Telecom Power Planning for Natural Disasters: Technology Implications and Alternatives to U.S. Federal Communications Commission's "Katrina Order" in View of the Effects of 2008 Atlantic Hurricane Season

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Overview

- Introduction
  - FCC order history
  - Perspectives on Katrina lessons
- Effects of the hurricanes of the 2008 hurricane season on communication networks.
- Merits of FCC's Katrina order with respect to 2008 hurricane season
- Conclusions

Historical background

» Hurricane Katrina made landfall in Buras, LA, on August 29, 2005.

Background: NASA

FCC's Katrina Order Timeline

» Primarily, two studies were conducted to understand this large outage causes: one by the University of Illinois at Urbana-Champaign (UIUC) and another by the U.S. government Federal Communications Commission through an independent panel formed by a diverse body including executives from communication companies and emergency responders.

» FCC's analysis was based on 5 meetings in order to "hear oral presentations" by "interested parties." Their report identified lack of power as one of the main causes for outages.

» UIUC work followed a scientific approach that included on-site damage assessments. Results were presented in INTELEC 2006 and although lack of power was identified as a main cause for outages, it also studied other important factors.

FCC's Katrina Order

§ 12.2 Backup Power.

Local exchange carriers (LECs), including incumbent LECS (ILECs) and competitive LECs (CLECs), and commercial mobile radio service (CMRS) providers must have an emergency backup power source for all assets that are normally powered from local AC commercial power,

including those inside central offices, cell sites, remote switches and digital loop carrier system remote terminals. LECs and CMRS providers should maintain emergency back-up power for a minimum of 24 hours for assets inside central offices and eight hours for cell sites, remote switches and digital loop carrier system remote terminals that are normally powered from local AC commercial power. LECs that meet the definition of a Class B company as set forth in Section 32.11(b)(2) of the Commission's rules and non-nationwide CMRS providers with no more than 500,000 subscribers are exempt from this rule.

FCC's Katrina Order Timeline

» Final report from FCC panel issued in June 2006.

» FCC Katrina order issued a year later. The order applies to the entire U.S. territory. Companies with less than 500,000 subscribers were exempt.

» The order was challenged by a group of wireless communication operators under the Cellular Telephone Industries Association, CTIA-The Wireless Association on the basis that the FCC was overstepping its power, and that additional back-up systems could create many practical issues, such as weight limitations in many cell site structures.

» In February of 2008 the U.S. Court of Appeals for the District of Columbia Circuit took some initial steps to hold the application of FCC's order

FCC's Katrina Order Timeline

» In July of 2008 the Court decided that it will not rule on the case until the Office of Management and Budget (OMB)—the OMB is an office within the U.S. executive branch that oversees the activities of federal agencies—decides on the matter.

» At the end of 2008 the OMB disapproved Katrina's back-up power

» After this disapproval the FCC decided to reformulate its approach in order to address the problems that originated with Katrina.

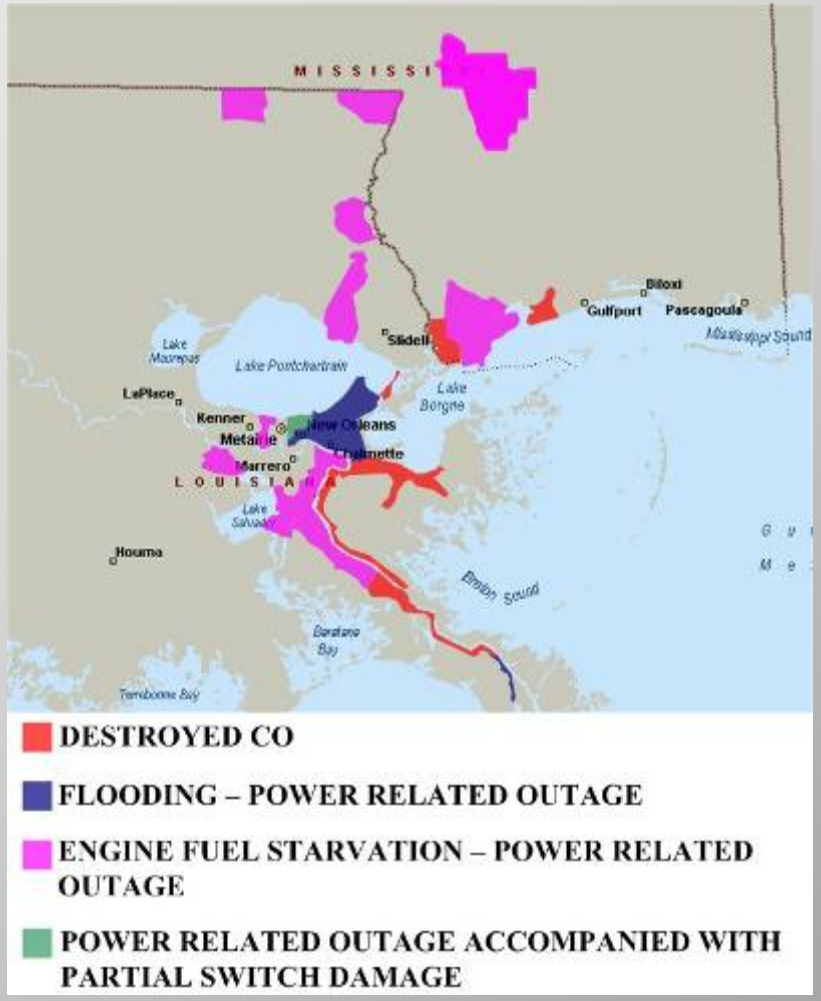
» Hence, it is important to study which aspects of the order are valuable and which ones need to be reformulated.

Katrina Lessons from UIUC Study

- PSTN: Most outages caused by lack of power (3/4 in central offices). Use of DLCs to replace damaged cables and destroyed COs.
- Mobile: Little damage to MTSOs and cell sites. Power issues were also the origin of most outages. PSTN failure was also an important problem. Inhomogeneous and often inadequate construction practices.
- Effects more severe on centralized network elements than on distributed network elements.
- Almost exclusive use of diesel gensets to provide long back-up power.
- Logistical issues: deployment of multiple gensets in cell-sites. Deployment of gensets to DLCs.
- Natural gas outage not as widespread as electrical outage.
- Little use of alternative energy sources (PV, wind, hydrogen).

Katrina Lessons from UIUC Study

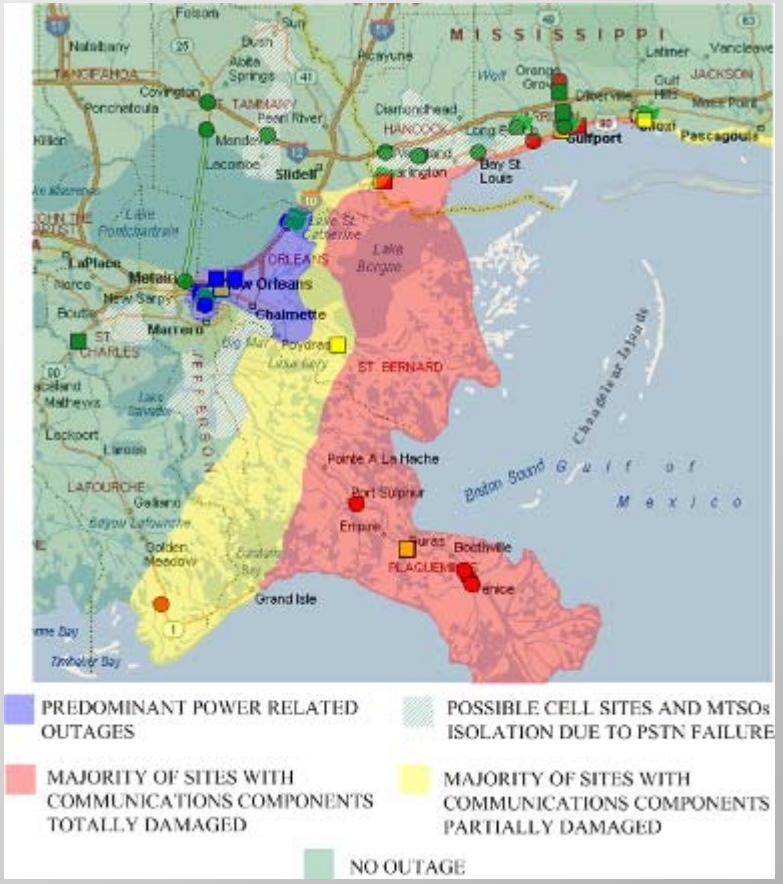
- Power in natural disasters
- Central offices issue. No power input diversity



Chalmette CO (Lower 9th Ward)

Katrina Lessons from UIUC Study

» Significant power issues in cell sites and DLCs (distributed elements) but low percentage of damaged DLCs or cell sites.



» Most cell sites and DLCs failed due to power issues

Katrina Lessons from UIUC Study

- Additional relevant suggestions from INTELEC 2006's paper:
  - Use natural gas to power back up power generating units.
  - Migrate from energy standby systems towards power distributed generation systems.
  - Implement homogeneous cell site construction practices locating all infrastructure above the flood plane.
  - Use portable COs instead of DLCs.
  - Coordinate deployment of portable gensets to one per site
  - Use wherever possible pole mounted systems over ground mounted systems.

Other Katrina Lessons

- Air conditioning is another important issue that relates with power supply issues during hurricanes and the lack of input diversity.
- Air conditioners are not backed up by batteries
- Power supply availability in normal conditions for the a/c is 4 nines. This is at least one order of magnitude less than what it is required. Worse availability can be expected during hurricanes
- Worst failure mode: utility grid outage followed by a genset failure.
  - Thermal inertia prevents immediate equipment failure.
  - But statistically and in normal conditions, the ac mains will take 2 hours to be repaired and the genset 5 hours. Worse values can be expected in hurricanes.
  - Inhomogeneous heat generation distribution may lead to some critical load failures within this timeframe.
  - Even if there is no failure, higher temperatures decrease components life.

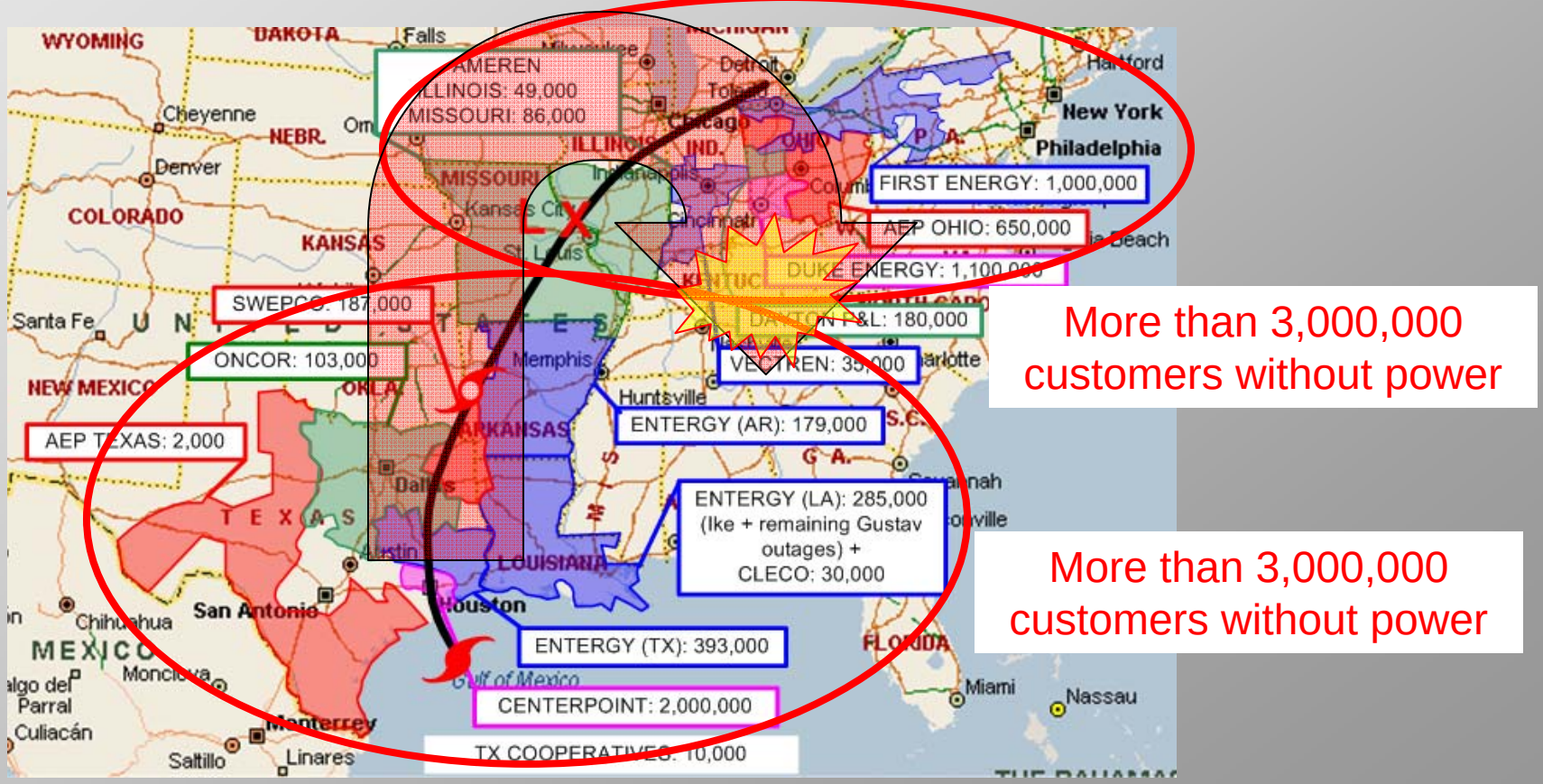
2008 Hurricane Season

- 3 hurricanes made landfall in the U.S.: Dolly, Gustav, and Ike.
- Dolly (landfall in S. Texas on July 23)
  - Few telecom outages
  - Area is not densely populated
  - Although flooding in some areas was significant, roads were not severely affected so COWs and gensets could be deployed quickly.
- Gustav (landfall south of N. Orleans on September 1). Landfall point was 60 mi west of Katrina's. Gustav's intensity was less than Katrina but moved slower.
  - Outages peak 50,000 lines, 72 hours after Gustav's landfall
  - Outages in distributed network elements in fixed telephony OSP was not a extensive as with Katrina because many DLCs had been located on platforms and some were equipped with permanent natural gas gensets

2008 Hurricane Season

» Ike (landfall in Galveston (Texas) on September 13). Its storm surge was significant.

» Effects were significant as far away from the coast as the Ohio River Valley. This unusual behavior affected logistics significantly.

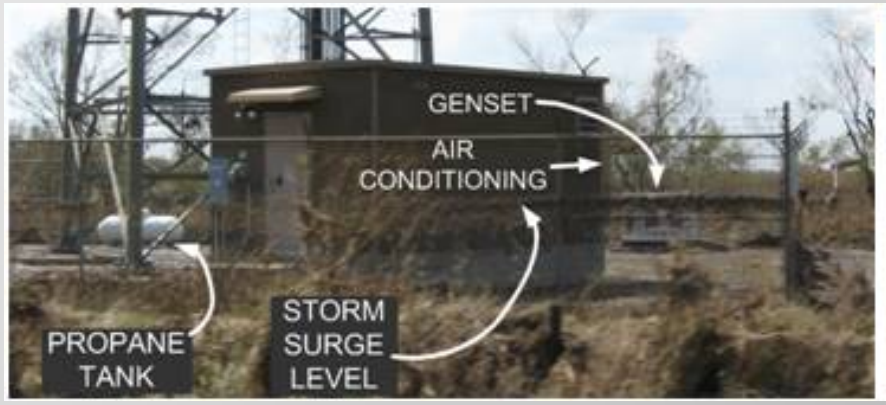


2008 Hurricane Season

- Ike
  - Fixed telephony outages peaked at close to 340,000
  - AT&T lost service in 5 CO. One of them, Sherwood was destroyed. Windstream lost service in 7 switching stations. Eastex lost service in 2 COs. Cameron communication lost at least two remote switches.
  - Remote terminals affected by lack of power.
    - AT&T: 551
    - Verizon: 321
    - Windstream: 237
    - Eastex: 82

2008 Hurricane Season

- Ike
  - Few damaged base stations



  - were replaced by COLTs and COWs

2008 Hurricane Season

- Ike
  - Damaged transmission links were restored with microwave transmission links

2008 Hurricane Season

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FCC Order Merits

» Ike's effects in the Ohio River Valley identifies a positive aspect of the order: countrywide application.

» Inclusion of CATV operators is also positive because of the increased used of digital telephony. However, there are issues on how to deploy generators to maintain operation after a hurricane.

FCC Order Merits

- Arguably the most controversial aspect of the FCC order is the backup time requirement:
  - 24 hrs in COs is below the existing standard so the order may not make a difference.
  - 8 hrs in distributed sites may not be in many cases enough (as demonstrated in DLCs which typically already have 8 hrs of backup).
  - Additional batteries can create structural issues.
  - Addressing power issues though locally stored energy do not target the fundamental problem of lack of diversity
  - Increased local energy for backup do not address power supply for the air conditioner during long power outages without gensets.
  - Permanent natural gas generators or DG may provide a more comprehensive solution to lack of power input diversity

FCC Order Merits

- Additional unaddressed issues in FCC's order:
  - Lack of consistency in distributed network elements—cell sites or outside plant remote terminals, such as DLCs—construction practices.
  - Service area interfaces at vulnerable locations

FCC Order Merits

- Solutions provided by service providers own initiative:
  - Increased use of propane in cell sites
  - Use of mobile switches to replaced those in destroyed COs.
  - Locate DLCs on elevated platforms.

Conclusions

» Countrywide infrastructure requirements and inclusion of CATV operators are positive aspects.

» FCC order did not address important issues, such as different construction practices for hurricane hardening

» Backup requirement based on locally stored energy may distract from the real issue which is lack of power input diversity. This problem is noticed with genset failures and/or air conditioning power supply vulnerabilities.

THANK YOU VERY MUCH

QUESTIONS?