"*Resilient Communications: Staying connected during a disaster".*

A presentation by the Telecommunications Services of Trinidad and Tobago Limited (TSTT) on behalf of CANTO

b mobile

Agenda

- Resilient Telecommunication Networks

- Challenges to Resiliency

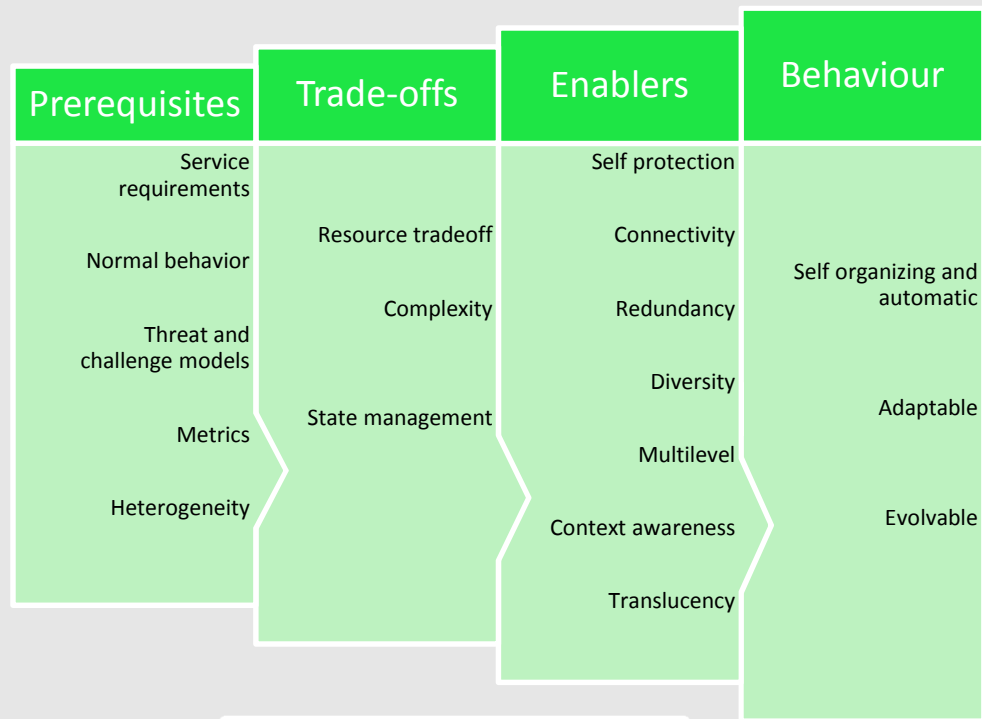- Context of our situation

Resilient Telecommunication Networks

What do we need to do?

What do we need to do?

- Establish who are our customers (perquisites)

- Surpass their requirements (tradeoffs)

- Develop a resilient network (enablers & behavior)

- Operationally resilience relies on three critical disciplines;
  "…redundancy for fault tolerance, diversity for survivability, and connectivity for disruption tolerance."

  Sterbenz, J.P.G., et. al. 2012

- Further from a disaster standpoint it is critical to have "…moveable and deployable resource units…" as was learned from Japans earthquake and tsunami event in 2011.

Resilience principles

Prerequisites	Trade-offs	Enablers	Behaviour
Service requirements		Self protection	
	Resource tradeoff	Connectivity	
Normal behavior			Self organizing and automatic
	Complexity	Redundancy	
Threat and challenge models		Diversity	
	State management		Adaptable
Metrics		Multilevel	
		Context awareness	Evolvable
Heterogeneity		Translucency	

Sterbenz, J.P.G., et. Al., 2012

What do we need to do?

"*People [continue to] recognize the importance of the ICT network as one of the major social infrastructures that needs to be resilient even under catastrophic disaster scenarios.*"

Sakano, T., et. al. 2013

- People rely on communication in time of disaster and like first responders we (TSTT) focus on people being **"safe, present and safe"** to maintain the network, either physical or data, when some aspect of the network fails.

- We like the population are governed by the Ministry of National Security – ODPM at the NEOC pre, during and post event.

What do we need to do?

- Our Network and ICT framework are best-in-class to deploy a reliable service.

- We do however need to be prepared for some catastrophic natural or man-made event!

What do we do?

"*Communication networks are constructed as a multilevel stack of infrastructure, protocols, and mechanisms: links and nodes, topology, routing paths, interconnected realms, end-to-end transport, and application interaction. The resilience of each one of these levels provides a foundation for the next level to achieve an overall goal of a resilient, survivable, disruption tolerant, and dependable Future Internet*."

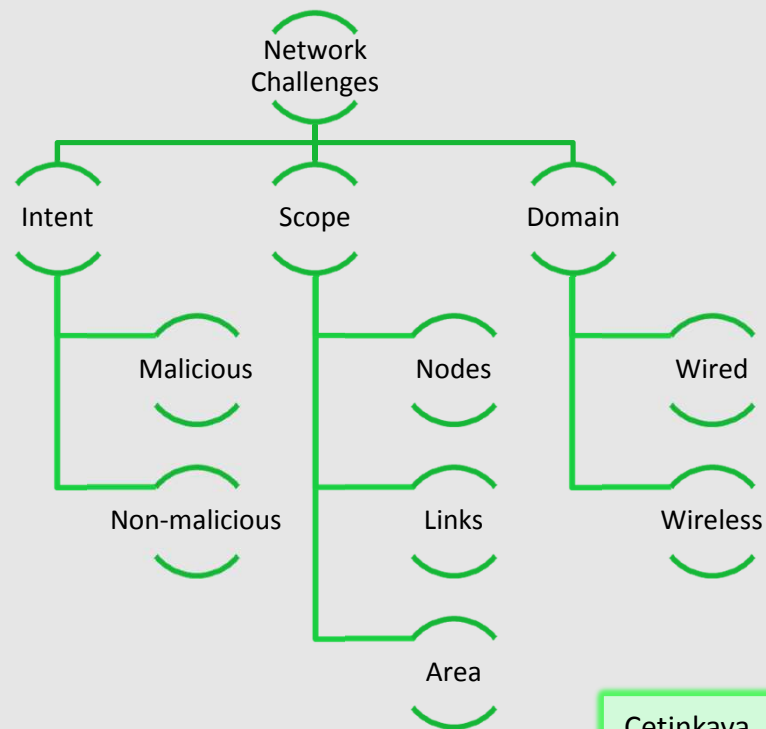*Sterbenz, J.P.G., et. al., 2013*

- Tropical Storm Brett – June 2017, tested some aspects of preparedness and response capabilities but highlighted our resilient network.

Challenges to Resiliency

Analysis, Simulation and Experimentation

Challenges to Resiliency

Taxonomy of Network Challenges

Cetinkaya, E.K., et.al., 2011

Challenges to Resiliency

Normal Operations are always challenged but consider

"…attacks and large-scale disasters, as well as…mobility and the characteristics of wireless communication channels."

Cetinkaya, E.K., et. al., 2011

Optimization is the key to deploy a more resilience network. Lean engineering and administration of a network can result in more time and resources deloped on "future state" rather than maintaining the "as is"

Think!

❑ This month and hurricanes have left Barbuda and Dominica devastated.

❑ possibility exists that they may require the deployment of more remote radio units (RRU's) also referred to as wireless base transceiver station (BTS) or Cellular on Wheels (CoW's) than fixed cellular towers.

❑ Tower design, land topography and RRU deployment must now be revisited

Challenges to Resiliency

- The obvious challenge to resiliency will be capital.
  - Networks must be robust to keep everyone connected but there comes a hefty bill!

  - We are becoming more affluent, creating exponential demands; "more bandwidth," "faster downloads," "no dropped calls" these are the customer needs and requirements

Challenges to Resiliency

- Being connected is critical for
  - Personal and
    - Imagine a dead zones and you had an accident, or are a victim of a crime?!!!
  - National requirements
    - emergency management at a domestic level and national response

Context of our situation

Resilient ICT in T&T

Our Situation

- We have multiple capital intensive programmes currently being implemented to bolster our network infrastructure to provide a more resilient service.

- Our company is moving from a historic legacy network to the standard bearer in technology in the region providing best in class cross-sectional solutions.

Our Situation

- Trinidad
  - Our own 24/7 NOC
  - Sit on the ODPM NEOC – ESF (Communication/ICT)
  - Functional Disaster Management Team (DMT)
  - Zoned EOC with supplies
  - Hotline for staff post emergency

- Tobago
  - Supported from Trinidad NOC
  - Sit on TEMA
  - Functional DMT
  - Hotline for staff post emergency

References

1. Cetinkaya, E.K., Broyles, D., Dandekar, A., Srinivasan, A. & Sterbenz, J.P.G. (2011) Telecommunications Systems Journal. *Modelling communication network challenges for Future Internet resilience, survivability, and disruption tolerance a simulation-based approach.*

2. Sterbenz, J.P.G., Cetinkaya, E.K., Hameed, M.A., Jabbar, A., Qian, S. & Rohrer, J.P., (2013) Telecommunication Systems Journal. *Evaluation of Network Resilience, Survivability, and Disruption Tolerance:Analysis, Topology Generation, Simulation, and Experimentation.*

3. *Sterbenz, J.P.G., Hutchinson, Cetinkaya, E.K., Jabbar, A., Rohrer, J.P., Scholler, M. & Smith, P. (2012) Telecommunication Systems Journal. Redundancy, Diversity, and Connectivity to Achieve Multilevel Network Resilience, Survivability, and Disruption Tolerance.*

4. *Toshikazu S., Zubair M.F., Thuan N., Hiroki, N., Masataka N., Fumiyuki A., Nei K., Atsushi T., Tomoaki K., Hiromichi K. & Shigeki Kurihara, (2013) IEEE Network Magazine.Disaster-Resilient Networking: A New Vision Based on Movable and Deployable Resource Units,(MDRUs).*