



Study Committee D2 Information Systems and Telecommunications

Assemblea Comitato Nazionale Italiano CIGRE

Roma, 29 Novembre 2018



Giovanna Dondossola



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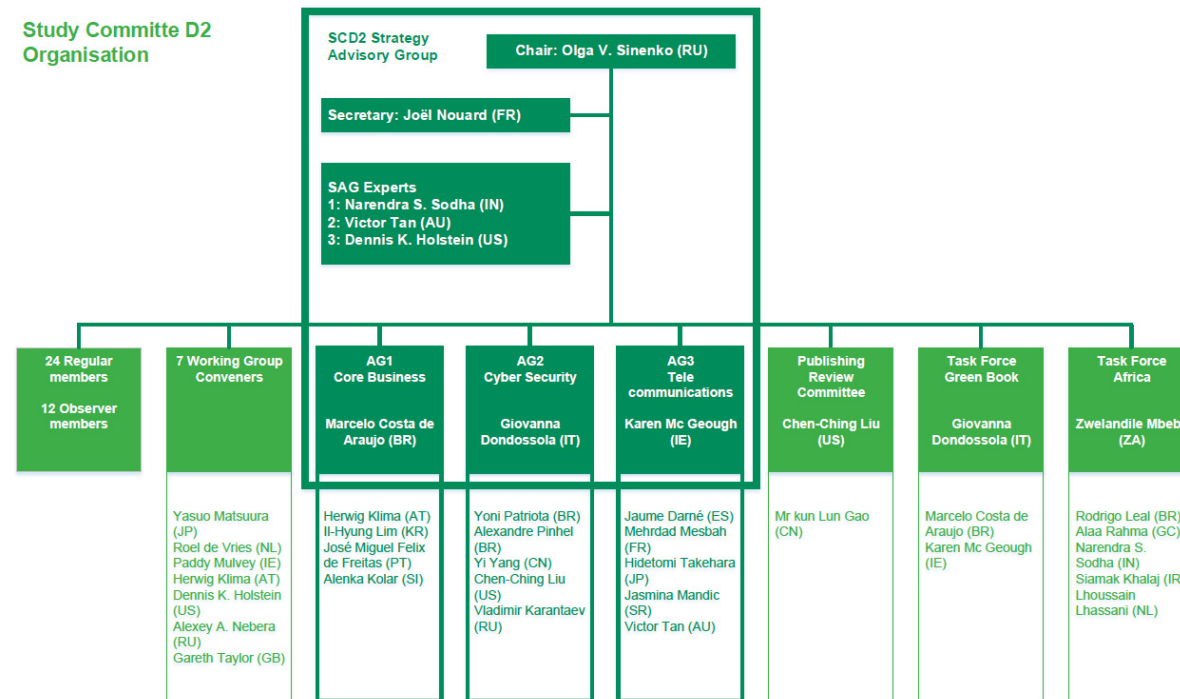
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SC D2 Regular Meeting



SC D2 Regular Meeting, Paris 28 August 2018

Study Committee D2 Organisation



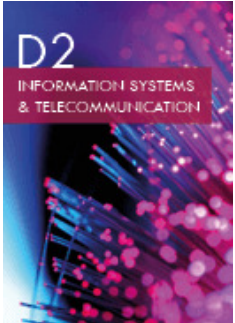
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Active WGs

WG	Title	Convenor	2018		2019		2020		2021	
			S2	S1	S2	S1	S2	S1	S2	
JWG C6/D2.32	Cyber risks and cyber security for the next generation of digital systems in EPU	Y. MATSUURA (JP)	█							
JWG D2/B2.39	Design, deployment and maintenance of Optical Cables associated to Overhead HV Transmission Lines	S. KWIK (ES)	█							
WG D2.40	Cyber risks and cyber security for the next generation of digital systems in EPU	D.K. HOLSTEIN (US)			█					
WG D2.42	Synchronization and time distribution in communication networks for time-sensitive distributed operational applications in the power grid	R. DE VRIES (NL)	Has been merged to create JWG B5/D2.67							
WG D2.43	Enabling Software Defined Networking for EPU telecom applications	V. TAN (AU)					█			
WG D2.44	Usage of public or private wireless communication infrastructures for monitoring and maintenance of grid assets and facilities	P. MULVEY (IE)					█			
WG D2.45	Impact of governance regulations and constraints on EPU sensitive data distribution and location of data storage	H. KLIMA (AT)					█			
WG D2.46	Cybersecurity future threats and impact on EPU organizations and operations	D.K. HOLSTEIN (US)				█				
JWG B5/D2.67	Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods	R. DE VRIES (NL)								█
JWG D2/C6.47	Advanced consumer side energy resource management systems	A.A. NEBERA (RU)					█			
JWG D2/C2.48	Enhanced information and data exchange to enable future transmission and distribution interoperability	G. TAYLOR (GB)					█			



Published Technical Brochures



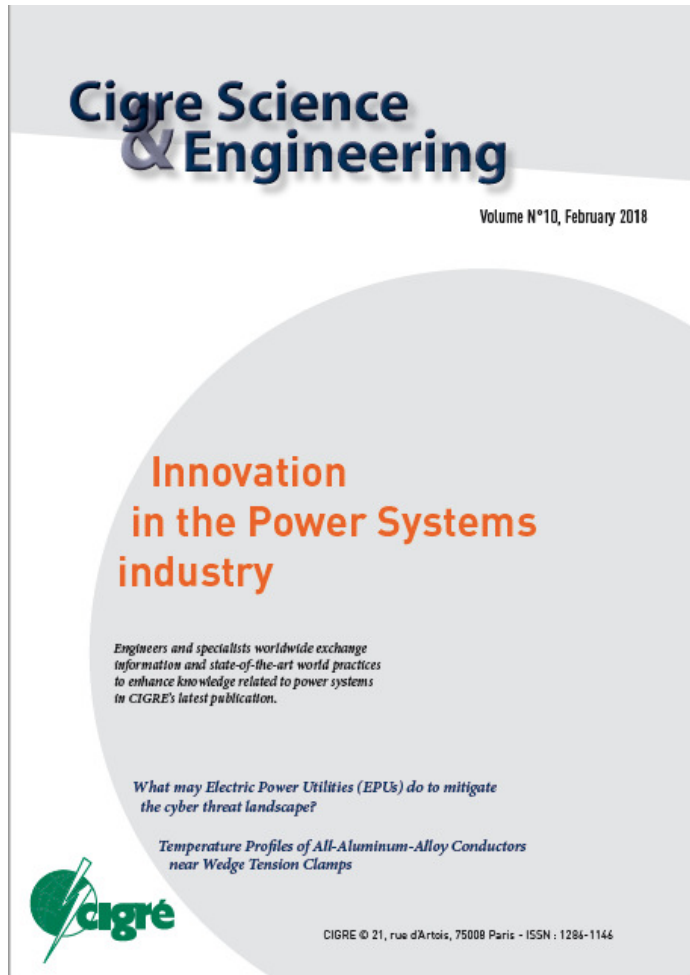
- TB 698 – “Framework for EPU operators to **manage the response to a cyber-initiated** 1 to their critical infrastructure”



- C2/D2 TB 732 – “Advanced utility data management and **analytics** for **improved operation** situational awareness of EPU Operations”
- TB nnn – “**Design, deployment and maintenance of optical cables** associated to overhead HV transmission lines”



AG D2.02 – Publications



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What may Electric Power Utilities (EPUs) do to mitigate the cyber threat landscape?	5
Assumptions and numerical parameters influencing the accuracy of thermal models for core-type power transformer windings	16
A Monitoring architecture for smart grid cyber security	27
Verification of the short-circuit withstand capability of transformers	33
Operational, short and long term profile optimization (economic dispatch) of distributed energy resources in Microgrid	41
Smart control of energy distribution grids over heterogeneous communication networks	
Impact of communication network performance on voltage control and energy balancing	54

- SC_D2_IEC_TC57 Joint paper
- Cigré Colloquium 2017 Selected paper

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Session 2018 D2 Papers selected for publishing into CSE



1. Evaluation of a LoRaWAN Network for AMR, by N. HATZIARGYRIOU, I. VLACHOS, G. KIOKES (GR)
2. Benefit and Resolution of operational issues for information and communication systems using virtualization techniques in the electric power industry, by H. DOI, D. KARIU, K. SAKAMOTO, M. SUSUKITA, T. SHIMA, H. NAGASAKI (JP)
3. An Indian Case Study of Hierarchically Integrated SCADA system upgradation and its impact on Connected Control Centres, by P.K. AGARWALL, K.V.S. BABA, H.K. RATHOUR, A. SHARMA, A. SINGHAL, K. GAUR (IN)

Result for publication will be known within a few weeks

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World Bank Working Group AFRICA

First Steps for SCs

- Determine what CIGRE considered to be the most useful resources available to assist in the development of knowledge and ultimately, the future African power sector → Survey sent to all SC Chairs on 20 February 2018 (2 weeks duration)
- Compilation of a Product Catalogue: SC Capabilities and Resources

What is expected from SCs:

- Launch WG's in support of Africa Initiative
- Enrich the Catalogue
- Volunteers to deliver Tutorials, Missions





SC D2 Southern Africa Tutorial

SC D2 - Information
Systems and
Telecommunication

Utilities Telecommunications Tutorial

Venue: SAIEE House, 18A Gill Street, Observatory,
Johannesburg

Date : 28 November 2018

Time: 8:00AM for 9:00 AM to 16:00h

RSVP: Matlou@eskom.co.za or +27 79 966 1092



In collaboration with AUTC, Webinar session sponsored by
SAIEE

The image is a promotional poster for a tutorial. It features a dark green background with a faint image of an electrical substation. The text is white and centered. At the bottom, there is a logo for CIGRE Southern Africa, which consists of a stylized globe with a lightning bolt and the text "cigre Southern Africa".

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Green book Electricity Supply Systems of the Future

- The TC has decided to publish a Green Book: its aim is to give CIGRE's **vision** of the future on Electricity Supply System
- Target Year: **2050** has been considered reasonable
- Target public: policy makers/decision makers/heads of the technical departments
- Target Year publication: 2020, but could be delayed if necessary to **2021**, the hundredth anniversary of CIGRE. Most important is to deliver a **high-quality** book rather than just keeping the initial deadline



Green book Electricity Supply Systems of the Future

- Each SC will have to write a **25 pages chapter**:
 - Introduction of the current situation
 - long range view of the domain
 - state of the art, and all future technical issues including education, financing
- A first draft of the chapter is expected **by January 2019**
- It has been decided to set up a **D2 Task Force** for the writing of the SC D2 Chapter
- **Mrs Giovanna Dondossola (IT) has been appointed leader of this TF**
- The work will be split over the 3 AGs' conveners
- To invite contributors in the Green Book task force, to define the titles of chapter, to assign chapters to writers, to define timelines, template coordination meetings
- The TF leader will liaise the editor christoph.baumann@springer.com



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SC D2 General Discussion Meeting



30 August 2018

Paris (FR)



SC D2 Preferential Subjects

PS 1 : Opportunities and challenges in **ICT applied to microgrid and DER**

- Communication solutions to remotely monitor and operate off-grid premises
- Facilities for control, monitoring, physical security and safety
- Standards, interoperability and cyber security issues

PS 2: Potential applications and implementation of **network and infrastructure virtualization**

- Opportunities and benefits using Software Defined Networking and Network Function Virtualization (SDN/NFV)
- Issues identified in implementation and operation of virtualization architectures
- Strategies to operate a secure SDN/NFV deployment

PS 3: Maintaining **reliable and secure operation** in an evolving environment

- ICT to support asset management and maintenance
- Life cycle management and integration of legacy and new devices
- Situational awareness, risk management and cyber incident responses

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SC D2 Papers / PS1

Paper No.	Title	Country
D2-101	Evaluation of a LoRaWAN Network for AMR	Greece
D2-102	Study on the construction of global energy research system based on economic-energy-electricity-environment integration analysis	China
D2-103	Analysis and visualization of residential electricity consumption based on geographic regularized matrix factorization in smart grid	China
D2-104	Implementation of Interoperability Adaptor for Interface with External Systems in Campus Microgrid	Korea
D2-106	Assuring operational communications across the sub-transmission and MV distribution electrical power grids	France



SC D2 Papers / PS2

Paper No.	Title	Country
D2-201	Substation Virtualisation: An Architecture for Information Technology and Operational Technology Convergence for Resilience, Security and Efficiency	Australia
D2-202	Benefit and Resolution of operational issues for information and communication systems using virtualization techniques in the electric power industry	Japan

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Paper No.	Title	Country
D2-301	Building a Secure Network Policies, Architecture and Incident Response Case: Chesf	Brazil
D2-302	A Hybrid Communications Network Approach for Advanced Applications on the Modern Grid	USA
D2-303	Network evolution towards packet switched technologies	Finland
D2-304	IED system management solution: a universal approach for all your grid IoT integration	Canada
D2-305	Teleprotection over Multiprotocol Label Switching (MPLS): Experiences from an Australian Electric Power Utility	Australia
D2-306	Research and application of deep security protection technology in power industrial control system [IEC 62351]	China
D2-307	Challenges in EGAT Telecommunication System Integration	Thailand
D2-308	An Indian Case Study of Hierarchically Integrated SCADA system up gradation and its impact on Connected Control centers	India



Paper No.	Title	Country
D2-309	Network and Data Cybersecurity Strategy of the Electrical Power System	South Africa
D2-310	Telecommunication solutions for IEC 61850-based substations at the Spanish TSO and its practical implementation	Spain
D2-311	MAIGE – IoT infrastructure for online asset management	Spain
D2-312	Development of information-analytical system for automatic fault analysis and relay protection performance evaluation	Russia
D2-313	Approach to maintaining secure operation of various systems in Japanese electric companies	Japan
D2-314	GOOSE performance monitoring based on IEC 61850 enabled switch	Taiwan
D2-315	Data Analytics Platform for Power Equipment Intelligent Lifecycle Management	Russia
D2-316	Asset Management with ICT Support in Indian Power System	India





SC D2 New WGs

- All members (regular + observer) are requested to give comments for approval
- – Federated Security Operations Center (FSOC) for smaller utilities
- Framework for an EPU SDN Data Operations Centre
- – Recommendations to improve cyber-physical security maturity assessments
- Expected WGs proposals
 - protections for MPLS networks
 - augmented reality

Future Events



PS 1: ICT supporting energy transition

SR M. Araujo

- Big data, data analytics using artificial intelligence (AI) for securing the electric power utilities operations
- Cloud computing
- Machine learning

PS 2: Cyber security

SR G. Dondossola



- Threats management in electric power utilities (EPU)
- Security assessments tools
- Cyber security maintenance in power system operation
- Electric power utilities credential management with blockchain technology
- Big data used for detecting cyber anomalies in electric power utility informational and operational technology (IT/OT)

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PS 3: New internet of things (IoT) application to support electric power utilities

SR S. Tanner

- 5G for utility networks
- New internet of things applications to support electric power utilities
- Cybersecurity issues in internet of things





Future Events



46 over 60 synopses have been selected

PS 1: ICT supporting energy transition

SR M. Araujo

19 synopses from

- Australia
- Bosnia and Herzegovina
- Belgium
- China
- Spain,
- Finland
- GB, FR, DE
- India
- Japan
- Russia
- Sweden
- Slovenia
- USA

PS 2: Cyber security

SR G. Dondossola

18 synopses from

- Australia
- Brazil
- Finland
- India
- Italy
- Japan
- Mexico
- Russia
- Russia, Germany
- Sweden
- Slovenia
- USA
- USA, USA, South Korea
- Taiwan, Germany

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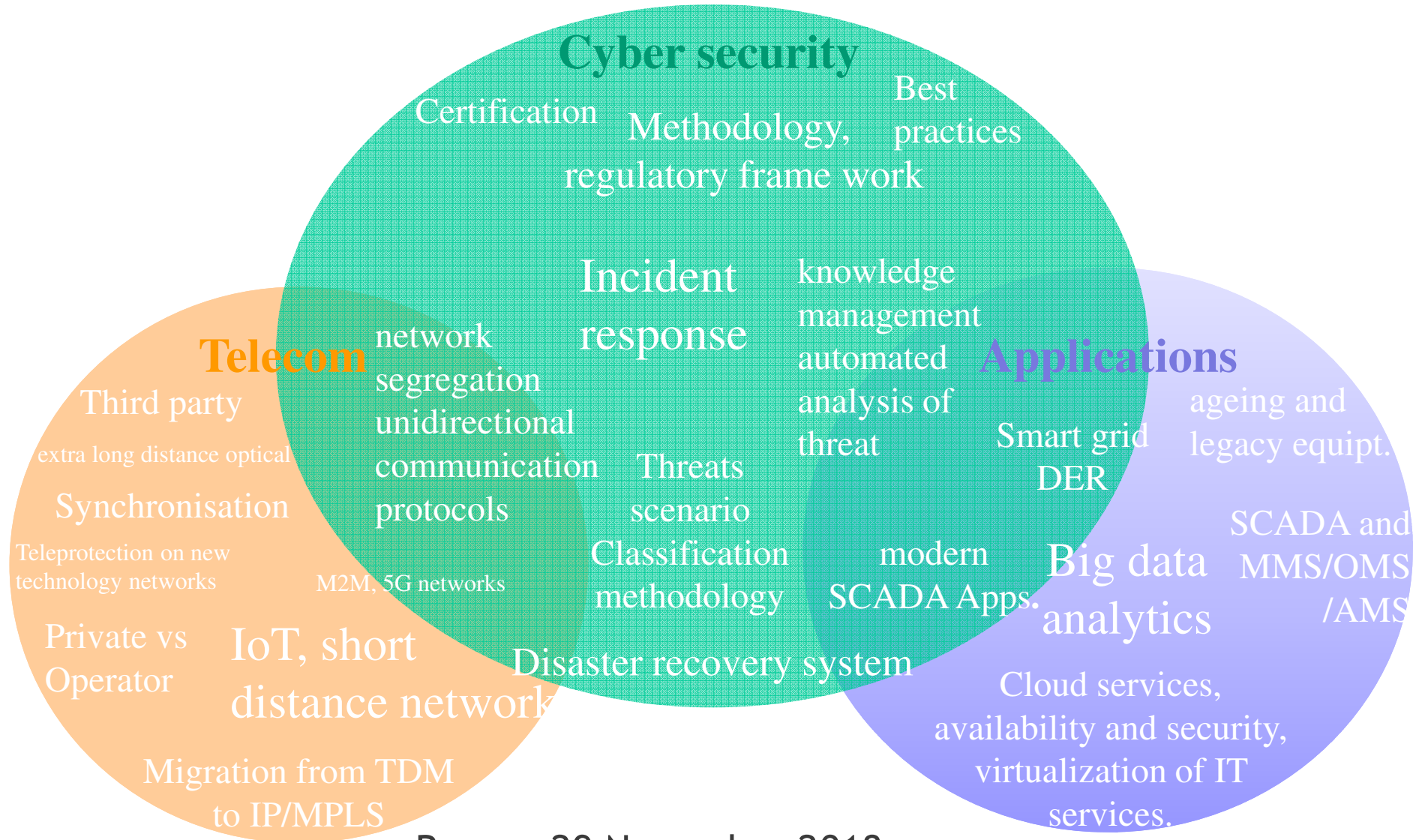
PS 3: New internet of things (IoT) application to support electric power utilities

SR S. Tanner

9 synopses from

- Australia
- Finland
- UK
- Japan
- USA

Preferential subjects for 2020





D2 PS for CIGRE Session 2020

PS1 – Benefits and challenges of new ICT on EPU (AI, Big Data, cloud, IoT, Blockchain)

- Benefits and challenges in System Operation
- Benefits in lifecycle management and disaster recovery



PS2 – New cybersecurity challenges in the changing electricity industry

- Cybersecurity challenges in the use of Industrial Internet of Things (IIoT), Big Data and Cloud-based platforms
- Cybersecurity challenges related to DER and interconnection of new flexibility providers
- Identification of cybersecurity threats using big data analysis and machine learning

PS3 – Providing packet switch communication to support EPU

- Migration from TDM to packet, SDH to WDM/OTN...
- Providing new connectivity for distribution network (PLC, 5G,...) and
- Time critical operational services over packet network



SC D2 Cyber Security



Giovanna.Dondossola@rse-web.it

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SC D2 Italy Country Report 2018



Event Name	Date yyyy-mm-dd:dn	City	Web site link	Comments
Cyber Security: Energy & Utilities	2017-09-27	Rome	Not available	Panel with industries and utilities
Cigré D2 Colloquium	2017-09-20:22	Moscow	http://www.d2_rus.cigre.ru/en/	Italian Paper and Tutorial on Cyber Security
Digital Energy Report	2017-11-23	Milan	http://www.energystategy.it/eventi/digital-energy-report-novembre-2017.html	Digital Energy Report
5G challenges	2018-04-16	Rome	http://www.isticom.it/index.php/seminari-isticom	5G technology
Italia Sec Summit	2018-05-15	Rome	https://www.cs4ca.com/italiasec/	Cyber security of industrial control systems - Italian scope
Electrify Europe	2018-06-19-21	Vienna	http://www.electrify-europe.com	Cyber security presentations
Cyber Security for infrastructure of Energy & Transport	2018-06-12	Genoa	http://www.csetconference.com	Cyber Security for Energy Infrastructure
Energy Cybersecurity Report 2018	2018-07-12	Milan	http://www.energystategy.it/eventi/cyber-security-report-12-luglio-2018.html	Energy Cybersecurity Report 2018

Event Name	Date yyyy-mm-dd:dn	City	Web site link	Comments
Cigré Session 2018	2018-08-26:31	Paris	http://www.cigre.org/Events/Session/Session-2018	Special Reporter D2.PS1
Cigré D2 Colloquium	2019-06-11:14	Helsinki	http://www.d2_rus.cigre.ru/en/	
Red Team Blue Team Exercise	2018-11-20:22	Den Haag	Not available, ENTSO-E initiative	

	Company Represented	Representative Name	Type Vendor Tx Utility Dx Utility Consultant Academic	Role Convener Secretary Regular Corresponding Support	Activity High Medium Low Non
1	RSE	Giovanna Dondossola	A	Con	H
2	Terna	Andrea Foschini	T	Sec	M
3	CESI	Alessandro Bertani	C	Reg	M

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AG D2.02 – Scope (1)

- Promote best practices in relation to operational cyber security system design, implementation, testing, operation and maintenance
- Publish papers and give tutorials within Cigré and other events to:
 - Inform EPU's of threats and risks associated with cyber security that may impact operational systems with special focus on EPU infrastructure such as substations, power plants, DERs, etc.
 - at the Cigré SC D2 Colloquium 2017 organised by the Russian National Committee 12 out of 35 presented papers were related to the resilience to cyber attacks of telecommunication and information systems in the electric power industry. One of these papers titled “A monitoring architecture for smart grid cyber security” has been selected for publication at the CSE Journal
 - Promote cyber security culture applied to operational systems by organizing workshops and introductory tutorials
 - AG D2.02 contributed to the Cigré SC D2 Colloquium 2017 by providing a tutorial on “Cyber security standard assessment”
 - A cyber security tutorial has been given by SC D2 during the Cigré Session 2018



AG D2.02 – Scope (2)

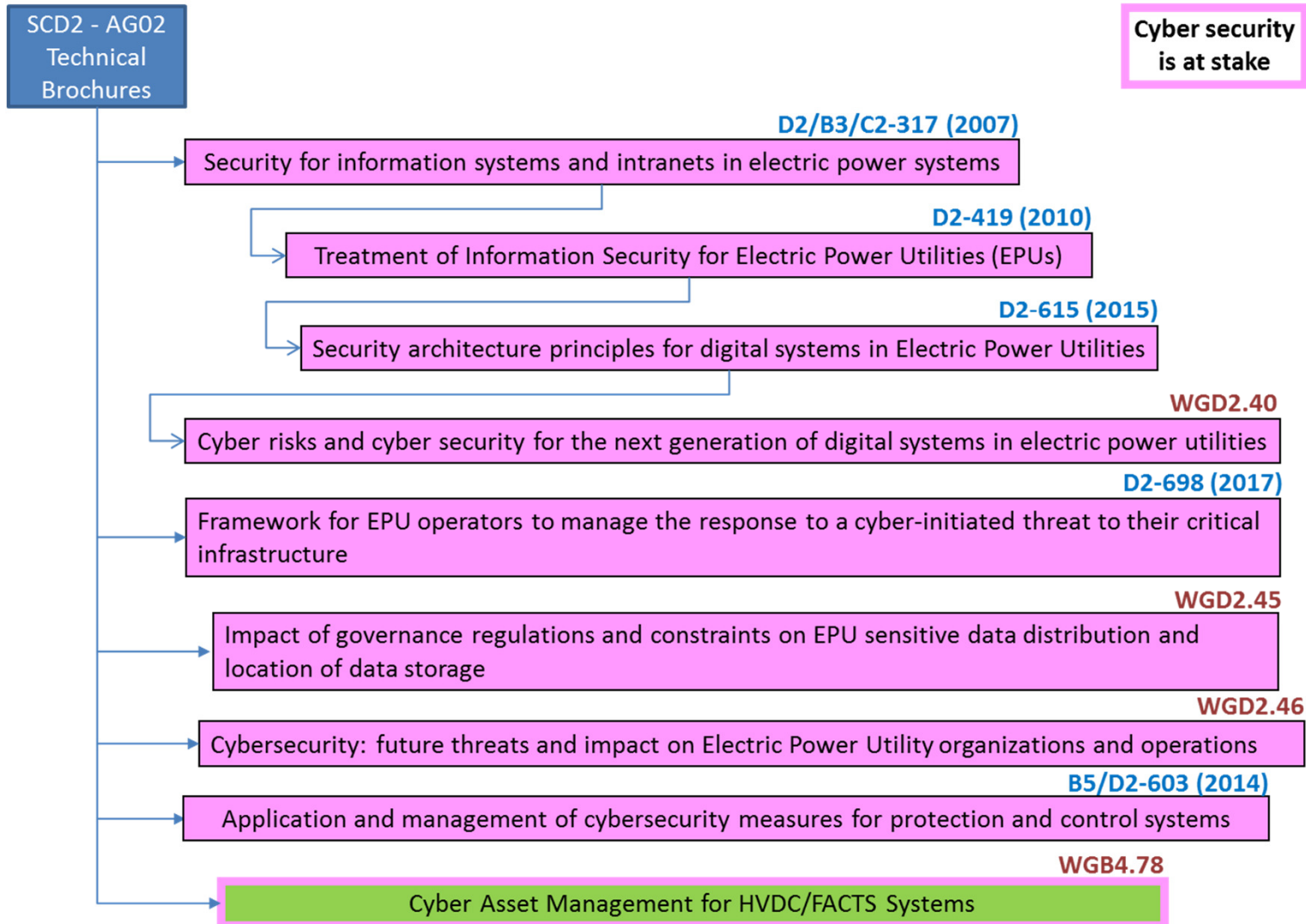
- Propose the creation of new Working Groups to study new topics and develop documents to help EPU's to adopt cyber security solutions.

Examples of relevant topics:

- IT/OT security information event management
 - Security of IoT technologies
 - Security of Network Function Virtualization, Cloud-based platforms
 - Blockchain applications for EPU's
-
- Collect needs and cyber security requirements from EPU's and Cigré WGs of other SCs, especially those related to smart grids and their operations
 - Survey on telco services, remote accesses, connectivity and security measures deployed by EPU's

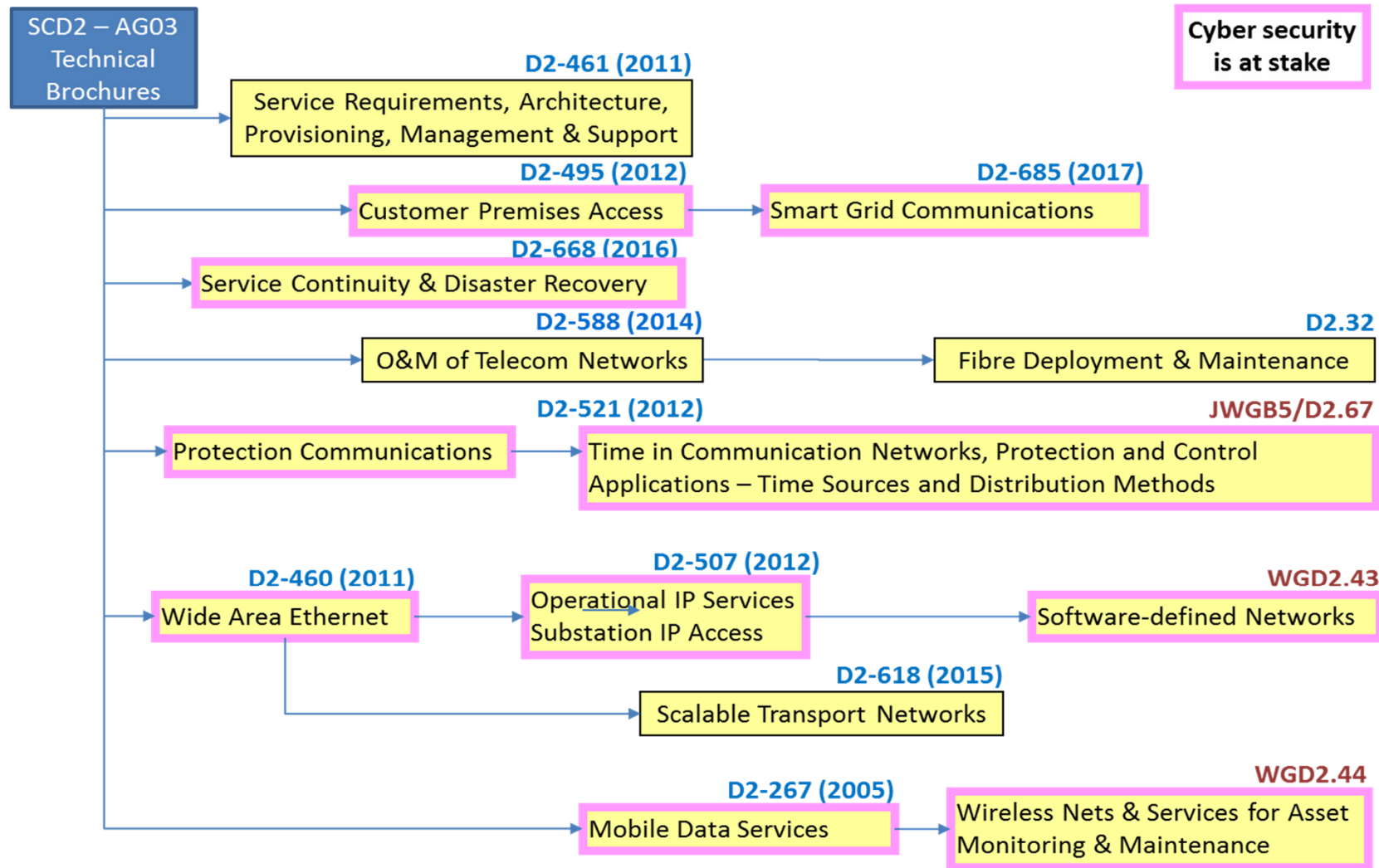


AG D2.02 – TB and WGs





AG D2.03 – TB and WGs





AG D2.02 – Scope (3)

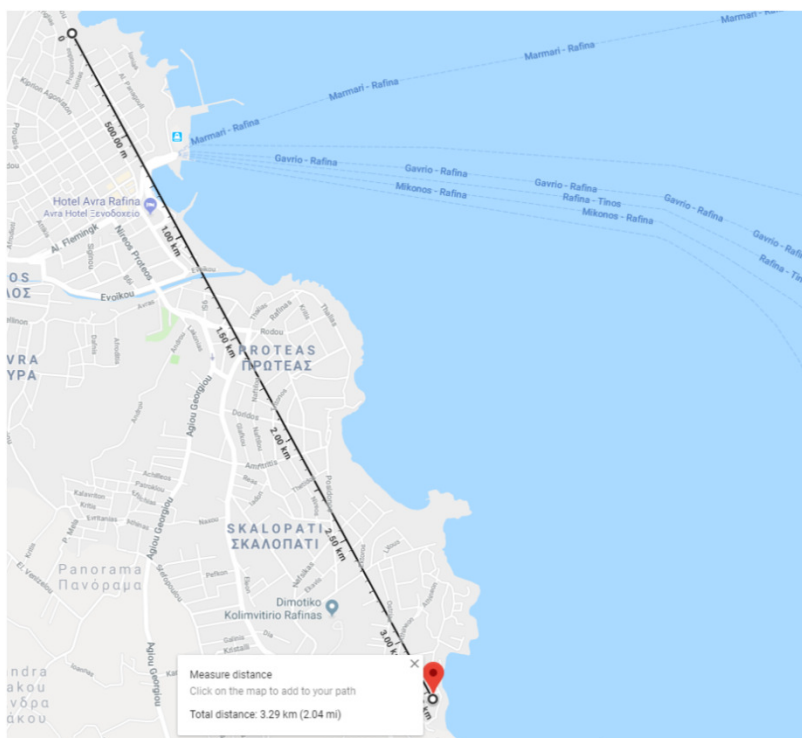
- Facilitate the development of security standards by identifying gaps and specifying uncovered requirements
- Establish liaisons with other international bodies to promote the work carried out by Cigré in the field of cyber security and obtain new inputs to determine key priorities for work
 - Collaborations with IEC TC 57 WG 15
 - a Cigré AG D2.02 update has been given at each plenary meeting of the WG 15 (IEC TC 57)
 - a joint paper titled “What may Electric Power Utilities (EPUs) do to mitigate the cyber threat landscape?” has been finalised and published in the February 2018 Edition of Cigré Science and Engineering Journal
 - Collaborations with IEC SyC WG3 Cyber Security
 - most relevant Cigré publications on cyber security will be referred in the white paper currently under preparation by the IEC SyC WG3 Cyber Security Task Force
 - A joint Cigré SC D2/C4/B5 initiative is undergoing related to the preparation of a paper titled “Facing the challenges of cyber security for Industrial Control Systems: Lessons from the Power Industry” for the 65th Annual Reliability and Maintainability Symposium, to be held on January 2019 in Orlando (Florida)



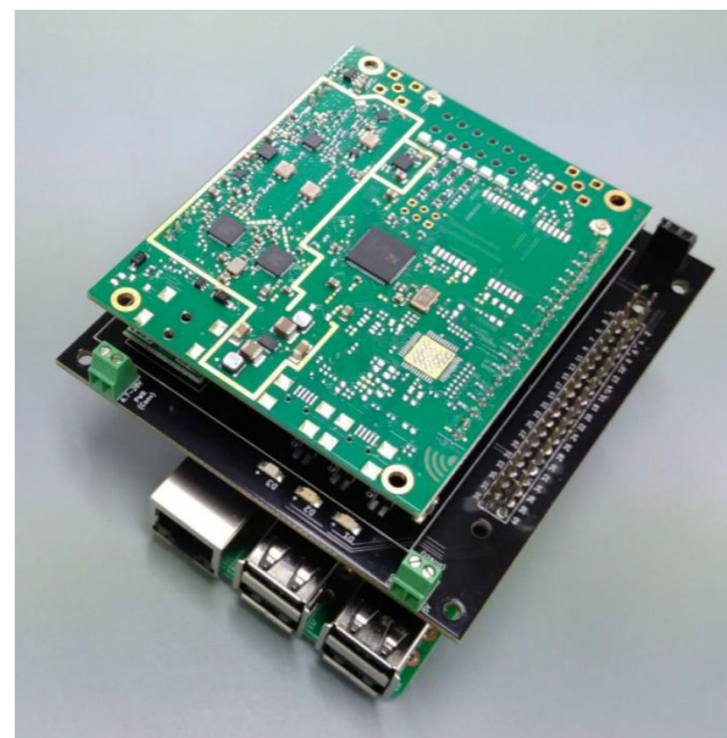
AG D2.02 – Cyber Security

Chair: G. Dondossola

PAPER D2-101: LORAWAN SETUP

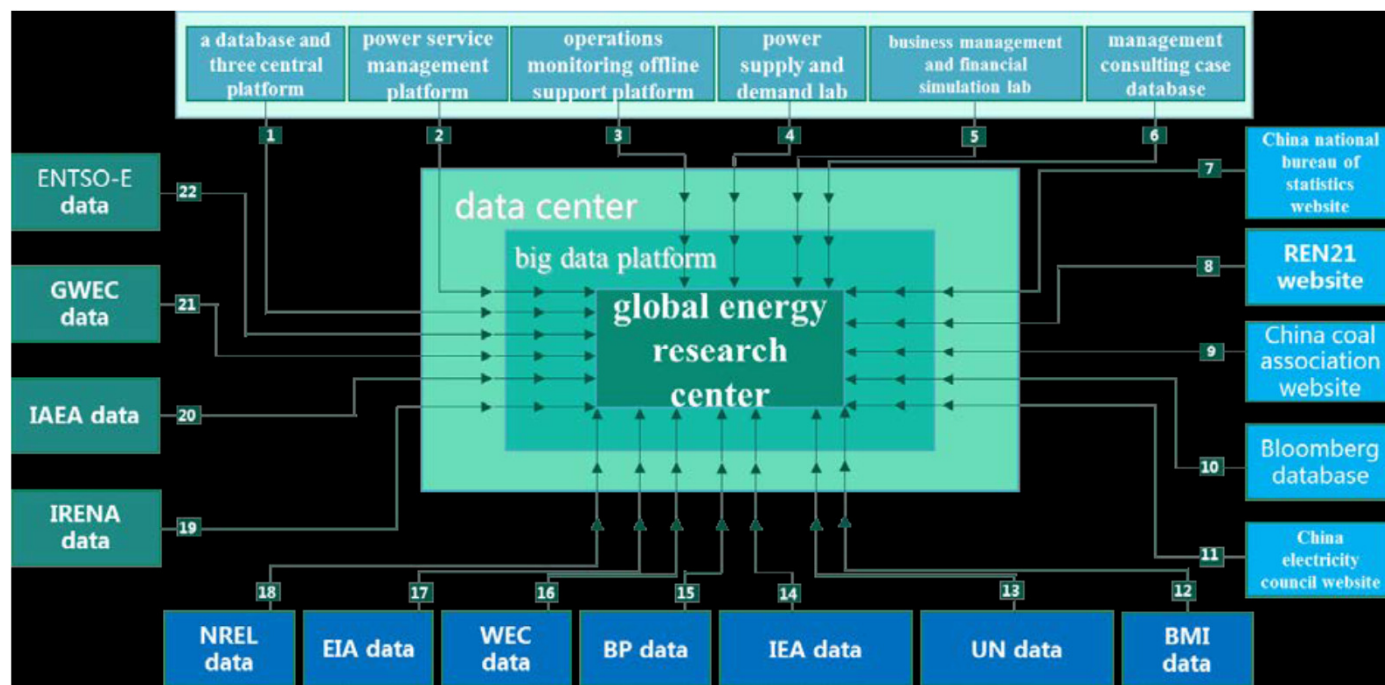


*Distance between LoRaWAN gateway and end-nodes
[Source: Paper D2-101]*



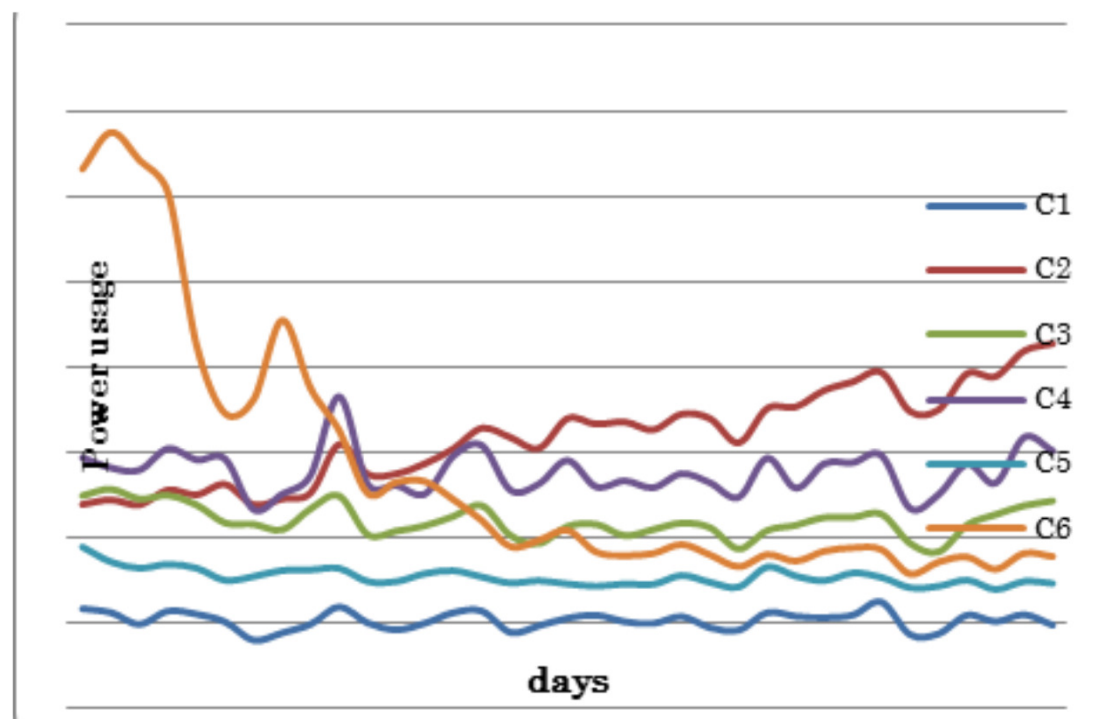
*Custom-built LoRaWAN gateway
[Source: Paper D2-101]*

PAPER D2-102: BIG DATA ANALYSIS



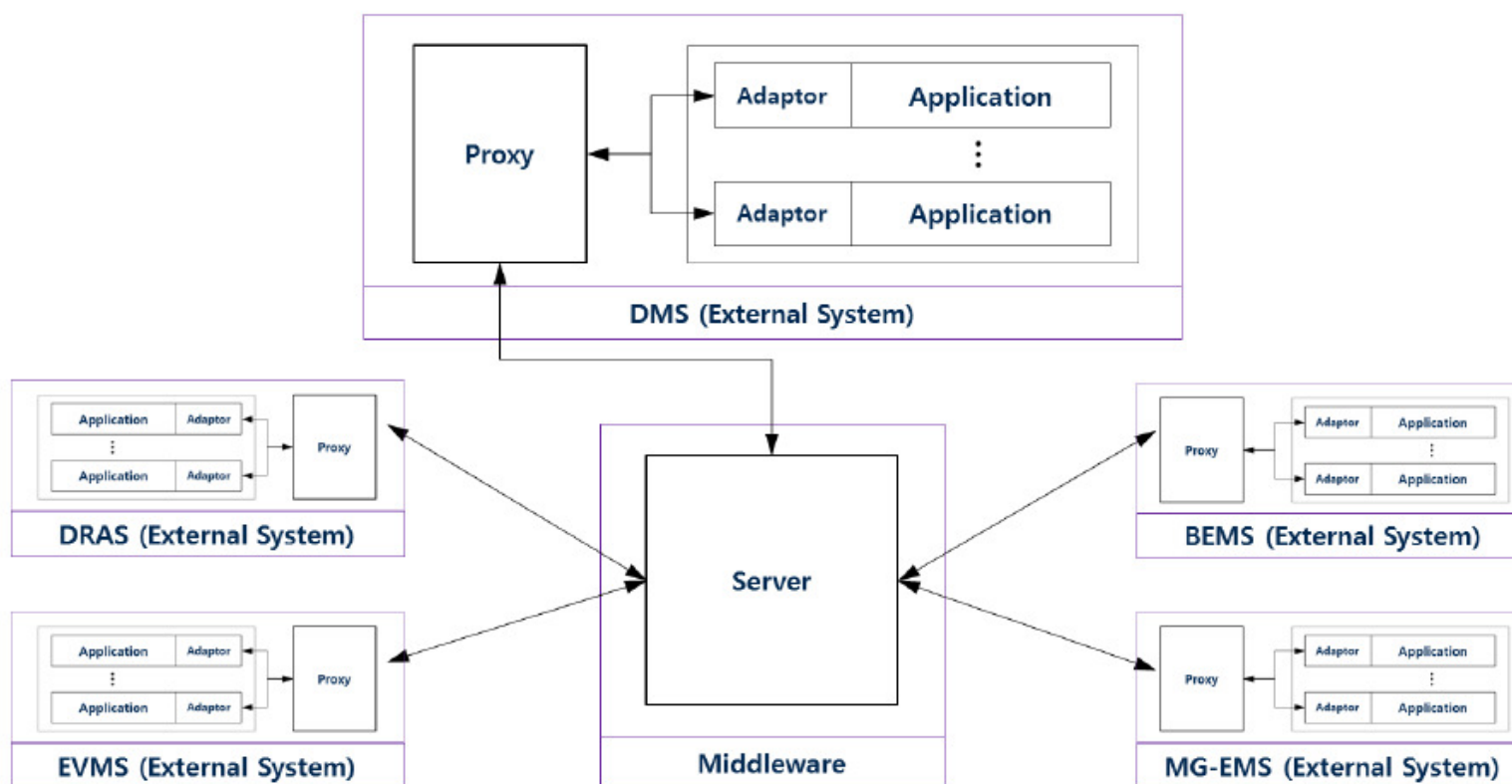
4E database for global energy and power [Source: Paper D2-102]

PAPER D2-103: BIG DATA AND GIS



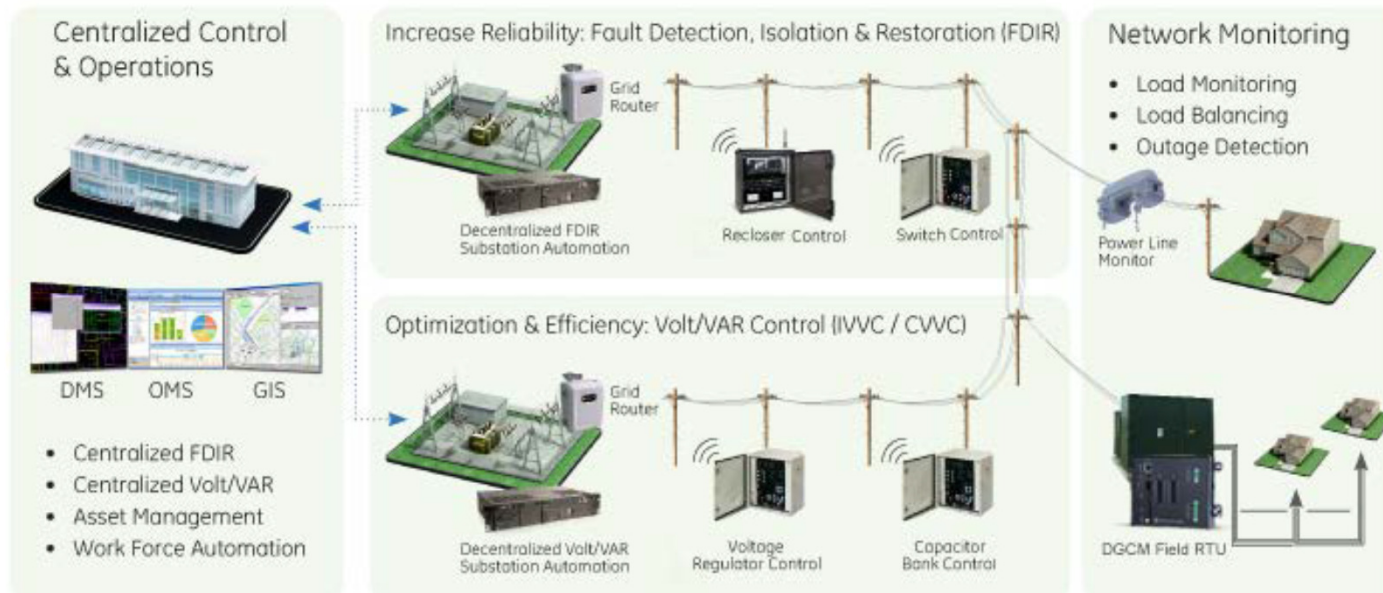
Average electric power usage in each cluster [Source: Paper D2-103]

PAPER D2-104: MICROGRID STANDARD



Deployment architecture of interoperability adaptor [Source: Paper D2-104]

PAPER D2-106: SMART GRID COMMUNICATIONS



Protection and Control applications in the Distribution Grid (GE Grid solutions) [Source: Paper D2-106]

QUESTIONS / ANSWERS

- 7 prepared contributions were received from 5 countries
- Q1-01: What are EPU expectations of the low power wireless technologies from the IoT market in relation to their claimed performance of radio coverage, power consumption, data rate and cyber security and associated CAPEX and OPEX costs? Are they able to meet the technical requirements of EPU applications at reasonable costs?
- According to the contributors there is the possibility to use IoT based communication architectures for **condition monitoring** applications with less demanding latency requirements, that consist of **wireless communication links and internet protocol stacks**
- For smart metering infrastructures private multi-hop wireless networks represent a technically suitable and economically feasible solution in urban areas, with advantages compared to PLC or cellular networks

QUESTIONS / ANSWERS

- Q1-04: What experiences on interoperability issues in microgrid implementations can be shared with the audience? How have they been solved?
- Microgrid development, although essential for the electrification of Africa, still has some interoperability issues to solve. Communication performance have to be carefully tested in relation to the microgrid scale

QUESTIONS / ANSWERS

- Q1-05: What are the most technically suitable and economically feasible communication solutions for the time controlled, predictable, reliable and secure operation of the sub-transmission and primary distribution grids?
- Several communication technologies need to be deployed for meeting the requirements of sub-transmission grids of the future. There is not one best solution, the correct design is to combine different technologies adjusted to each specific situation to achieve the goals (PLC, wireless, optical fiber)

QUESTIONS / ANSWERS

- Q2-01: What are the opportunities for virtualisation technology (which includes server/application virtualisation, SDN and NFV) for EPU's? What are some of the specific use cases already adopted by EPU's, or potential use cases that might deliver value?
- Distributed Energy Resources and Renewables are expected to bring additional challenges to EPU's, due to the large volume of data originating from various locations in the grid. These include advances in Machine Learning, Big Data, AI and IoT, which bring tremendous opportunities to the electricity industry, at the same time present new challenges to EPU's in the areas of information systems and telecommunications
- In DER, data is expected to be large in volume, and distributed in nature. Centralised processing of all information in the traditional EPU datacentre is no longer sufficient. Distributed processing is required. This is where data is pre-processed at the nearest location possible, for example in the field devices and at the substations, after which the aggregated and summarised data is handed onto the central location
- Virtualisation, in the form of both the application and network virtualisation (SDN & NFV) have the potential to meet these requirements. With virtualisation, application and network functions can be consolidated into shared common commodity server hardware - this reduces the physical and power footprint of distributed processing, with the ability to form flexible interconnects between sites securely with the use of SDN/NFV

QUESTIONS / ANSWERS

- Q2-02: In EPU's telecommunication networks, how do SDN and NFV fit in the larger picture of existing technologies already deployed in EPU's such as SDH/SONET, MPLS and VLANs?
- Q2-03: EPU applications such as SCADA and HMI have now been virtualised and supported by the various manufacturers and software developers of these applications. What are some of the applications that are still difficult to virtualise, and what are the challenges that need to be overcome for successful virtualisation of these applications?
- The use of SDN/NFV in EPU's is in an early stage, with Telecommunication Service Providers / Carriers leading the way in implementation – however, similar to MPLS in the early days of EPU adoption, SDN/NFV will likely become successful, if its ability to improve efficiency and reduce costs is proven and brought to maturity is proven



CIGRE – World Bank Working Group AFRICA

Determine Goal

- CIGRE – the International Council on Large Electric Systems – elaborates unbiased international technical guidelines for the power system including technical and market aspects. It provides the platform for knowledge sharing and networking. More than 3,500 experts from across the globe actively collaborate in structured work programs.
- The World Bank has a strong focus on African electricity system developments. World Bank staff have the challenge to prioritize which infrastructure investments have the best multi-criteria benefit/cost ratios.
- Together, the World Bank and CIGRE enhance sustainable electricity projects and know-how transfer, e.g. in conferences, tutorials and through digital media. They assist African countries to develop internal expertise by providing access to unbiased, up-to-date technical experience in several innovative ways.
- The 4-year CIGRE/World Bank Africa Working Group manages this systematic dissemination effort of CIGRE work results to managers, engineers and planners in Africa.
- This fits well with CIGRE's goal of „Sustainable Electricity for All“ and the Technical Council Reference Paper on Sustainability.



CIGRE – World Bank Working Group AFRICA Approach

CIGRE and the World Bank cooperate to achieve the following general goals:

- Transfer of knowledge to facilitate development of the electricity sector and access to electricity in Africa, focused on differentiated target groups (see next slide)
- Establishment of CIGRE cooperation agreements with the World Bank and African electricity associations and of joint collaborative organizational structures to ensure implementation of the agreed actions; this includes working structures focused on dissemination of knowledge and implementation in Africa, e.g. a temporary steering group, regional councils, specific microgrid WGs.



CIGRE – World Bank Working Group AFRICA Approach

- Knowledge transfer to enable more African CIGRE institutional and individual members who over time organize future dissemination and implementation activities in a more autonomous way.
- Definition of a financial framework for training, workshops and implementation support consulting, for topics related to CIGRE work products and of WB interest, which addresses cost and efficiency concerns of African countries and of WB.

An MoU is signed between CIGRE and the World Bank on 26 Aug. 2018, which governs this cooperation for dissemination of CIGRE results in Africa.



CIGRE – World Bank Working Group AFRICA

Identify Audience

With the ongoing working group, we reach out to managers, engineers, economists and planners as well as academia in the following institutions:

- Energy ministries, regulators and legislators;
- Electric utilities incl. transmission and distribution system operators, generators, energy suppliers;
- Large industrial and mining users of electricity;
- City administrations;
- Microgrid/nanogrid installation and maintenance companies and community groups of village leaders;
- Universities and Centers of Excellence.

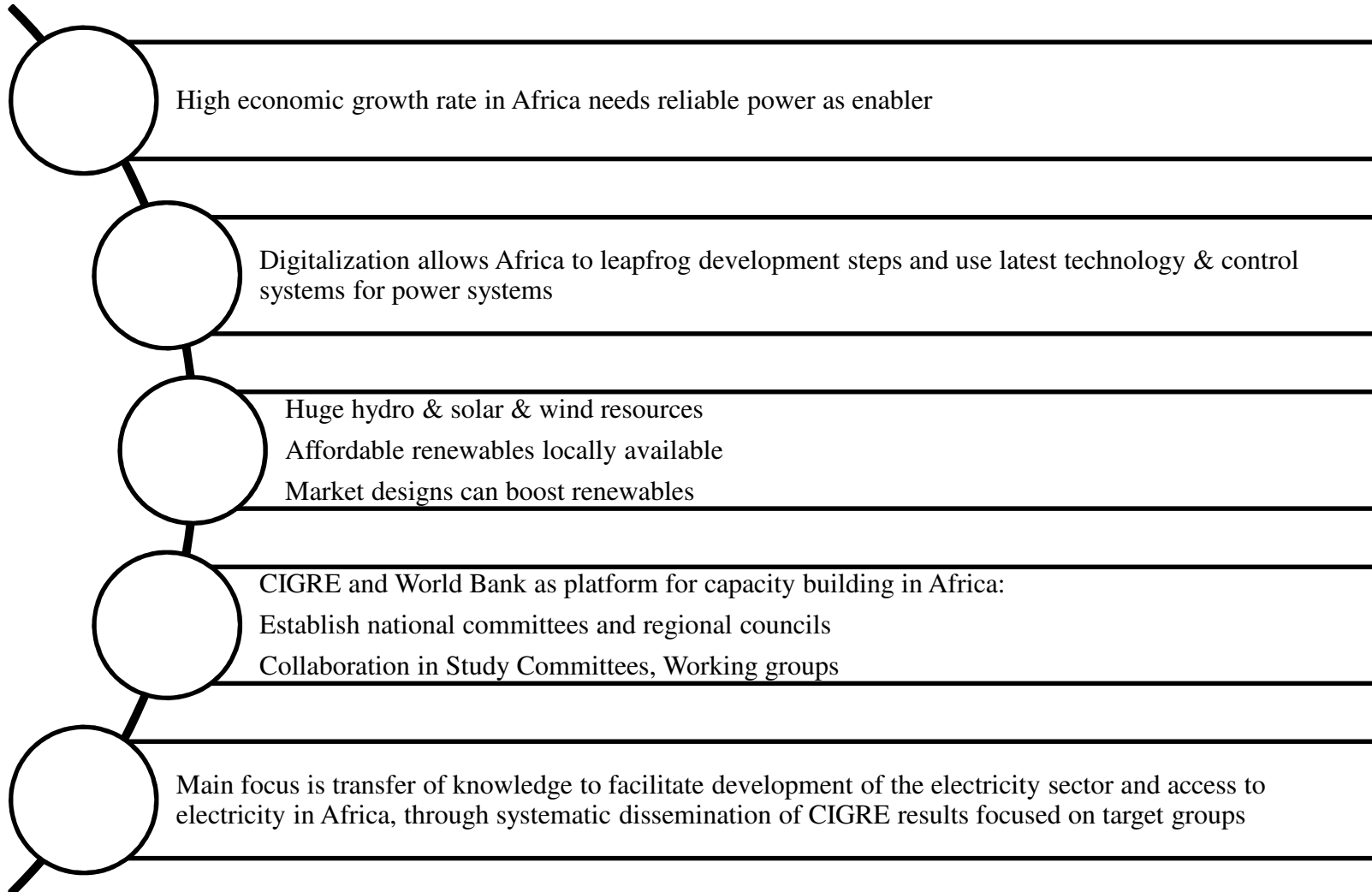
The working group will identify a sequential regional focus.

An important task is identifying CIGRE experts for knowledge transfer.



CIGRE – World Bank Working Group AFRICA

Develop Messages





CIGRE – World Bank Working Group AFRICA

Select Communication Channels

Print media

- Technical brochures
- Green Book
- Electra
- Papers for conferences
- Poster
- Other journals

Digital media

- Public CIGRE & Worldbank websites
- Knowledge management System KMS
- E-cigre
- LinkedIn
- Blogs
- Webinars
- Journals
- Partner websites

Conferences

- Session
 - Symposia
- Regional focus**
- Conferences CIGRE, World Bank, IEEE, CIRED
 - Tutorials
 - Working group meetings

Exhibitions/ Events

Booth at CIGRE
Session; roll-up, video

Regional focus

World Bank Events
CIGRE National
Events
African Power Pools
events