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Resilience of Critical Infrastructure

a presentation to MENOG 4

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IEEE CQR Chair Emeritus

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Outline

- Overview of the EC ARECI Study

(Availability and Robustness of Electronic Communications Infrastructures)

  - European Commission-funded
  - led by Bell Labs
  - European in scope, but applicable more broadly

- Introduction to the IEEE ROGUCCI Study

(Reliability of Global Undersea Communications Cable Infrastructures)

  - under auspices of IEEE
  - led by Bell Labs
  - global in scope, some special focus for ME region

EC ARECI Study - Introduction

Purpose of the Study:

Provide guidance on how to make Europe's networks more available and more robust

EC ARECI Study - summary statistics

10 Recommendations (Section 4)

25 Member expert team conducted study (Section 7)

71 European-confirmed Best Practices (Section 2)

81 Intrinsic vulnerabilities considered (Appendix B)

100 Key Findings (Section 3)

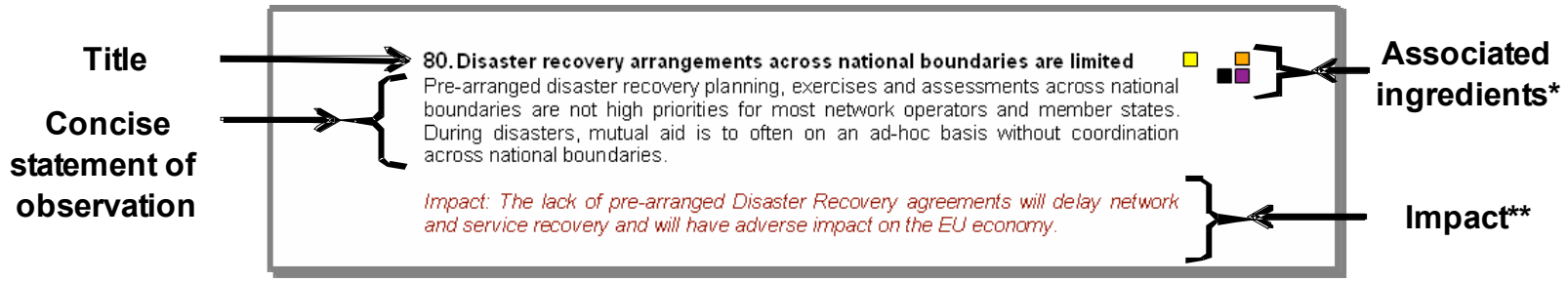
150 Contributing European stakeholder experts (Section 2)

200+ Critical trends considered for impact

30,000+ Distinct data points researched and analyzed during study

The Eight Ingredient Framework introduces meaningful linkages . . .

Format of Key Findings in Section 3



* Power, Software, Payload, Human, Environment, Hardware, Network, Policy

** *statements in red indicate a negative impact; statements in blue indicate a positive impact*

EC ARECI Study Overview . . . www.bell-labs.com/ARECI

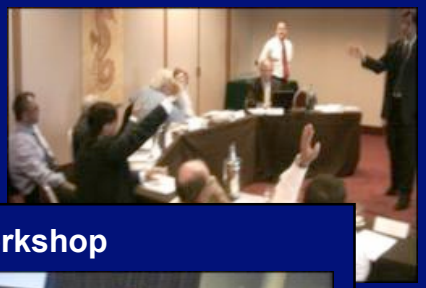
- **10 Recommendations** – signposts to point the way toward actions that will improve the availability and robustness of Europe's communications infrastructure
- **100 Key Findings** – insightful observations on the current state of Europe's communications infrastructure, gleaned from the knowledge of experts throughout Europe
- **71 Best Practices** - a collaborative collection of good ideas put into practice, agreed to by industry subject matter experts
- **Intrinsic Vulnerabilities** – innate characteristics of the building materials of communications infrastructure, which can be exercised by threats to impair it
- **8 ingredients** – Components that have been shown to fully represent all aspects of a communications system, and which can be used for the systematic analysis of those systems

ARECI Study Participants

Bell Labs uniquely positioned as a neutral facilitator . . .

Roundtable discussions
Individual conversations
Virtual interviews
Four workshops

Environment & Power Experts Workshop



3 October 2006
Rome, Italy

Network & Payload Experts Workshop



6 October 2006
London, U.K.

Hardware & Software Experts Workshop



11 October 2006
Berlin, Germany

Policy & Human Experts Workshop

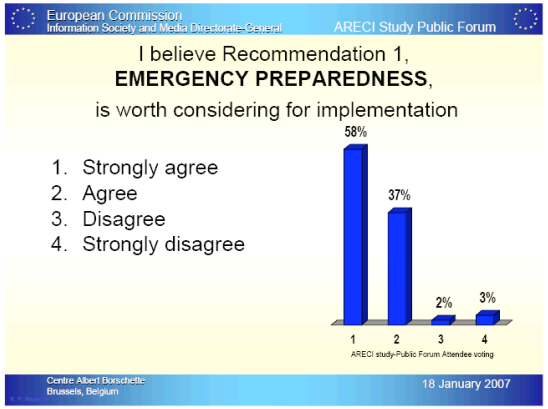


15 November 2006
Brussels, Belgium

10 ARECI Study Recommendations

1. Emergency Preparedness
2. Priority Communications on Public Networks
3. Formal Mutual Aid Agreements
4. Critical Infrastructure Information Sharing
5. Inter-Infrastructure Dependency
6. Supply Chain Integrity and Trusted Operation
7. Unified Voice in European Standards
8. Interoperability Testing
9. Vigorous Ownership of Partnering Health
10. Discretionary European Expert Best Practices

86% of stakeholders agree or strongly agree



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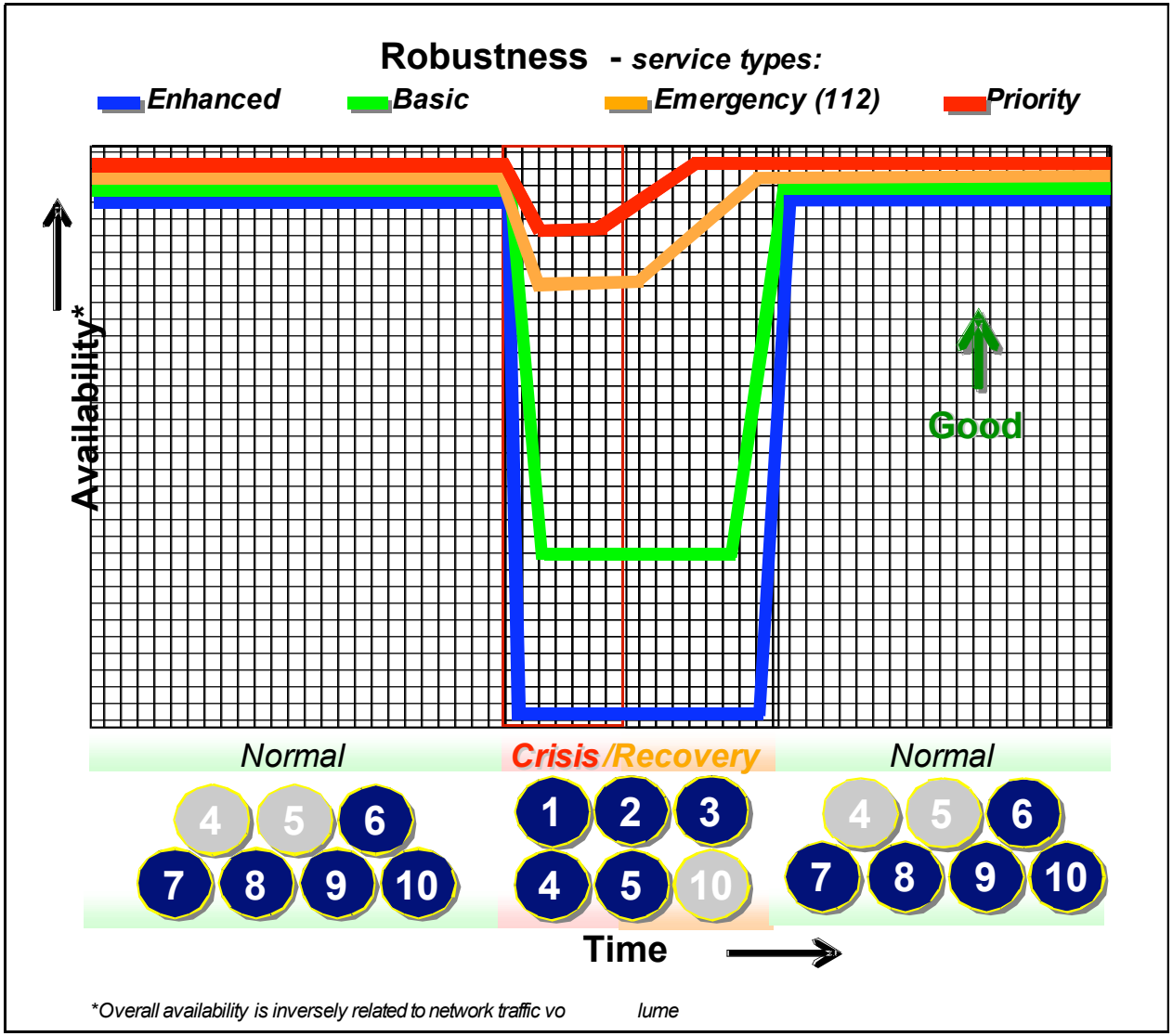
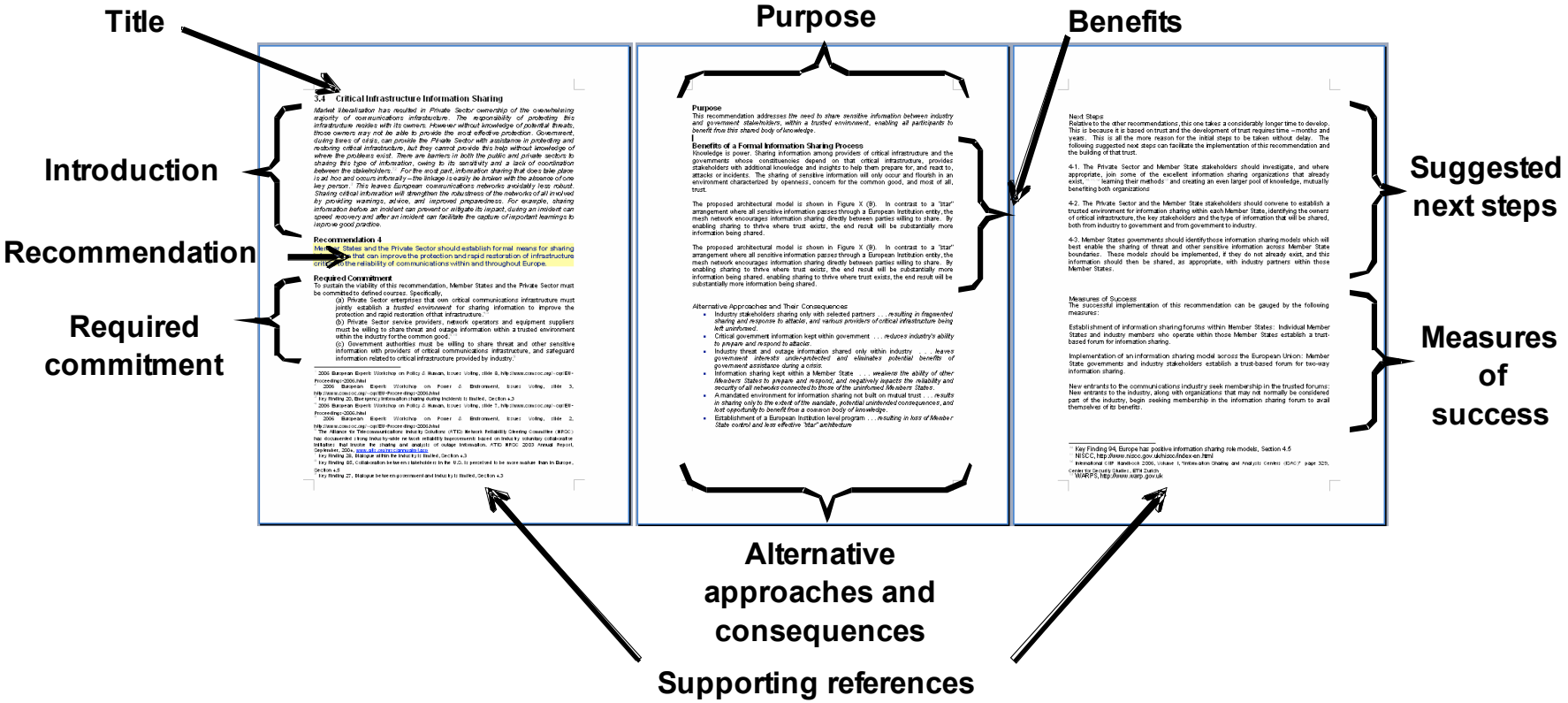
10 ARECI Study Recommendations



Recommendation Presentation

Format of Recommendations in Section 4



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IEEE ROGUCCI Study - Introduction

Purpose of the Study:

Provide an assessment of the reliability of the global undersea communications cable infrastructure and, where appropriate, make recommendations to strengthen the reliability of this global infrastructure

IEEE ROGUCCI Study - Introduction

Background

Undersea communications cable infrastructure plays a vital role in the world, connecting the continents and their ~1 billion computer users, sustaining global markets and economies, and supporting countless important purposes including government, education, transportation and research. It can be surmised that undersea cables make the worldwide web, "worldwide."

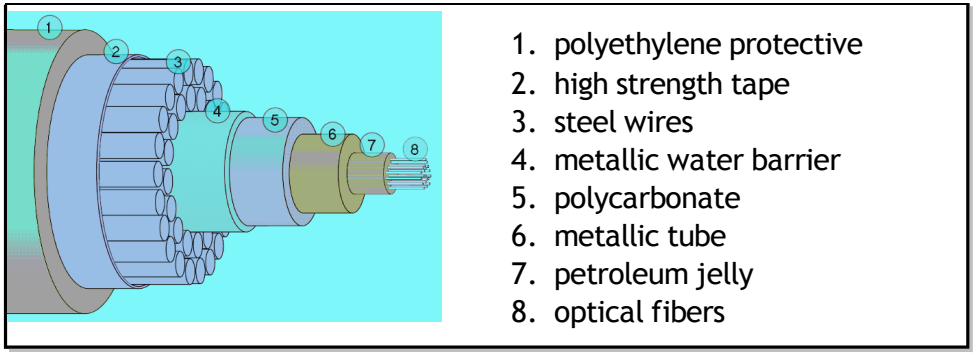
Private sector network operators and industry consortia are responding with often heroic efforts in scientific and engineering advances and in the deployment of much needed systems to meet the world's insatiable thirst for bandwidth. Even so, some imperative questions remain unanswered at the global level:

Is investment keeping pace with global demand?

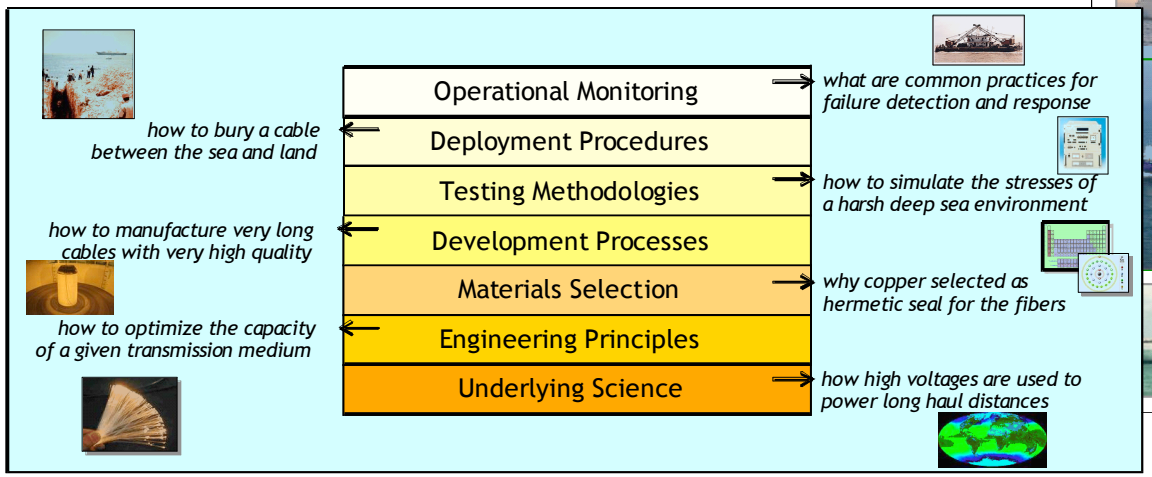
Is the level of reliability appropriate for the level of dependence?

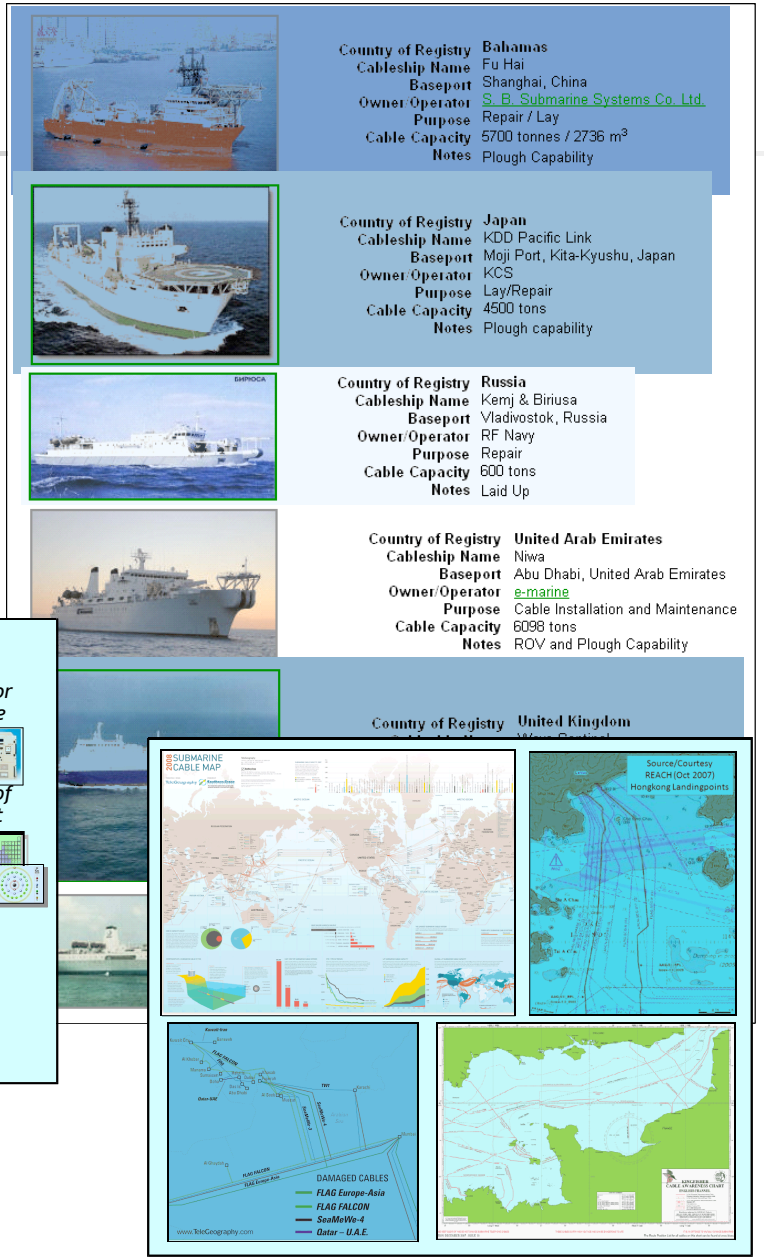
Are there avenues of global infrastructure failure that have remained latent until now?

Publicly available information . . .



1. polyethylene protective
2. high strength tape
3. steel wires
4. metallic water barrier
5. polycarbonate
6. metallic tube
7. petroleum jelly
8. optical fibers





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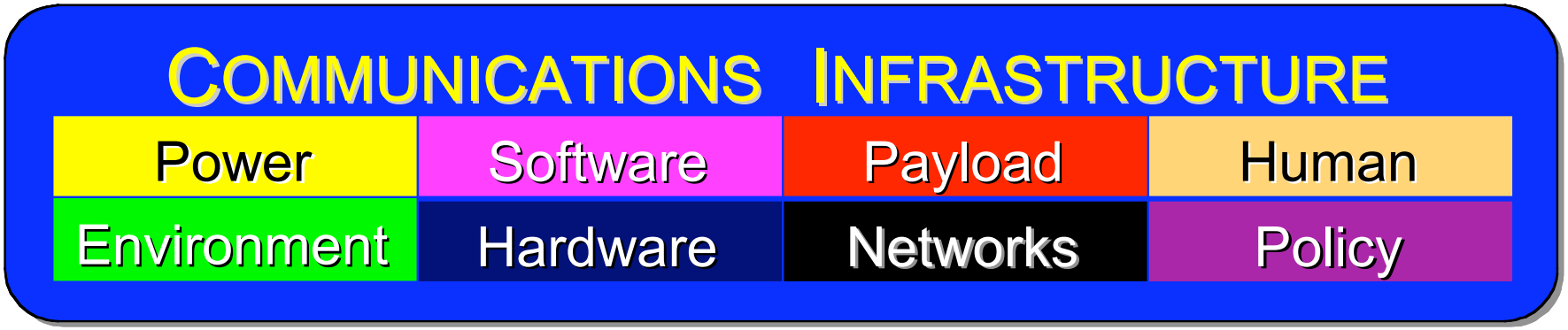
The Eight Ingredient Framework



The Eight Ingredient Communications Infrastructure Framework enables a true post 9-11 approach by enabling systematic intrinsic vulnerability analysis

Intrinsic Vulnerabilities

VULNERABILITY
uncontrolled fuel combustion
fuel contamination
fuel dependency
battery combustion
battery limitations
battery duration
maintenance dependency
require manual operation
power limitations
frequency limitations
susceptibility to spikes
physical destruction

VULNERABILITY
ability to control (render a system in an undesirable state, e.g., confused, busy)
accessibility during development (including unsegregated networks)
accessible distribution channels (interception)
accessibility of rootkit to control kernal/core
developer loyalties
errors in coding logic
complexity of programs
discoverability of intelligence (reverse engineer, exploitable code disclosure)
mutability of deployed code (patches)

VULNERABILITY
ation
alicious content
s-authenticaton)
ry of critical compone
nts observablity)

VULNERABILITY
physical (limitations, fatigue)
cognitive (distractibility, forgetfulness, ability to deceive, confusion)
ethical (divided loyalties, greed, malicious intent)
user environment (user interface, job function, corporate culture)
human-user environment interaction

COMMUNICATIONS INFRASTRUCTURE

Power	Software	Payload	Human
Environment	Hardware	Networks	Policy

VULNERABILITY
accessible
exposed to elements
dependence on other infrastrucu
contaminate-able
subject to surveillance
continuously being altered
identifiable
remotely managed
non-co

VULNERABILITY
chemical (corrosive gas, humidity, temperature, contamination)
electric (conductive microfiber particles – carbon bombs)
radiological contamination
physical (shock, vibration, strains, torque)
electromagnetic energy (EMI, EMC, ESD, RF, EMP, HEMP, IR)
environment (temperature, humidity, dust, sunlight, flooding)

VULNERABILITY
lure
n (congestion)
hronization
perability, interdependence, conflict)
pairs

ERABILITY
andards, policies, regulations)
te or partial)
multi-)

The Eight Ingredient Framework has been used by numerous critical government-industry collaborative fora, engaging over one thousand subject matter experts.

ASPR dependence on misinformed guidance
ASPR ability to stress vulnerabilities
ASPR ability to infuse vulnerabilities
Inappropriate interest influence in ASPR

IEEE ROGUCCI Study - Teams

10 virtual teams

- each of 8 ingredients

  (environment, power, hardware, software, network, payload, human, policy)

- outage analysis
- new policy development and deployment

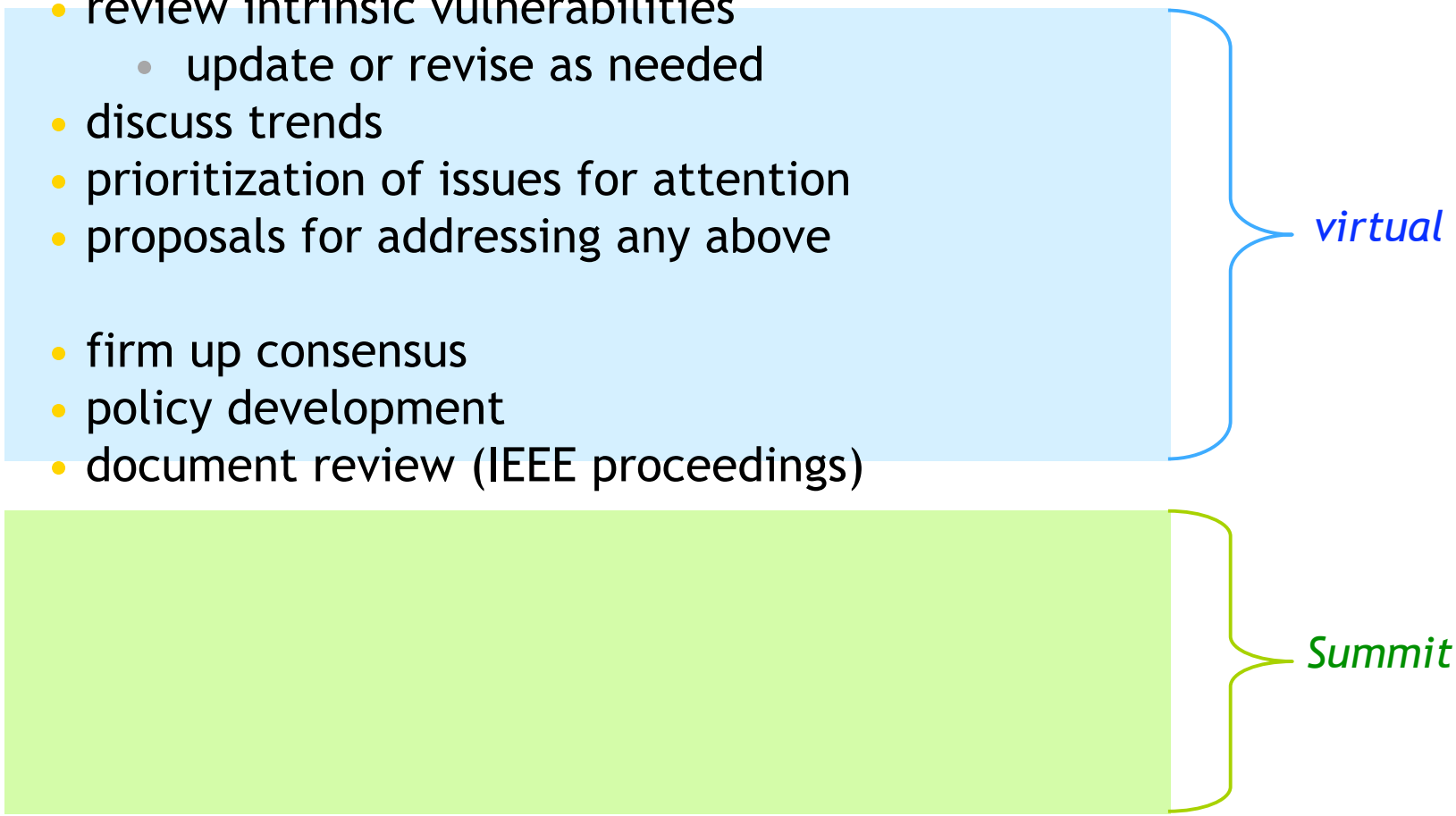
In addition, a ROGUCCI executive council will serve as a steering committee to support the above teams and plan for the Global Summit. The executive council will continue after the completion of the study to promote the adoption of recommendations that may be developed.

IEEE ROGUCCI Study - Teams

Process for ingredient teams . . .

- review intrinsic vulnerabilities
  - update or revise as needed
- discuss trends
- prioritization of issues for attention
- proposals for addressing any above

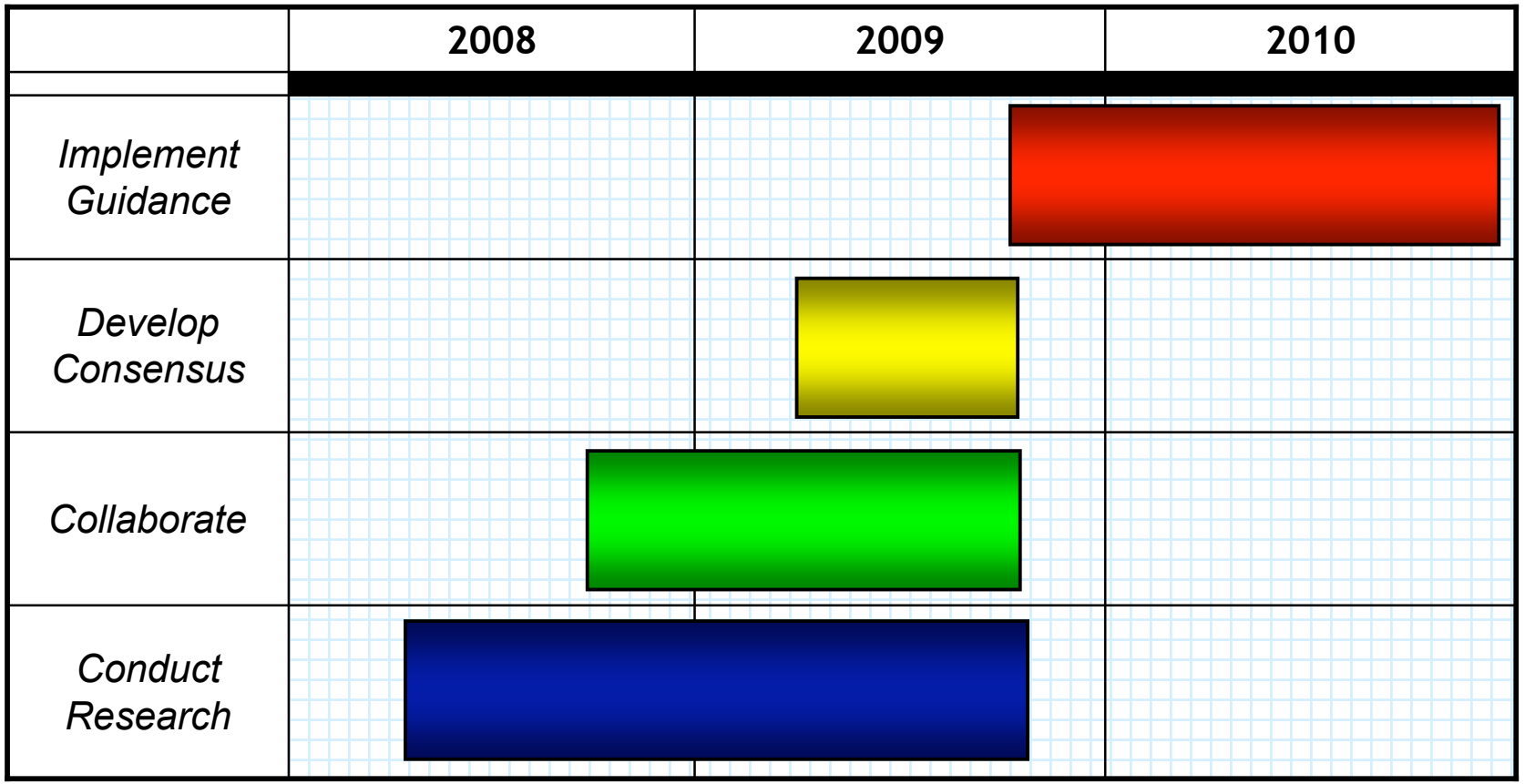
- firm up consensus
- policy development
- document review (IEEE proceedings)



THE RELIABILITY OF GLOBAL UNDERSEA COMMUNICATIONS CABLE INFRASTRUCTURE

Global Summit

ROGUCCI Study Process



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THE RELIABILITY OF GLOBAL UNDERSEA COMMUNICATIONS CABLE INFRASTRUCTURE

Summit basics . . .

- IEEE auspices
- Dubai, U.A.E.
- October 2009
- ~80 to 150

Summit Outline & Agenda

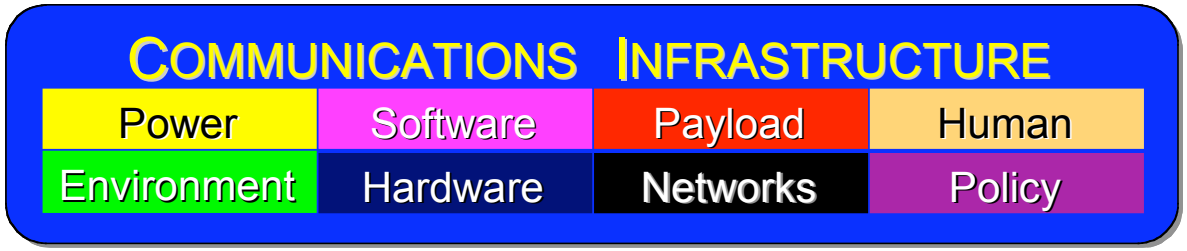
	Sunday	Monday	Tuesday	Wednesday	Thursday
Morning		8i technical sessions/tour	Plenary Trends Recent outages Potential impacts 8i Highlights	Recommendations and Next Steps	wrap–up leadership team meeting
Afternoon	leadership team meeting	8i technical sessions/tour	Facilitated discussion & recommendation development		
Evening		networking reception	Summit dinner		

More information . . .

ARECI Report: www.bell-labs.com/ARECI

ROGUCCI Study – to get involved: krauscher@alcatel-lucent.com

- please include “ROGUCCI in subject
- please suggest virtual team ingredient or outage events



I hope this was helpful

Thank you.