Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: IG DEP Review of Responses to Call for Interest(CFI)

Date Submitted: March 10, 2015

Source: Ryuji Kohno(YNU/CWC-Nippon)

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Re: IG DEP Review of Responses to Call for Interest(CFI)

Abstract: Review of Responses to Call for Interest(CFI)

Purpose:

IEEE 802.15 IG DEP

Review of Responses to Call for Interest(CFI)

Berlin, Germany
March, 2015

Objectives

To make sure demands and major requirement for wireless dependability in automotive and medical industries, responses to Call for Interest(CFI) are reviewed in the sessions this week.

Then sessions can move forward to discuss on Time Line and Project Plan, and Drafting CSD and PAR.

List of Responses to CFI

Responses to IEEE P802.15 IG DEP (dependability) Call For Interest — March 9th, 2015

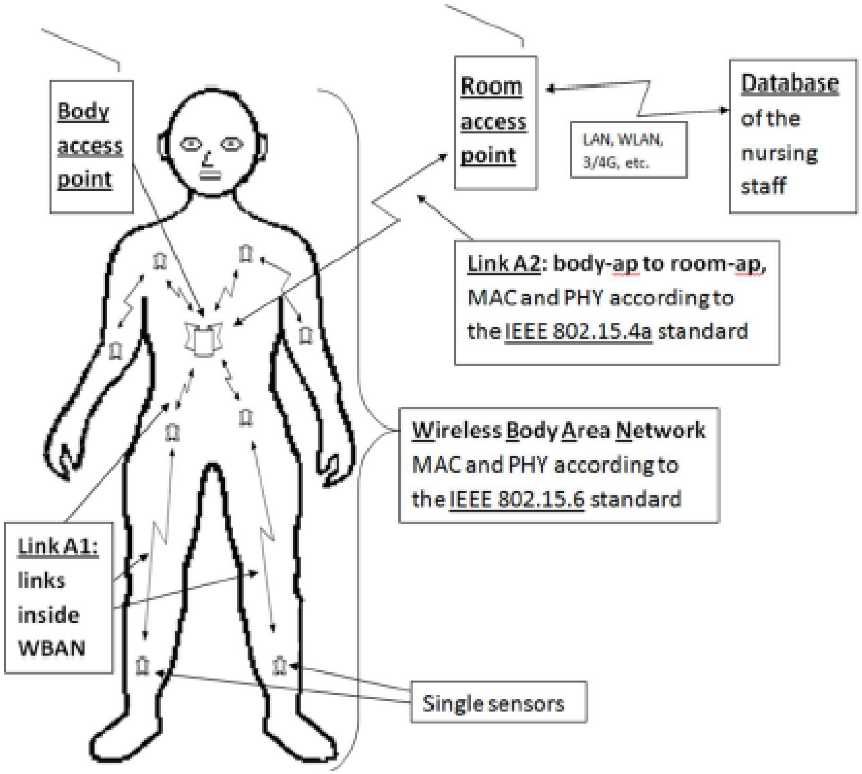
NO	Institutes and Companies	Reprectsentatives, Contcts	Dates	Interest	Major Interestsl	Detail
1	Centre for Wireless Communications(CWC), University of Oulu, Finland	Jari Iinatti, Matti Hämäläinen, Tuomas Paso, Ville Niemelä, Jussi Haapola, Centre for Wireless Communications, Department of Communications Engineering, University of Oulu	6-Jan-15	○	Remote Healthcare Monitoring	
2	Nissan Automotives	Hiroshi Kobayashi <h-kobayashi@mail.nissan.co.jp>	10-Mar-15	○	Factory Automation	
3	Sumitomo Chemistry, Japan	Tomoyuki Watanabe <watanabet10@sc.sumitomo-chem.co.jp>	24-Oct-14	○	Remote Sensing and Controlling	
4	Volks Wagen, Germany	Kwoczek, Andreas (K-EFFI/K) <Andreas.Kwoczek@volkswagen.de>	11-Nov-14	○	Car Internal Sensing and Controlling	
5	BMW, Japan and Germany	Taakashi Ehara <takashi.ehara@bmw.co.jp>, Ms. Kirsten Matheus	5-Mar-15	○	Collision Avoidance Radar	
6	Daimler, Japan and Germany	Jochen Feese <jochen.feese@daimler.com>, Takachi Ohta <takashi.ohta@daimler.com>,	15-Jan-15	○	InterVehicle Communications and Ranging	
7	Medical ICT Center, Yokohama National University, Japan	Chika Sugimoto <chikas@ynu.ac.jp>, Ryuji Kohno <kohno@ynu.ac.jp>	3-Mar-15	○	Wearable and Implant Wireless Medical Sensing and Contorliing	
8	Nanotron, Germany,	Jens Albers <J.Albers@nanotron.com>	20-Feb-15	○	Applications of Ultra Wide Band Radio	
9	IEICE Professional Study Group on Reliable Robust Radio Control	Masaaki Katayama <katayama@nuee.nagoya-u.ac.jp>	15-Sep-14	○	Reliable Robust Radio Control	
10	Tohsiba Co., Healthcare Company	Shigenobu Minami <shigenobu.minami@toshiba.co.jp>	9-Dec-14	○	Wearable Healthcare Sensing	
11	NEC, Co.	Manabu Yagi <m-yagi@bx.jp.nec.com>	10-Nov-14	○	Wireless Remnsing and Controlling	
12	ETSI Smart BAN Project	John Faserotu <john.farserotu@csem.ch>, Hirokazu Tanaka <hi.tanaka@toshiba.co.jp>	9-Sep-14	○	Secure Remote Healthcare and Meadicine	

Response to CFI: Case 1

Jari Iinatti, Matti Hämäläinen, Tuomas Paso, Ville Niemelä, Jussi Haapola
Centre for Wireless Communications, Department of Communications Engineering, University of Oulu

Use case: Medical Wireless Monitoring

Complete concept with today's standards



(Case 1) **Would a good wireless solution benefit your application?**

If yes, please describe the benefits you would like to realize

Yes, as it provides, e.g., the following features:

- Data transmission from patient to diagnosis devices
- Wireless sensors and monitoring
- Data transmission during transportation
- One-desk registration
- Data transmission to doctor when approaching patient
- Data transmission from devices to the system
- Wireless location and tracking, both indoor and outdoor
- Automatic guidance through premises
  - Security
  - Reliability
- Data transmission from system to doctor
- Data transmission to a common database

(Case 1) **Have you tried wireless solutions?**

What worked and what did not (be specific).

We have done extensive system level evaluations on IEEE 802.15.4-2011 and IEEE 802.15.6-2012 standards.

- What worked:
  - 802.15.4-2011 UWB low-band mandatory channel data rates sufficient for monitoring up to 6 patients in a ward room.
  - 802.15.6 UP use works sufficiently when having medical and non-medical data.
- What did not work:
  - 802.15.6 UWB PHY communications range not sufficient to cover a ward room.
  - 802.15.6 superframe structure impossible to configure to work efficiently and enable low-delay UP7 transmissions.
  - 802.15.4-2011 UWB Aloha mode delay too unpredictable for individual data packets.
  - 802.15.4-2011 does not support priorities, CFP and 802.15.4e-2012 DSME allocation restrictions produce unwanted tradeoffs.
  - Not sufficient number of medical data user priorities for purely medical applications.

(Case 1) What is missing with what you tried?.

- Support for infrequent very low latency emergency messaging in a multi-user environment (rigid allocation of EAPs does not work here).
- Medical environment needs finer granularity of user priorities.
- Fast network handovers.
- In 802.15.6 hub-to-hub communications missing.

(Case 1) What are the essential performance requirements for your applications' communications link, whether that link is wired or wireless?

- For high-priority medical messages in a multi-user environment, systematic (>95% of case) link delay of less than 15 ms.
- Data packet delivery ratio > 99% in multi-user environment (maximum communications range 15m).
- Mobility support for less than 3 m/s.
- Star and mesh network communications capability.
- PAN/BAN interoperability to enable large, seamlessly transparent networks.

(Case 1) **Also please indicate if you would be interested in participation of the development of this standard.**

Yes, we are interested in participating in the development of this standard.

Contacts:

Jari Iinatti, jari.iinatti [at] ee.oulu.fi

Jussi Haapola, jussi.haapola [at] ee.oulu.fi

Response to CFI: Case 2

Tomoyuki Watanabe, Sumitomo Chemistry Co. Ltd.

We are interesting in standardization of dependable wireless network for agriculture farming and factory automation and its related applications.

1. major applications

- **wireless remote sensing plants and controlling facility for farming**
- **wireless remote controlling robots for factory line process with wireless remote sensing**

2. requirement

- **precise sensing health condition of plant same as human health condition**
- **reliable sensing and controlling all of factors in manufacturing line of factory with multiple sensors and actuators in the same time**

3. marketing

- **immediately apply for current ongoing agriculture farm and factory automation**
- **within a few years**

Response to CFI: Case 3

Tomoyuki Watanabe, Sumitomo Chemistry Co. Ltd.

We are interesting in standardization of dependable wireless network for agriculture farming and factory automation and its related applications.

1. major applications

- **wireless remote sensing plants and controlling facility for farming**
- **wireless remote controlling robots for factory line process with wireless remote sensing**

2. requirement

- **precise sensing health condition of plant same as human health condition**
- **reliable sensing and controlling all of factors in manufacturing line of factory with multiple sensors and actuators in the same time**

3. marketing

- **immediately apply for current ongoing agriculture farm and factory automation**
- **within a few years**

Response to CFI: Case 3

Andreas Kwoczek
Konzernforschung, Fahrzeuginformationssysteme
Vernetzte Karte und Ortung (K-EFFI/K)
Volkswagen AG

I am interested as long as we are not creating another standard that could jeopardize our Vehicle -to- Vehicle communication (802.11p).
Creating a wireless senor network inside the car is of high interest to save weight and simplify production.

Response to CFI: Case 4

Jochen Feese
Accident Research, Sensor Functions, Pedestrian Protection (RD/KSF)
Mercedes-Benz Cars
Daimler AG
Takashi Ohta, Mersedes-Benz Research & Development,
Daimlar Japan, co.

I am interesting in responsiblility for Accident Research, Sensor Functions, Pedestrian Protection within the Mercedes development department.

We have interest in collision avoidance radar in 76GHz in Japan as well as all others in a world.

Response to CFI: Case 5

Masaaki Katayama, Nagoya University,
Shinsuke Hara, Osaka City University
Ryuji Kohno, Yokohama National University

Overview of Japanese IEICE SG on Reliable Radio Remote Control(RRRC)

Doc.:IEEE802-15-14-0163-00-dep

http://www.ieice.org/~rcc/

(Case 5) **Would a good wireless solution benefit your application?**

If yes, please describe the benefits you would like to realize

< Aim >

- Promote R&D and business in an interdisciplinary field between controlling and communications.
- Create new ICT theories and technologies for dependable wireless not assuming intelligence of nodes unlike human communications in an usual communications.
- Create new controlling theories and technologies for dependable control assuming errors in M2M and controlling network.
- Promote researching activities in multi-disciplinary fields among fault tolerance, information security, artificial intelligence, and related fields around communication and controlling theories.
- Promote business activities in wide variety of industries such as **medical healthcare, transportation, smart grid of energy, disaster prevention, public safety, emergency rescue, factory automation, building construction etc.**

Dependable Wireless

Background

- **Safe, secure sustainable fruitful QoL** is looked forward.

Need for **Highly Reliable, Robust Communications for Controlling**

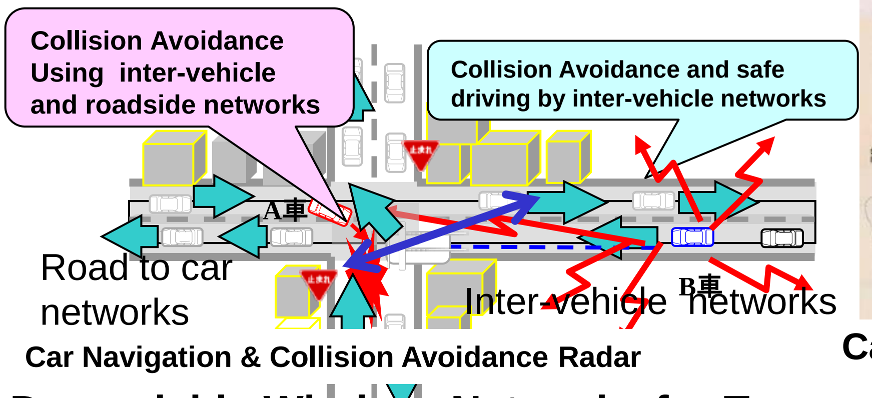
- Transition from Human communications **to Machine-to-Machine (M2M) communications.**
- Highly reliable, safe, secure and robust communications for **M2M Controlling** is necessary.
- **Integrated wired and wireless networks** provide dependable, green and ecological networks adaptable for environment.

Emotion and Sustainability

- **Medicine, Robot, ITS, Energy Supply, and Manufacturing** require more dependability in **controlling network, integrated circuit, connection in micro devices.**
- Medical equipments and industrial products need **long life time, fault tolerance.**
- **Dependable Network Architecture** for **M2M controlling**.

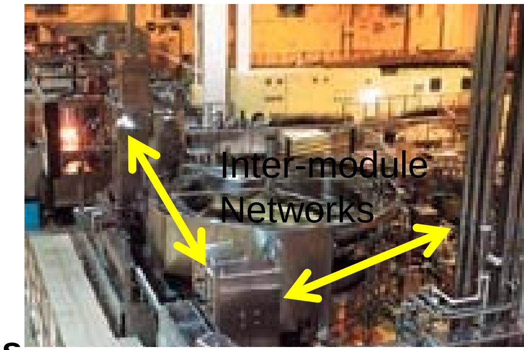
Ryuji Kohno(YNU/CWC-Nippon), Jussi Haapola(CWC), Aurtur Astrin(Astrin Radio)

Applications for Highly Dependable Communications for Controlling



Car Navigation & Collision Avoidance Radar

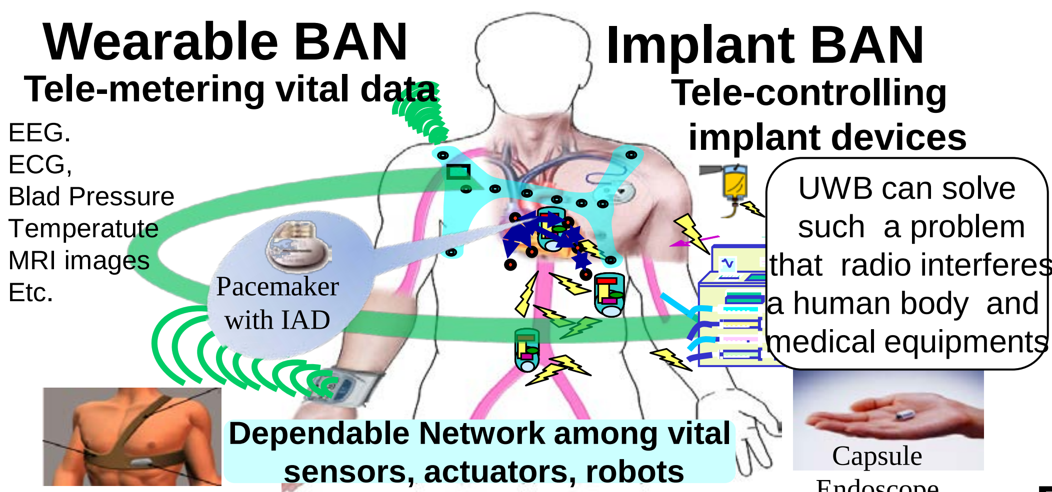
Car LAN & Wireless Harness

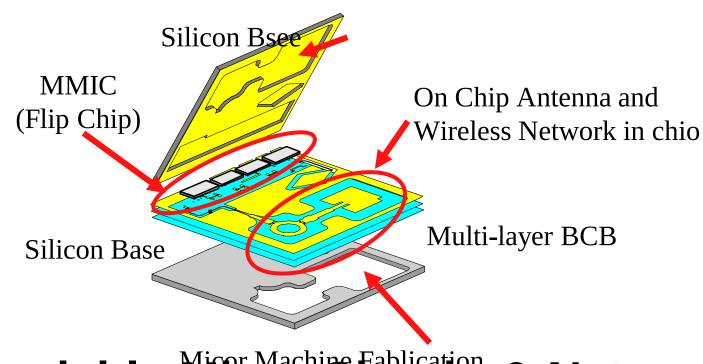


Factory Automation (FA)

Dependable Wireless Networks for Transportation

Dependable Wireless Sensing & Controlling for Manufacturing (CIM)





Dependable Micro Circuit & Network in Devices

Dependable BAN for Medical Healthcare

Examples of Dependable Remote Sensing and Controlling

Case of Office, Factory, Parking, Storage:

Robust and efficient transmission and geolocation

Case of Emergency Rescue

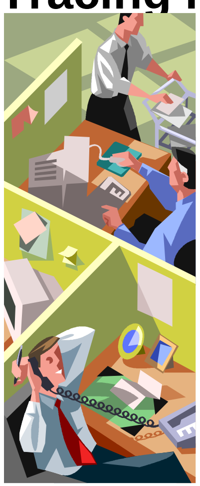
Detection of injured persons and remote monitoring disaster condition

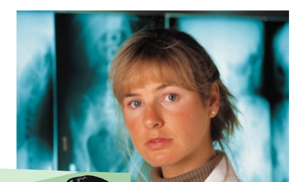
Case of Medical Healthcare

Remote monitoring and maintaining patients

Case of hobby and industrial remote control

- Tracing radio controlled helicopter and realistic video transmission





(Case 5) **Have you tried wireless solutions?**

What worked and what did not (be specific).

Physical Layer Technologies for Dependable Wireless

According to variance of channel condition, worst performance should be improved to guarantee necessary requirements.

Various advanced wireless technologies should be applied to improve the worst performance.

- Transmission Power Control
- Avoid & Filter Undesired Signals
- Space, Time, Frequency Diversity

→ **S/N and D/I improved**

Time Diversity(RAKE,Channel Coding)
Space Diversity(Array Antenna, MIMO)
Frequency Diversity(OFDM, UWB)

Ryuji Kohno(YNU/CWC-Nippon), Jussi Haapola(CWC), Aurtur Astrin(Astrin Radio)

PHY Technologies for Dependable Wireless

1. **Spread Spectrum (CDMA, Radar)**
2. **Adaptive Array Antenna(Smart Antenna, MIMO, Space-Time Coding, Collaborating Beamforming)**
3. **Diversity** (Space, Time, and Frequency Domains)
4. **Multi-band, Multi-Carrier(OFDM), Multi-Code**
5. **Coding(Turbo Coding and Decoding, LDPC, Space-Time Coding, Network Coding)**
6. **Software Reconfigurable Radio（SDR:Software Defined Radio), E2R(End-to-End Reconfigurability),**
7. **Cognitive Radio & Network**
8. **Ultra WideBand (UWB) Radio**
9. **Collaborative Communications and Sensing**

Higher Layers Technologies for Dependable Wireless

1. **Contention Free Protocol in MAC (TDMA, Polling, Hybrid CFP & CAP etc)**
2. **ARQ and Hybrid ARQ in Data Link (Type I, II) combination of transmission and storage(buffering)**
3. **Parallel Routing** (Risk Diversity) and **Network Coding** in network architecture
4. **Fault Tolerant Network** (Redundant Link and Parallel Hopping) and **Cognitive Networking**
5. **Encryption and Authentication in Application Layer** (AES, Camellia, Secret Sharing)

Cross Layer & Multi-Layer Optimization for Dependable Wireless

Dependable Wireless with
Less Power Consumption & Robustness

Application Layer: **Information Security(Encryption and Authentication, User Friendly Interface ･･･**

Network Layer: **Integrated Wired & Wireless Network Architecture, Network Security(IP SEC) ･･･**

Data Link & MAC Layer: **Priority Access Control, Fault Tolerant Routing, ARQ, Hybrid ARQ, Distributed Resource Management, ･･･**

Physical Layer: **Cognitive, Reconfigurable, Adaptive, Robust Radio, Error-Controlling Coding, Space-Time Diversity, Equalization, Coded Modulation, ･･･**

Device/ Electronics Layer: **Tamper Free Hardware, Robust Packaging, SoC, SOP, On-chip CODEC for channel Coding and Encryption･･**

Joint Optimization of Multi Layers

(Case 5) **What is missing with what you tried?**.

- Requirements for Dependable M2M
  - Definition of dependability with scientific criteria and numerical necessary values as well as design policy.
  - Classification of applications; application matrix
  - Mandatory technical requirements in PHY and MAC to satisfy the dependability criteria and values
  - Optional technical requirements in upper layer such as fault tolerant network, authentication and encryption.
  - Self organizing (forming /reforming network within minutes)
  - Feasibility study (bandwidth and power efficiency)
  - Compliance testing body

(Case 5) What are the essential performance requirements for your applications' communications link, whether that link is wired or wireless?

(1) Although conventional controlling theory does not care of errors in a link or a channel, a new controlling theory will be established in a case of assuming channel errors in a controlling link or network.
A **new communication theory for M2M controlling** should be established to achieve much more reliable, secure, robust against errors, or dependable connection.
(2) Common theories and algorithms between **controlling and communication theories** will be established. For instance, Levinson-Darvin algorithm in linear prediction has commonality with Barlecamp-Massy algorithm of coding theory.
(3) Dependable wireless M2M may promote **a new global trend of R&D and business** in wide variety of industries, car, energy, communications, finance, construction, medicine in a world.

(Case 5) **Also please indicate if you would be interested in participation of the development of this standard.**

Future Vision of Safe and Secure Social Infrastructures

Major 5 Infrastructures of Communications, Transportation, Energy, Commerce and Medicine

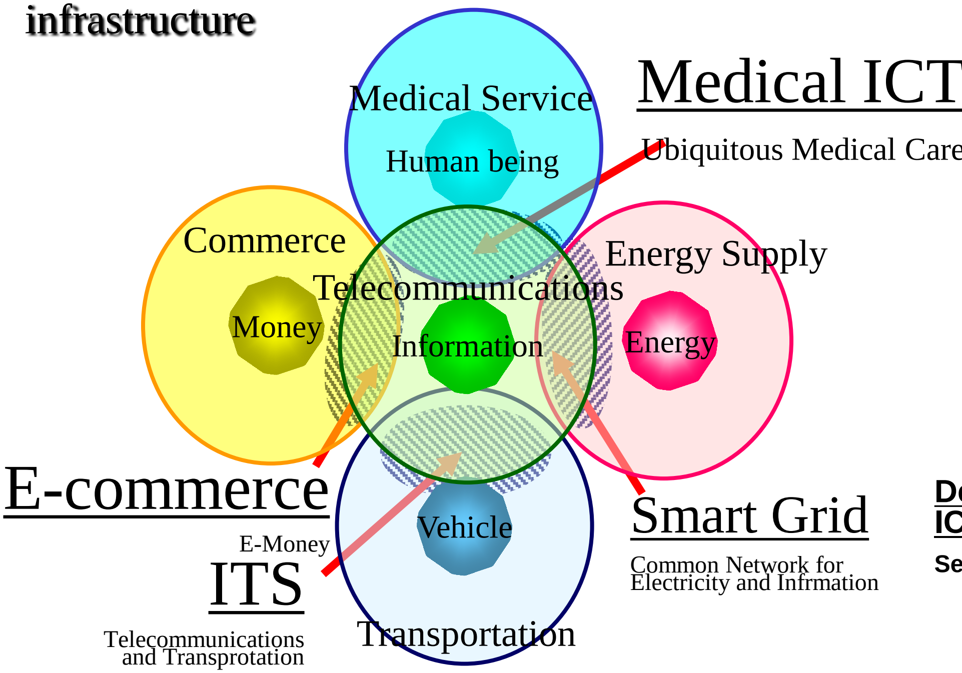
A. Information Traffic（Telecommunications）
B. Vehicular Traffic（Transportation）
C. Energy Traffic(Power & Energy Supply）
D. Money Traffic（Commerce）
E. Patient, Drag Traffic(Medicine)

should be integrated to control all flows in future infrastructure

（Example）

A+B ➔ **ITS** (Intelligent Transport System)
A+C ➔ **Smart Grid** (Flexible Energy Network)
A+D ➔ **E-Commerce** (Borderless Secure Trade)
A+E ➔ **Medicine ICT** (Ubiquitous Medicine)

To Dependable Wireless



Response to CFI: Case 6

Hiroshi Kobayashi, Nissan Automotive Co. Ltd.

Development of Wireless Sensing System for Factory

Doc.:IEEE802-15-15-0XXX-00-dep

Expecting Time Line

	2014								2015												2016												2017											
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Defining application-dependability matrix	x	x	x	x	x	x																																						
Study Group Formed							x																																					
Call for Interest 1st stage			x	x	x	x	x																																					
Review Call for Interest 1st stage								x	x	x	x																																	
Call for Interest 2nd stage									x	x	x																																	
Review Call for Interest 2nd stage											x	x	x																															
Drafting PAR and CSD									x	x	x	x	x	x	x																													
PAR and CSD Approved															x																													
Task Group Formed															x																													
Call for Applications															x																													
Review Applications																x	x	x																										
Technical Guidance Framework																x	x	x																										
Selection Criteria																x	x	x																										
Coexistence Criteria																		x																										
Call for Proposals Issued																	x	x																										
Prelim Proposals Heard																			x																									
Call for Final Proposals issued																			x																									
Present Final Proposals																				x	x																							
Baseline Proposal(s) Selected.																					x																							
Build Baseline																						x	x																					
Adopt Baseline																							x																					
Draft Ready for TG Review																								x	x																			
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Thank You !

Any Questions ?