation and more specifically natively without use of IPv4. This has been proven by the deployment of KDDI that has decided to move from switching to IPv6 directly to avoid dual stack deployment and the complexity that will hamper deployment of services. This is an ideal case where KDDI never wanted to use IP until its main supplier of switches Toshiba decided to discontinue manufacturing of switches and advised its large customers to move to IP routers instead.

As another example, the worldwide penetration of cell phones has reached almost 4 billion users of which 10% are using Internet services in one form or another. The 400 M users of Internet based phones come on top of 1.5 B Internet users listed on the Internet Stats:

http://www.internetworldstats.com/stats.htm. Therefore, complexity will be triggered by the use of NAT and private addressing will be quite challenging in the future.

According to Jawad Khaki, Corporate Vice President, Windows Networking & Device Technologies, an expert in networking with IPv6 with responsibility for the IPv6 deployment on Vista and Windows Server 2008 showed recently a graph where he highlighted that the cost of hardware and software is dramatically declining from the 90s to the end of 2010 while the cost of management and support is sky-rocketing taking a lion's share of 140B$ from a total of 200 B$ in the US market. That is 70%. Management of the installed base is becoming on the most critical elements in running current networks and operations.

As a result, the work of T6.4 should keep in mind the impact on the end-user benefits as product and service commodity is becoming the rule while complexity is increasing at an exponential rate.

4. Research Process

In order to evaluate the socio-economic implications, the first step is to identify the related technical features, test results or any data from the various Work packages (WPs) of the EFIPSANS project as an input to T6.4. Considering the size and many ambitious goals of this project, it is necessary that all partners provide lead to T6.4 in the form of a list of features or test results from their ongoing EPIPSANS work that promise some socio-economic impact. This information forms the basis of T6.4 for the entire duration of the project. An interview questionnaire will be designed based on these inputs to investigate the research questions:

- "How will the paradigm shift advocated by autonomic networking principles truly relieve network management personnel from the daunting, complex and time consuming operations on the networks, which are increasingly calling for automation?" (D6.6)

- "How will the performance management issues unsolved efficiently by the current technology be addressed to guarantee better Quality of Experience?" (D6.6 and D6.8)

- "What are the socio-economic implications of improved practices or new services recommended by EFIPSANS?" (D6.8)

D6.6 aims to broadly classify and estimate the amount of time spent by network management personnel on day-to-day activities and the challenges facing them. For example, what percentage and level of network management personnel effort is spent on network configuration, performance management, security management and fault management issues? What are the key drivers and inhibitors to advanced context-aware and situation-aware network services with guaranteed QoE? How does the progress beyond the state of the art delivered by EFIPSANS impact the QoE and operation management of networks?

D6.8 will carry forward and enhance the findings of D6.6 along with an emphasis on the implications of improved practices or new services. Due to the highly technical nature of the EFIPSANS project, the social impacts are likely to revolve around the technical and economic ones. However, identification of new services or processes from the project outcome is

expected to augment the social aspects of the study.

By doing so, it will be possible to match the technological contribution of EFIPSANS to the network management issues of most concern and at the same time map the level of likely improvements over the existing technologies in a coherent manner.

5. Research Method

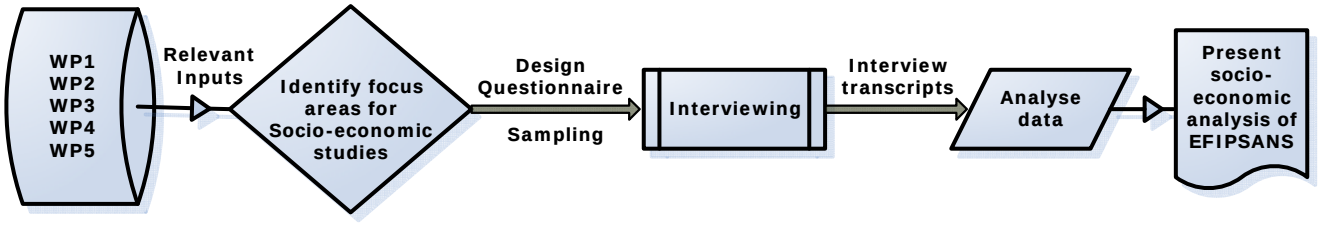
In general, the topic of IPv6 and autonomics is not matured to an extent to support quantitative study. Therefore, a qualitative exploratory research method is suitable for this type of study. Exploratory research is preferred as there is a need to clarify a less known situation for which interviewing serves as an effective data collection method. At least five in-depth interviews for D6.6 and D6.8 each will be conducted with people who have experience with managing large data networks. Interviewing process will utilise a semi-structured interview method. A set of thematic questions mostly open ended aligned with the EFIPSANS objectives will be designed but the order and the specific details of the information sought from the interviewee will vary depending on their area of expertise.

Due to the advanced nature of this topic, there are very limited experts available around the world that would be able to illuminate on the topic of autonomics and IPv6. Therefore, the population of interest will be carefully chosen utilising the convenience sampling technique. EFIPSANS consortium members have large industry contacts within Europe and outside so it must be possible to convince suitable persons to agree for an interview on a good-will basis.

A lot of information needed for this research is considered to be a trade secret and hence it is difficult to find a suitable person and an organisation willing to participate. As a result, there is no available study that addresses the socio-economic aspects on the level envisaged by EFIPSANS. However, we plan to overcome this limitation by keeping the interviewee and the associated organisation name confidential in our report and addressing them as say Interviewee A, Company A, etc.

Moreover, this research is essentially not seeking any company level information but the views of the people from their own experience of network management. The interviews will be recorded and the transcripts analysed to identify the significant interrelationships, patterns, trends, etc. with the view to present the socio-economic impacts of the EFIPSANS project. A pictorial representation of the data collection and analysis procedure is shown in Figure 1.

Figure 3: Data collection & analysis procedure



6. Initial Survey Questionnaire on Autonomicity

On top of the questionnaire designed for the socio-economic benefits of IPv6 (D6.3), http://pro20.sgizmo.com/survey.php?SURVEY=XO9TW8VIZDY91X4R3ZTV1GEBMYQNIG-62141-32726882&pswsgt=1237687582&_csg=342HONALZ0IQk&notice=DO-NOT-DISTRIBUTE-THIS-LINK

The following questions have been designed to further address specifically the autonomicity and its anticipated future impact. The questions are designed to:

- Evaluate the awareness regarding autonomics
- Expected benefits of autonomic networking
- Investigate the operating issues surrounding network management
- Examine the sufficiency of appropriately trained human resources for network management, and
- Measure the business value added by current network management practices.

(A) Autonomics awareness

A1) Awareness level

1	Are you aware of autonomicity?	Yes	No
2	Are you involved in any research in autonomicity with IPv4?		
3	Are you involved in any research in autonomicity with IPv6?		
4	Do you make any difference between autonomic and autonomous?		
5	Is autonomicty similar to auto configuration?		
6	Did you use any autonomic network?		
7	Do you think autonomic networking will be deployed within the next three years?		
8	Do you think autonomic networking has been standardised?		
	- By IETF (Internet Engineering Task Force)?		
	- By ETSI (European Telecommunications Standards Institute)?		
9	Did you hear about ETSI AFI (Autonomic Future Internet)?		
10	Do you wish to participate in the standardisation work done by AFI?		

A2) Expected benefits of autonomics

What will be the likely benefits of autonomicity to ISPs? Click one or more

- Easy to install networks
- Easy to manage networks
- Easy to maintain remote networks
- Easy to upgrade networks
- Reduces OPEX and CAPEX
- Infrastructure becomes highly exploitable
- Saves me time
- Reduces down time
- Ensures Quality of Service

A3) What will be the likely benefits of autonomicity to users? Click one or more

- Ease of use
- No need to know about network (Infrastructure agnostic)
- Saves me time
- Reduces my down time
- Improves performance of applications

B) Network Management Issues

B1) Are today's networks a lot more complex than five years ago?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

B2) Is interoperability of major concern in network management?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

B3) Automatic network management tools provide effective 'pre-event' diagnosis?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

C) Human Resources

C1) Is there a shortage of appropriately skilled network engineers to manage such networks?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

C2) What percentage of effort is spent on routine network management tasks?

Tasks	<20%	20-40%	40-60%	>60%
Fault management				
Configuration and change management				
Performance management				
Security management				

D) Business Value

D1) Is network management a significant component of an enterprise overall IT budget?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

D2) The network management costs is predominantly devoted towards:

☐Running the business (maintain)

☐Changing the business (new initiatives)

7. Way Forward

This initial survey is expected to provide some data for both IPv6 deployment and the current level of awareness regarding autonomics. It will also give us directions for further investigations through interviews that will follow the below procedure:

7.1 Survey track

- Feed above questionnaire in the survey
- Submit this questionnaire to the panellists and audience of the EFIPSANS organized Self-Managing Future Internet Workshop - "Self-Managing Future Internet powered by IPv6/IPv6++", 15-16 April, Beijing, China.
- Through our partner BUPT
- Send the questionnaire to the researchers community of the Management & FISE-mailing list
- Send the questionnaire to the AFI members for all ETSI members to fill out
- Send the questionnaire to all IPv6 Forum members and its 60 chapters around the world

7.2 Interview track

- Select a number of European industry leaders doing research work on autonomicity from vendors and operators. An active search will be undertaken with the help of consortium members to find the appropriate person for interview in companies like Vodafone, Telefonica, Ericsson, etc.

8. Expected Outcome

An analysis of the socio-economic impact based on EFIPSANS technological advancement will be presented. Network management issues (e.g. Application Performance Management) that can be better tackled adopting an autonomic approach will be identified and supported with evidence from the data collected. A number of secondary sources of data like industry publications, whitepapers and reports from consultancy firms like Forrester, Aberdeen Group, OSS Observer, IDC, etc. will be utilised to enhance the analysis and findings. The study is expected to elucidate the issues surrounding network operations and quality of service along with the ability or inability of autonomic IPv6 networks in dealing with them.