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Trends and Concerns regarding the Use of IP and other communication transport solutions in the utility environment

by

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SUMMARY

Working Group D2.35 "Scalable This paper describes the main results of the survey that was conducted by working group D2.35 in 2012 amongst Cigré members with the objective to identify the current and expected use of scalable communication transport solutions over optical networks by electrical power utilities. As IP based networks are a main focus for Wide Area Networks and communication transport solution this survey provides a renewed view on the visions of the power industry and as such can be seen as a continuation or update of the survey held by working group D2.28 in 2009 – 2010. In order to identify the high level trends and developments the results of the two surveys are compared.

KEYWORDS

Scalable Communication Transport Solutions, TCP/IP networks, Wide Area Network, User requirements.

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1. Introduction

The introduction of smart applications in the electrical power utility and the subsequent dispersed intelligence, result in a tremendous increase in the need for information to be exchanged across the power system. A result of this paradigm shift is in many cases a change of scale in the requirements of the telecommunication infrastructure and often the deployment of a core data transport network, which can be implemented using different technologies and architectures.

At present the majority of the communication networks deployed by power utilities are based on SDH. However the use of current packet based communication and in particular Ethernet based connections is growing very fast. This is expected to bring the necessity to adapt and /or replace network technologies.

Working group D2.35 is working on a Technical Brochure with the objective to identify and analyse alternative solutions and migration plans in the light of optical transport data network technology evolutions, new application requirements and the utility's capability to maintain and support the next generation communication systems. To avoid that the Technical Brochure is developed in isolation, a survey was conducted amongst Cigré members. The objective of the survey was to obtain the market's perspective on the trends and developments regarding scalable communication transport solutions over optical networks. The survey results reveal where the greatest potential is expected, which technologies are the strongest candidates, which issues need to be addressed still and where utilities would like to go in the near future.

2. Survey introduction

During 2009 and 2010, Cigré working group D2.28 conducted a survey amongst Cigré members to identify the current and expected future use of IP based networks within electric power utilities. The results of that survey have been published as part of Technical Brochure 507.

In 2012 - 2013 working group D2.35, as part of its task of defining a Technical Brochure on scalable communication transport solutions over optical networks decided to conduct another survey. Where working group D2.28 focussed on the use of IP networks for electrical power utilities in general, working group D2.35 focusses specifically on the use of optical communication transport networks. Although the scope of working group D2.28 was around the use of IP in substation, the results from the D2.28 survey provided a solid basis for what electrical power utilities expected their IP networks to look like in the (near) future. As IP based networks are part of scalable communication transport solutions over optical networks working group D2.35 conducted a follow-up survey during 2012 and 2013 to not only get new input on transport solutions but also to identify trends in the use of IP networks and network technologies.

The results of the D2.35 survey have been used to determine which technologies should be covered in the D2.35 Technical Brochure that is currently under development.

3. Survey explanation

The survey was setup with the objective to not only get new input on transport solutions but also to identify trends in the use of IP networks and network technologies. Therefore the existing survey questions used by D2.28 have been used as a basis. These were adopted and

extended to cover the broader scope of D2.35 but at the same time kept the same as much as possible to facilitate the identification of trends and tendencies. The new survey that was developed contains the following questions:

1. Are you a TSO, DSO, Consultant, Vendor or Other?
2. Within your own company, which substation applications are using IP and IP networks? (For vendors: Which applications do you see at customer´s sites?)
3. What substation applications (currently not running on IP) could potentially be migrated to IP?
4. What applications are you using outside the substation that could potentially be migrated to IP?
5. What are the main operational challenges of using IP as a communication transport solution over optical networks?
6. What are the main psychological barriers with using IP protocols in applications?
7. Are all of your applications compatible with IP at the moment?
8. What is your prediction for the migration of all operational communications into IP?
9. What percentage of the existing applications within your company are already using IP as communication transport solution?
10. How to deal with legacy protocols and equipment?
11. Considering that all applications will move to IP, what are the requisites and concerns for the telecommunication network?
12. Which underlying technologies are the most promising to provide secure and reliable transport communications in the access network?
13. Which underlying technologies are the most promising to provide secure and reliable transport communications in the core network?
14. Should the IP network be reserved for operational service or also be used for corporate services? Two physically/virtual separate networks or one network?
15. What type of scalability needs to be addressed?
16. Are you aware of any activities / documents concerning communication transport solutions over optical networks that may be of interest for D2.35 to consider for the Technical Brochure?

As the question 1, 4 to 7 and 9 to 13 are similar if not the same as the ones asked in the surevey held by D2.28 the responses to these questions were compared to the responses from the D2.28 survey two years earlier to identify differences and trends.

4. Survey results

The survey was submitted to a broad group of people within the Cigré membership. In total eighty two (82) surveys from twenty nine (29) different countries were returned to working group D2.35. The technical brochure for D2.35 contains a list of the companies and countries that participated in the survey. The survey results are however treated anonymous, so that it will not be possible to tie any specific result to any specific participant in the survey. Table 1 shows the different countries that took part in the survey and the percentage that the country contributed to the total survey results.

Argentina	1%
Denmark	2%
Thailand	5%
Brazil	2%
United Kingdom	2%
Portugal	1%
Switzerland	4%
Belgium	1%
Australia	22%
New Zealand	1%
Bangladesh	1%
India	8%
Finland	4%
South Africa	1%
The Netherlands	2%
Spain	1%
Israel	1%
Germany	1%
Norway	4%
Russia	1%
Mexico	6%
China	6%
France	1%
Suadi Arabia	1%
Bosnia and Herzegovina	4%
Ethiopia	1%
Canada	2%
Poland	1%
Japan	10%

Table 1 Participating countries

As shown in Figure 1 the majority of the survey respondents work for Transmission and/or Distribution System Operators. Please note that the total adds up to more than 100%. This is because some participants indicated that they work for more than one kind of company (e.g. TSO and DSO).

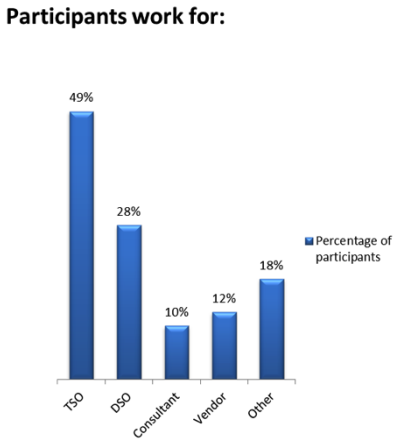

Figure 1 Type of companies of survey participants

As shown the survey contains in total sixteen (16) questions. This paper focuses however on a selection of the results of the survey with the objective to show the major trends and tendencies that can be obtained from the survey results.

Requirements for communication networks are highly dependent on what the network will be used for. Therefore it is important to identify what the main purpose and usage of the networks is and is expected to be in the (near) future. The survey addresses this in questions 2, 3 and 4. In Figure 2 an overview of the applications is given that according to the survey participants should be hosted on their IP networks. The blue bars in this figure represent applications that are currently using IP, the red bars represent applications that are eligible for use over IP networks and the green bars represent the sum of the current use and the expected use. The green bars thus provide a good indication for the actual need for applications that IP networks need to be able to host. For example, an IP network that is not designed to deal with telephony will (eventually) not be acceptable for 97% of all participants.

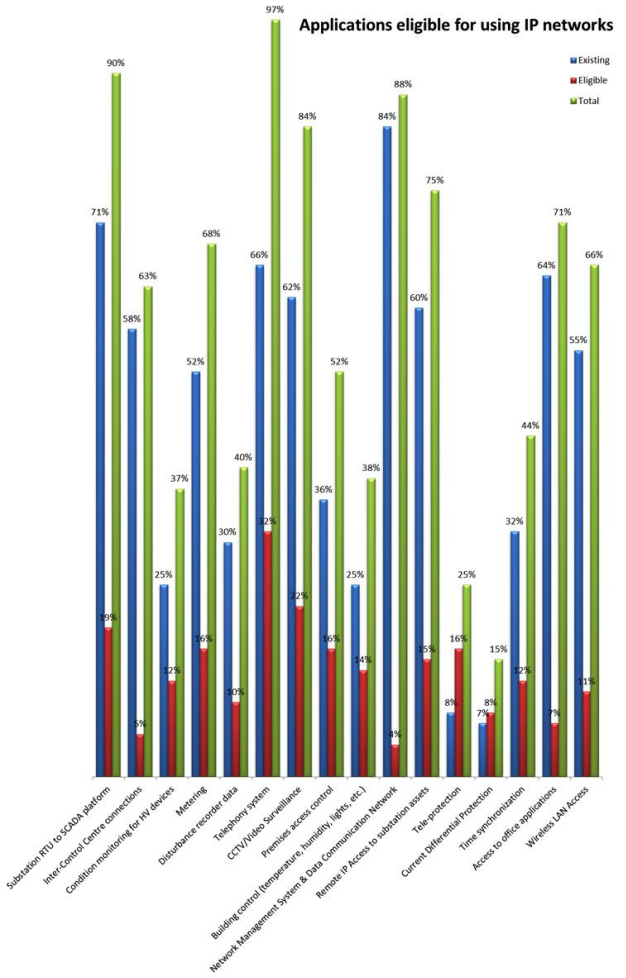

Figure 2 Current and expected applications using IP

An important parameter to be taken into account when defining transport solutions of the future is time. Migration strategies are depending on the availability of the right technology at the right time and an indication of when certain solutions are needed can help defining the right strategy. Figure 3 shows the timeframe in which participants indicate that they expect their operational traffic will migrate to IP. Overall 98% of all participants indicated that they will move to IP and more than 70 % indicate that the will do so within ten years. This result confirms that IP is and will be a dominant technology that must be taken into account when defining the implementation strategy of scalable communication transport networks.

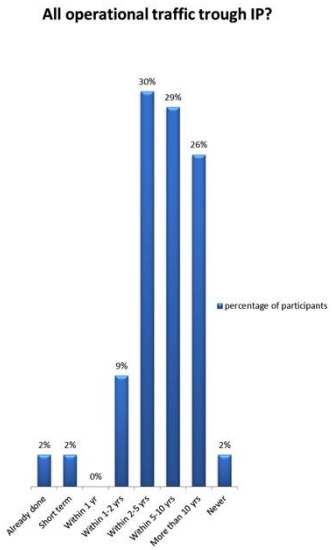

Figure 3 When will all operational traffic be migrated to IP?

As with all migration strategies there will need to be a way to deal with legacy equipment and protocols. As shown in Figure 4 a majority of the participants expects to deal with legacy equipment and protocols through gateways and protocol encapsulation. Nevertheless there is also a large group that plans to keep the legacy equipment and protocols on a separate network. The latter solution requires maintaining and supporting an additional network. This implies that the required knowledge, equipment, spare parts and specialist staff must be maintained operational as long as the separate network exists. This again is something that must be part of a migration strategy as it can have a serious impact on the business models.

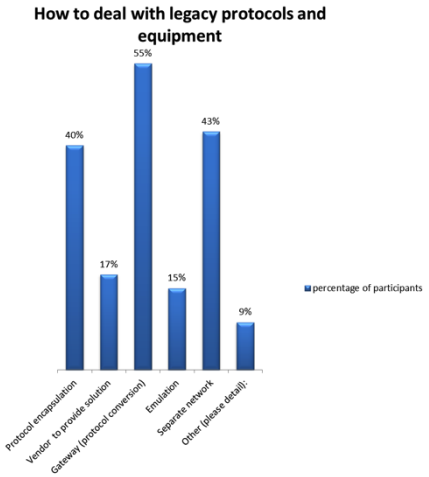

Figure 4 How to deal with legacy protocols and equipment

There are several technologies available that could be used for the core level and the access level of the communication architecture. These technologies include CWDM, DWDM, IP-MPLS, OTN, PBB, MPLS-TP and RPR. When asked the survey participants indicated that SDH, WDM and MPLS are seen as the most promising core technologies. The same technologies plus Ethernet are seen as the most promising access technologies. This indicates that there is a possibility to harmonize core and access technologies and use one technology for both. Whether that is achievable depends of course on the actual architecture and the strategy for the migration of that architecture for the short, medium and long term.

Figure 5 shows the most promising technologies for access networks and core networks.

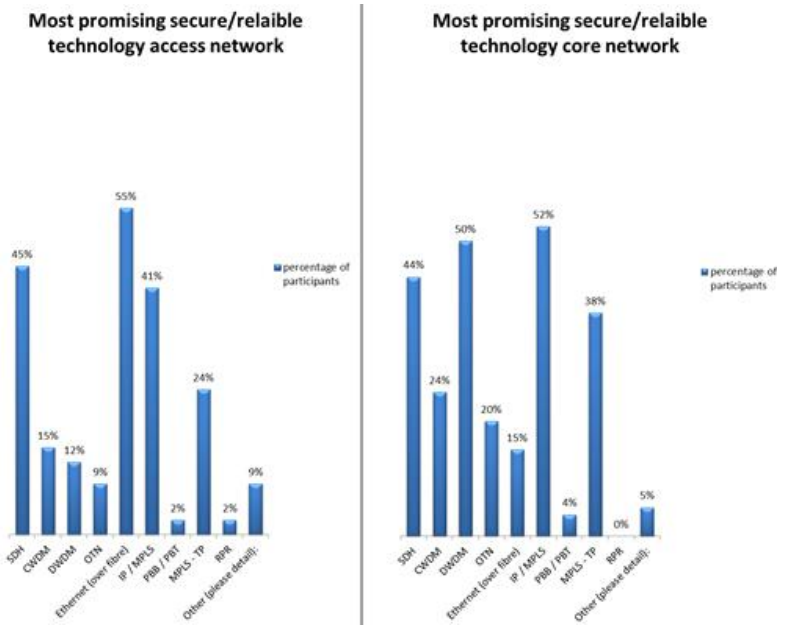

Figure 5 Most promising access/core technologies

Scalability is a term that is often used in relation with communication architectures. However there is not one single definition for scalability. Often scalability is related to the maximum bandwidth that can be obtained and how easy it is to increase the bandwidth so that it matches the required bandwidth over time. There are however several other parameters that need to be flexible and scalable for the communication architecture to support its usage requirements over time. These parameters include the number of users, the number of applications, the number and the variations in protocols, the number of interfaces, the number of nodes and the number of services supported. The kinds of scalability that are considered important is part of the survey and Figure 6 shows what kind of scalability participants believe should be taken into account for their IP networks.

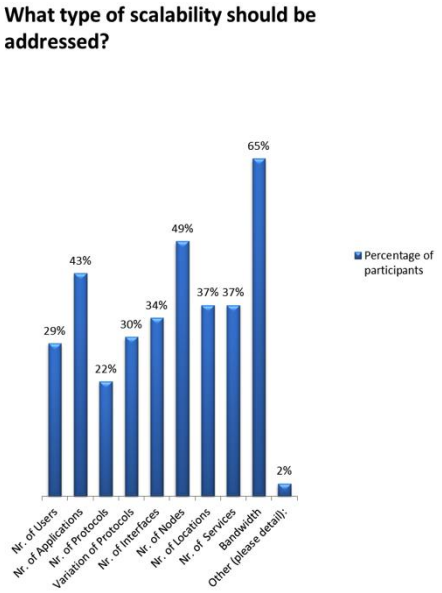

Figure 6 What kind of scalability should be addressed?

While this is only a selection of the survey results, these results provide valuable information as they show what kind of applications will (most likely) have to use IP, when these applications are expected to use IP, how IP networks are expected to coexist with legacy communication architectures and which technologies the survey participants expect to be using and what scalability requirements are important to take into account when defining new communication architectures.

5. Trends and developments

The surveys held for D2.28 and D2.35 are similar, but not exactly the same. The technical brochure for D2.35 will contain the latest survey results and is using these results to identify the most important things to be addressed as well as the trends and tendencies that can be extracted from the comparison and analysis of both survey results. The technical brochure will contain a complete comparison between the two surveys for all relevant questions.

Some interesting trends that follow from the comparison of the two surveys are:

- Analysis of the two surveys shows that there is a significant increase in demand for Wireless LAN Access. The 19% in 2010 has increased to 49% of the survey participants in 2012.
- Quality of service is becoming more an operational challenge, while environmental ruggedness and interoperability according to the survey participants are becoming less of a challenge.
- In 2010 47% of all participants expected to need more than 10 years to move all their operational traffic to IP against 28% in 2012. This supports the general trend of an increase in IP usage in different domains

- Participants are becoming less concerned with the existence of physical infrastructure to host their IP networks (2010: 69%, 2012: 55%) and the identification of applications (2010: 39% against 23% in 2012)

From the D2.35 survey also follows that there is a growing interest in MPLS and WDM as a possible replacements of the existing networks that currently are mainly SDH based.

Also the majority of the survey participants remain concerned about the possible security issues associated with the use of modern communication architectures. They furthermore indicate they believe that some kind of separation between operational and other networks is, and will be required. This could be done through physical or logical separation in the core or at the access/edge level.

6. Conclusion

The surveys show that a growing group of utilities is using IP networks and are planning to expand their IP networks in the foreseeable future. Analysis of the survey results and the comparison of the results from this survey with the results from the survey held earlier by working group D2.28 show that the trends identified in 2010 are confirmed in 2012. The analysis of the surveys shows that the knowledge of IP networks and different core technologies within the utilities is growing, but that at the same time security and selection of the right technology remain a concern.

Most survey participants indicate that WDM and MPLS are seen as likely candidates to replace SDH in the future but at the same time large group indicates that they expect that SDH will continue to be used as the core technology. It can therefore be expected that more and more communication architectures will have a coexistence of SDH with either MPLS or WDM.

The results of the survey of 2012 and the comparison of the results from the survey conducted in 2010 form the basis for the guidelines and information in the technical brochure for D2.35.

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BIOGRAPHIES

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