Disaster Management
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Resilient ICT Infrastructures to Support Disaster Management

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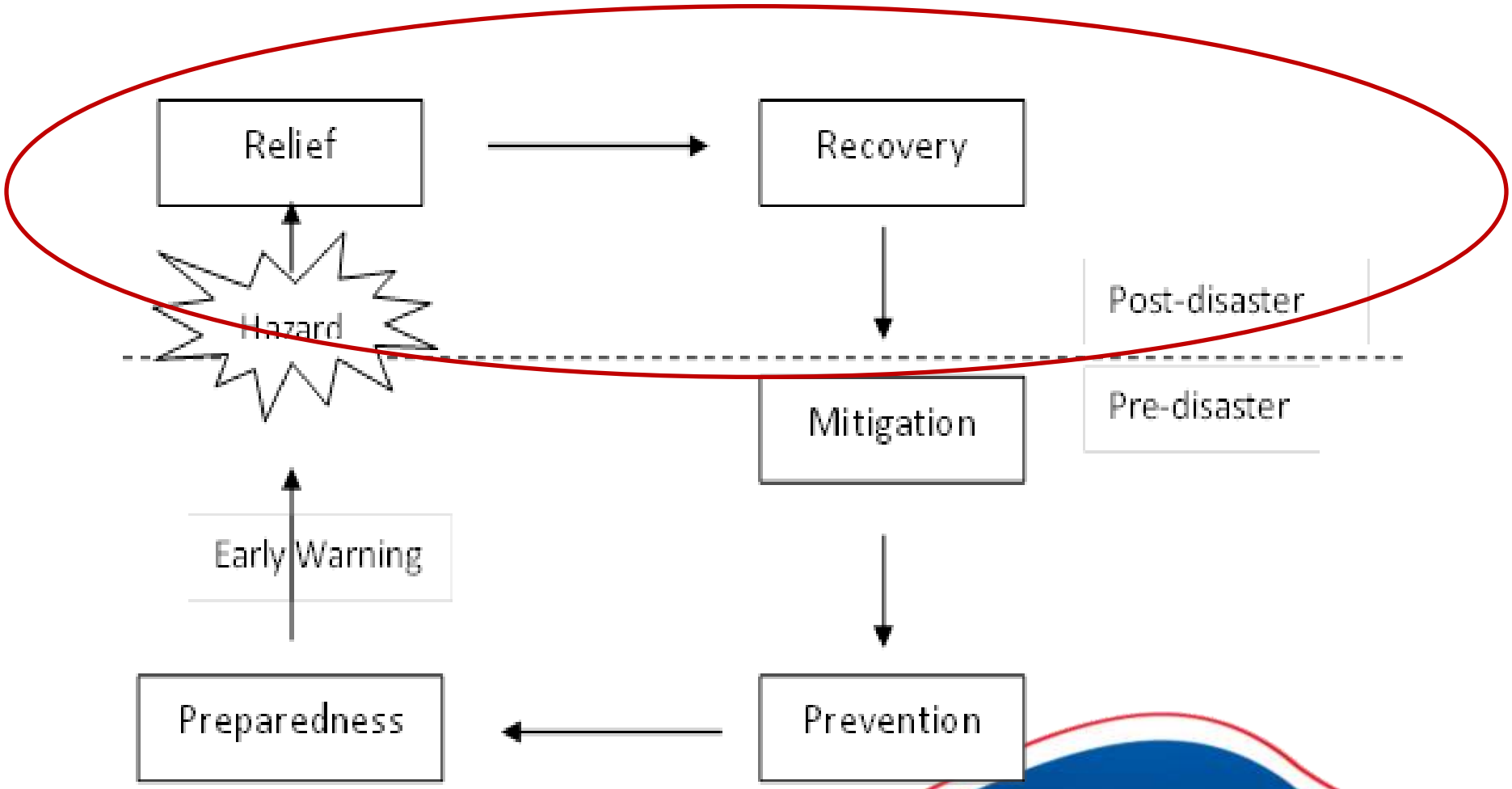
Pro-poor. Pro-market.

Scope of the paper: After the disaster



Post-disaster role of information & communication

- Natural disasters & humanitarian crises cause disorder and panic
- Communication services may not be considered a priority when basic needs such as food, clean water and shelter are lacking
  - But, access to accurate information is what calms societal turbulence
- For information to be communicated
  - Underlying network must function
  - Supporting soft infrastructure (e.g. institutions and policies) must exist

Spatial coordination

- ICTs allow for synchronous or asynchronous communication across space, enabling greater coordination of spatially separated actors
- Especially important when
  - A disaster has a geographically wide scope (a tsunami or a cyclone versus a localized landslide) and
  - Physical transportation systems may have been degraded or even destroyed
- Even with localized disasters, ICTs enable coordination of assistance from unaffected areas

Resilience of communication networks

- Network itself is vulnerable
  - Cables can break
  - Towers can topple
  - Power sources (and the backups) can fail
  - People who operate the systems can die, be injured or be unable to get to their stations
- Degree of vulnerability depends on the technological platform

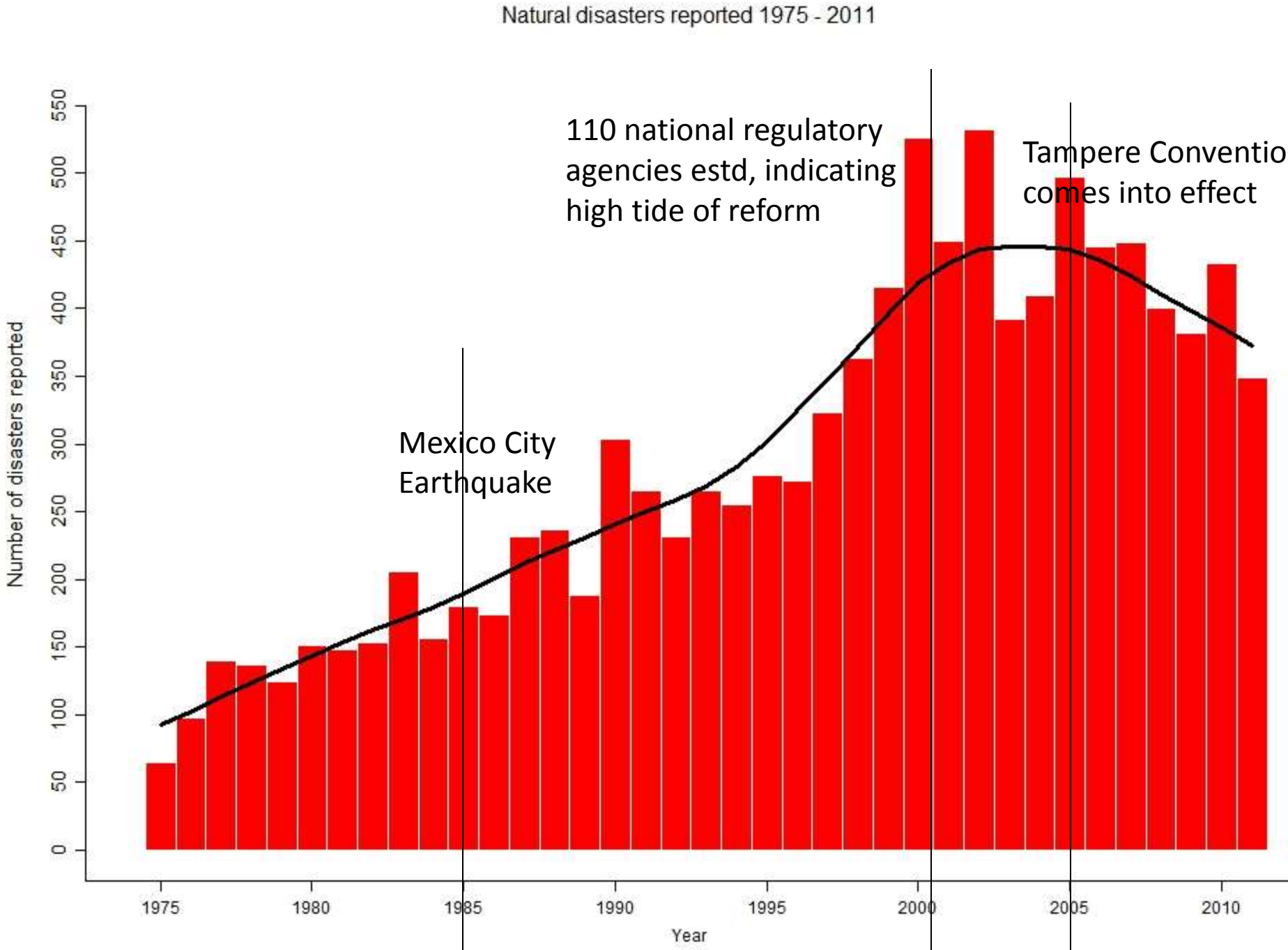
Mexico City, 19 September 1985: The disaster that begat an international treaty

The top three floors of this communications building collapsed, cutting off domestic and international long-distance calls and significantly impacting local services in Mexico City after the 1985 earthquake.

Source: USGS

Puzzle of Tampere

- Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations was negotiated in 1998 and came into effect in 2005, just after the 2004 Indian Ocean tsunami
  - Sri Lanka is a signatory
- While it may have had good effects on contingency planning, not one country has invoked its provisions
- Conceived when integrated monopolies and undersupply of service was the norm, was Tampere made irrelevant by liberalization?


Natural disasters reported 1975 - 2011
Number of disasters reported
0
50
100
150
200
250
300
350
400
450
500
550
1975
1980
1985
1990
1995
2000
2005
2010
Year
110 national regulatory agencies estd, indicating high tide of reform
Tampere Conventio comes into effect
Mexico City Earthquake

Pros & cons of liberalization

- In the old days, one integrated network with the strengths and weaknesses of monopoly
  - Plentiful resources to harden the network
  - Single point of contact for emergency responders
  - If one big network fails, no alternative
- With multiple, independently-managed, access networks, total failure is less likely, but
  - Solutions such as “emergency roaming” become feasible
  - Perhaps less incentive exist to invest in hardening networks
  - Sharing of towers and essential facilities may reduce redundancy, recreating problems of monopoly

Domestic & international backhaul

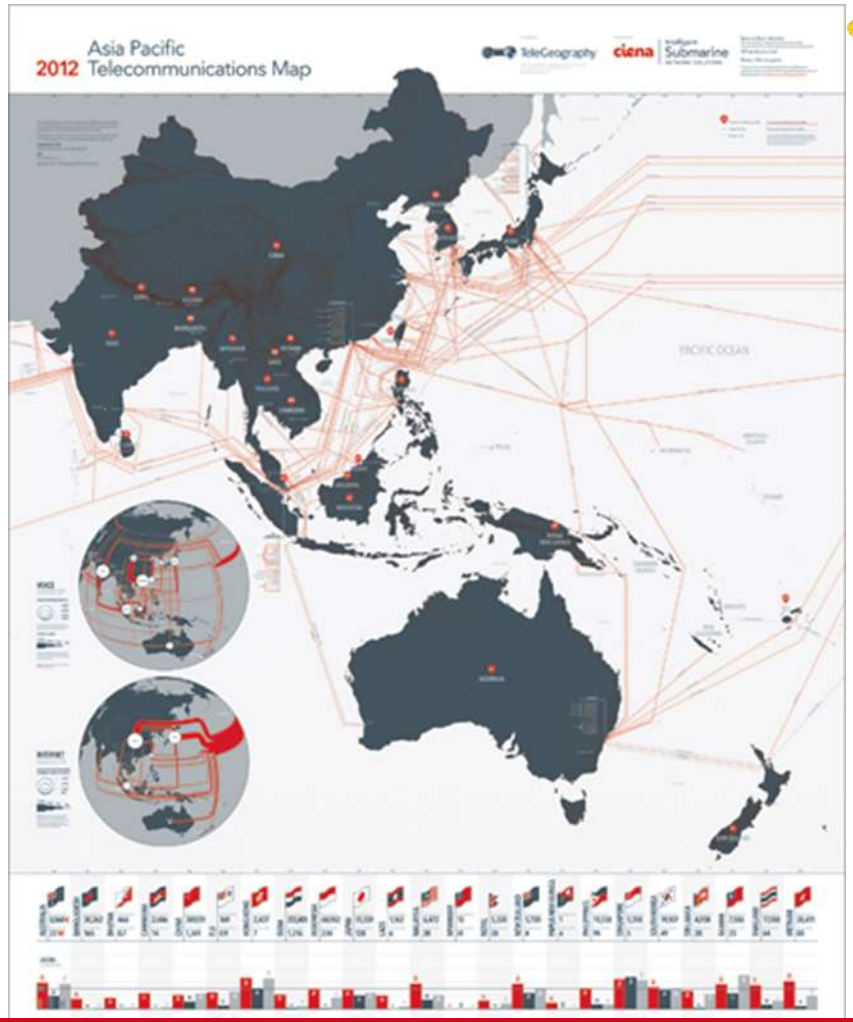
- More traffic in “big pipes”; more “choke points”; greater impacts from failure
- Greater attention must paid to
  - Contingency planning
  - Moving from ring architecture to mesh
- Identifying vulnerabilities is important
- It’s not hardening OR redundancy; but hardening AND redundancy
  - Hardening infrastructure is important
  - So is ensuring real redundancy (paths/technology)

Example: Post-2004 tsunami changes in the Maldives (pop. ~ 400,000)

- Both operators changed their cable network topologies from a series type to a ring
- Two VSATs (satellite terminals) installed for emergency communications in strategic locations (Vilimalé and South Gan)
- Interconnection of country's 2 submarine cables to reduce risk of losing international connectivity
- National roaming and priority calling will be activated with the official announcement of a disaster ("state of exception")

Need to develop submarine-terrestrial mesh for Indian Ocean-Asia

- Now with Africa also building terrestrial cable, Asia may be the region with least terrestrial cables
- Terabit shows that existing bilateral terrestrial cables are used to bring traffic to Singapore and Hong Kong and then out on submarine cables
- Indian Ocean has three chokepoints: Suez/Red Sea; Malacca Strait and Taiwan Strait
- Fragmented efforts to work around by private actors; but as Terabit shows, there is a need for seamless terrestrial connectivity



LIRNEasia working with UN ESCAP since 2010 to make this a policy priority for the Asia Pacific

Source: TeleGeography

Access networks

- Localized vulnerability
  - Effects not as widespread as with failure of backhaul, but to end user, the effect is the same
- Best defense is robust design of towers, base stations, etc.
- Recent trend of infrastructure sharing could be increasing vulnerability and requires that even greater attention be paid to location of infrastructure

Example: Great Tohoku Earthquake and Tsunami, 2011

- Fixed network cables & switches and mobile base stations (BTSs) destroyed in the affected area
- Batteries and generator fuel exhausted
- Congestion on both fixed and mobile networks continued for days
- A total of 1.9 million fixed lines damaged; 29,000 BTSs in the mobile network stopped working
- Aftershock that occurred 3 weeks after the main earthquake added to damage, affecting another 68,000 fixed lines and 4,100 BTSs.

Learnings from 2011 Japan

- Buried cables should be used in critical backhaul segments as aerial cables are more vulnerable
- A percentage of BTSs covering majority of population in high-risk areas should be equipped with 24-hour backup power
  - Approximately 1,900 BTSs (covering about 65% of Japan's population) are being equipped with an electricity generator and/or 24-hour-life batteries

Congestion

- Is a serious problem at the moment of disaster, with extraordinary demand overwhelming the normal functioning of networks
  - No easy solution, since it does not make economic sense to dimension networks just for these extraordinary spikes in demand
  - First responders must be provided with non-interconnected communication capabilities, e.g., TETRA sets
- A few hours after the disaster, congestion is likely to subside, allowing normal communication if the physical network is standing
  - But congestion effects persisted for days in 2011 eastern Japan, causing attention to be paid to network dimensioning and reallocation of network resources across regions

In conclusion

- Disasters in increasingly complex societies require attention to be paid to communication networks, not just to immediate relief
- If communication networks are functioning, disaster response and relief can be made more effective
- Tragic though they are, natural disasters are our laboratories
  - Recent disasters have given us important lessons re, e.g.,
    - Importance of mesh architecture in backhaul networks
    - Need for 24 hour power backup in parts of access networks
    - Necessity of replacing aerial cables with buried cable
    - Rules re “states of exception”