Dealing with Communications Outage Risks

Los Altos Hills
Emergency Communications Committee

7 February 2017

Jim Oberhofer
EC, Cupertino ARES/RACES

Topics

1. **Managing Risks; recommendations**
2. **A mutual problem and proposal**
3. **Are the risks real?**
4. **Understanding the risks… what could fail**
5. **What could cause a failure**
6. **Some light reading**

Looking at the Risks

What's been done so far

- National Infrastructure Protection Plan (NIPP)
  - FEMA, 2006, Risk Management Framework to address pre-existing threats that may occur from natural disasters, cyber-attacks, and terrorism.

Critical Infrastructure Sectors

1. Chemical
2. Commercial Facilities
3. Communication
4. Critical Manufacturing
5. Dam
6. Defense Industrial Base
7. Emergency Services
8. Energy
9. Finance Services
10. Food and Agriculture
11. Government Facilities
12. Healthcare and Pub Health
13. Information Technology
14. Nuclear Reactor, Mat'ls, Waste
15. Transportation Systems
16. Water and Wastewater

Looking at the Risks

What's been done so far

- National Infrastructure Protection Plan (NIPP)
  - Communications Sector-Specific Plan (CSSP)

An approach to a local risk assessment

1. ***What could fail?*** *(potentially impacted systems)*
   - *Telephony*
   - *Internet*
   - *Radio*
   - *Messaging*
   - *Video*
   - *others?*
2. ***What could cause a failure?*** *(impacting events vs. initiating hazards)*
   - *loss of power*
   - *loss of connectivity*
   - *system overload*
3. ***How likely is it to occur?*** *(characterize the risk)*
   - *redundancy, diversity, recoverability*
   - *probability and seriousness*
4. ***What do we do when it does occur?*** *(develop the plan, prioritize actions)*
   - *mitigations & contingencies*
   - *recommendations*

Managing Communications Risks

What can we control?

- Local backup generators
- Local 2-way radio systems
- AM TIS Stations
- Ham Radio
- First responders, local staff and volunteers

What can't we control?

- Power generation and distribution
- Landline telephone network
- Cellphone network
- Digital network

This implies that we should…

apply **Mitigations** here

apply **Contingencies** here

Recommendations for Cupertino

What do we do when it does occur? – mitigations & contingencies

1.3 Recommendations for the City

1. Move the TIS station to a more secure facility, or retrofit City Hall.
2. Complete the TIS station backup battery upgrade.
3. Improve the reliability of the City Hall backup generator.
4. Define the Public Information Outreach plan.
5. Define the Community Emergency Assistance Request Intake plan (***9-1-1 alternate***).
6. Complete the build-out of the Cupertino Emergency Intranet (ARKnet).
7. Perform testing of specific backup communications measures.
8. Explore other emerging technologies and means for communicating with the community during an emergency.

1.4 Recommendations for the Community

9. Public Outreach to the community:
    a. Encourage residents to have a car cell-phone charger.
    b. Encourage they have at least one corded phone for home wireline telephones.
    c. Encourage every home to have a portable AM/FM radio.

Problem / Situation

1. County Comm receives assistance requests by the 9-1-1 system, and ad hoc reports from Sheriff, Fire, EMS, and other PSAP data transfers.
2. Three Santa Clara County cities – Cupertino, Saratoga, Los Altos Hills – contract with the County for all their public safety and PSAP/dispatch services.
3. A wide spread / extended communications outage is possible and would be caused by:
   - natural disasters (earthquakes)
   - accidental causes (cable cuts)
   - intentional causes (cable cuts, wide spread power outages, infrastructure hacks)

Problem / Situation

4. On loss of telephone service,
   - jurisdictions with their own PSAPs can receive 9-1-1 requests from local public safety and volunteer organizations, such as RACES.
   - jurisdictions without their own PSAPs do not have a defined process to get 9-1-1 requests to County Comm by an alternate means.
5. To address this, County Comm preferred for these cities to pass 9-1-1 requests by amateur radio to RACES members deployed to, and operating at, County Comm.

Objectives

(What does the solution look like)

1. County RACES manages incremental activities and training on County Comm Operations for RACES MAC responders.
2. County Comm amateur radio equipment is in place, tested, and operational.
3. A process exists to gain access to County Comm Amateur Radio equipment.
4. 9-1-1 request messages from the field Amateur Radio operators are correctly formatted and sufficiently complete to facilitate a 9-1-1 dispatch.

Deliverables – County Comm

1. Develop the procedural details on the information hand-off from County RACES to County Comm dispatch (Objective #1)
2. Implement an access control policy change to accommodate responding County RACES MACs (Objective #3)
3. Confirm the minimum 9-1-1 message definition (Objective #4)

Deliverables – SCC RACES

1. Training material, scheduling, and notifications on a County Comm operations course (Objective #1)
2. Equipment Plan – what to buy (Objective #2)
3. Equipment Test Plan. Periodic equipment testing is required to confirm its readiness (Objective #2)
4. Process for periodic notification to County Comm with the list of County RACES MACs who are qualified to operate from County Comm RACES Radio Room (Objective #3)
5. Field Forms. Adopt or adapt County Comm's manual process paper form for field use (Objective #4)
6. Automated Tools. Develop application add-ons to Packet Radio that manage the workflow for collecting and transmitting 9-1-1 field requests to County Comm's (Objective #4)

Schedule

Project Start:	**1 March 2017**
Requirements Checkpoint:	**1 April 2017**
Design Checkpoint:	**1 May 2017**
Deployment Checkpoint:	**1 August 2017**
System Test:	**1 November 2017**

Are the risks real?

Looking at the Risks

What's been done so far

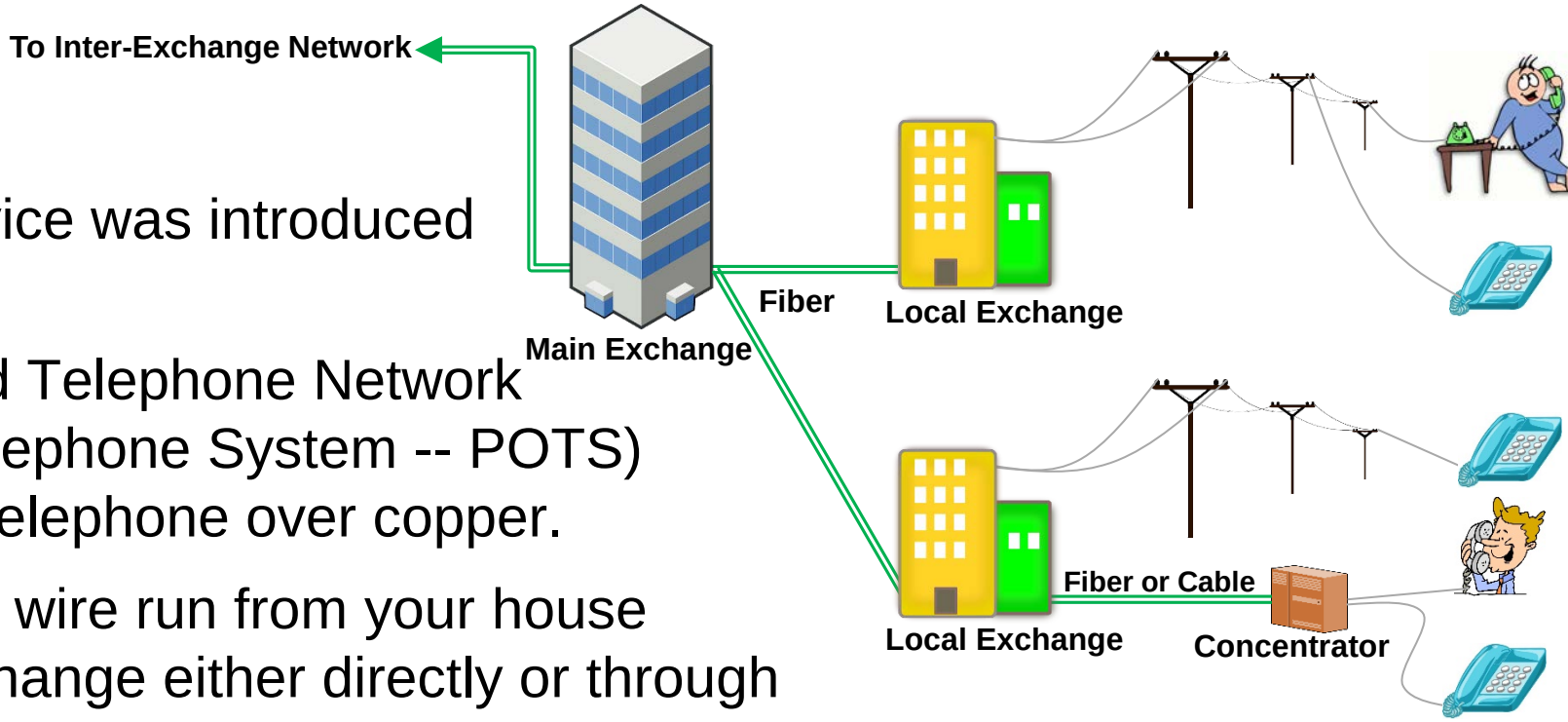
- National Infrastructure Protection Plan (NIPP)
  - Communications Sector-Specific Plan (CSSP)

An approach to a local risk assessment

1. ***What could fail?*** *(potentially impacted systems)*
   - *Telephony*
   - *Internet*
   - *Radio*
   - *Messaging*
   - *Video*
   - *others?*
2. ***What could cause a failure?*** *(impacting events vs. initiating hazards)*
   - *loss of power*
   - *loss of connectivity*
   - *system overload*
3. ***How likely is it to occur?*** *(characterize the risk)*
   - *redundancy, diversity, recoverability*
   - *probability and seriousness*
4. ***What do we do when it does occur?*** *(develop the plan, prioritize actions)*
   - *mitigations & contingencies*
   - *recommendations*

Landline Telephone Network

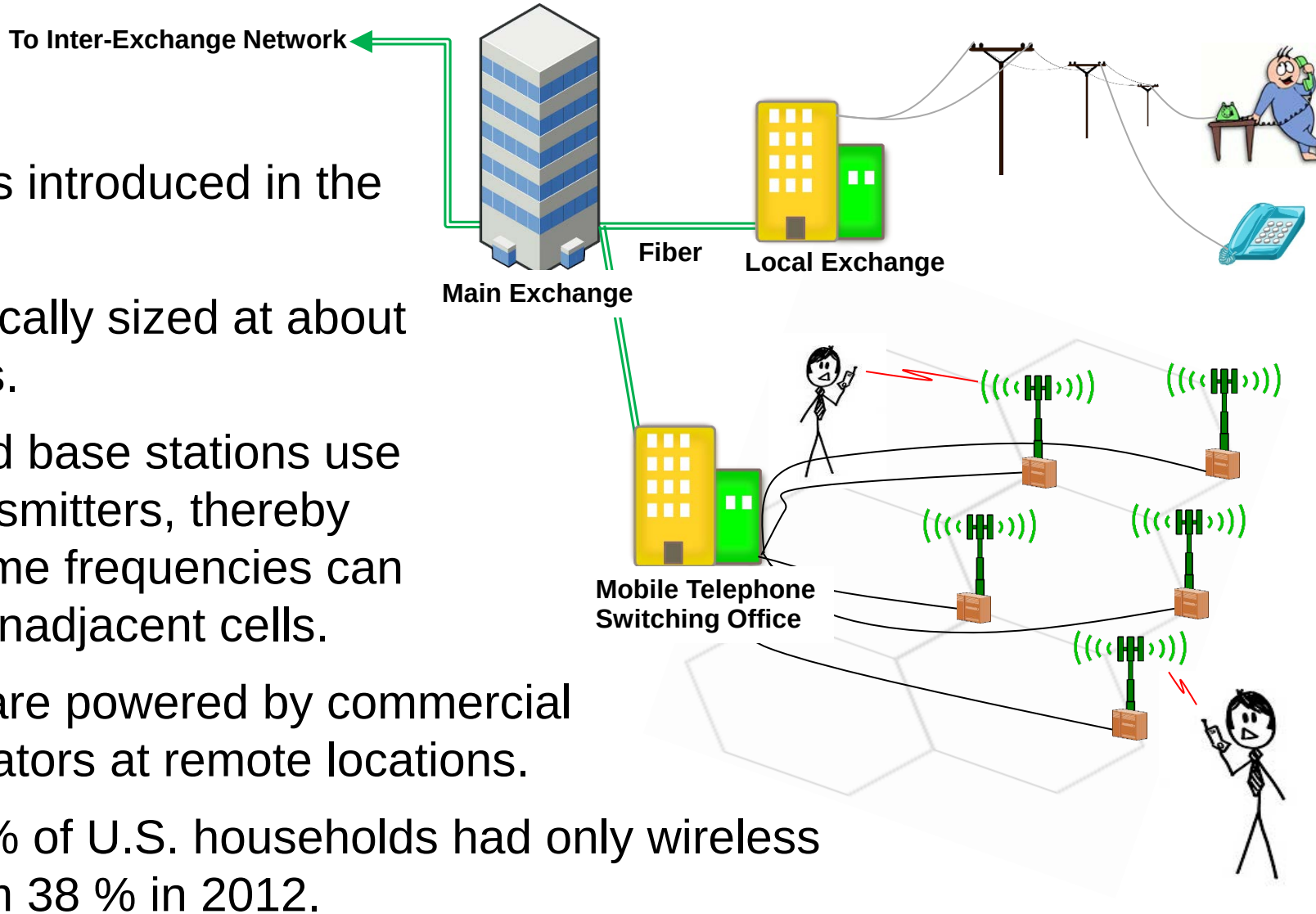
What could fail?



1. Telephone service was introduced in 1876.
2. Public Switched Telephone Network (or Plain Ol' Telephone System -- POTS) is voice-grade telephone over copper.
3. Copper pairs of wire run from your house to the local exchange either directly or through a digital concentrator.
4. Local calls are kept local; Out of area calls are switched to the Inter-exchange Network.
5. In 2013, there were 1.16 billion landline subscribers worldwide.

Cellular Telephone Network

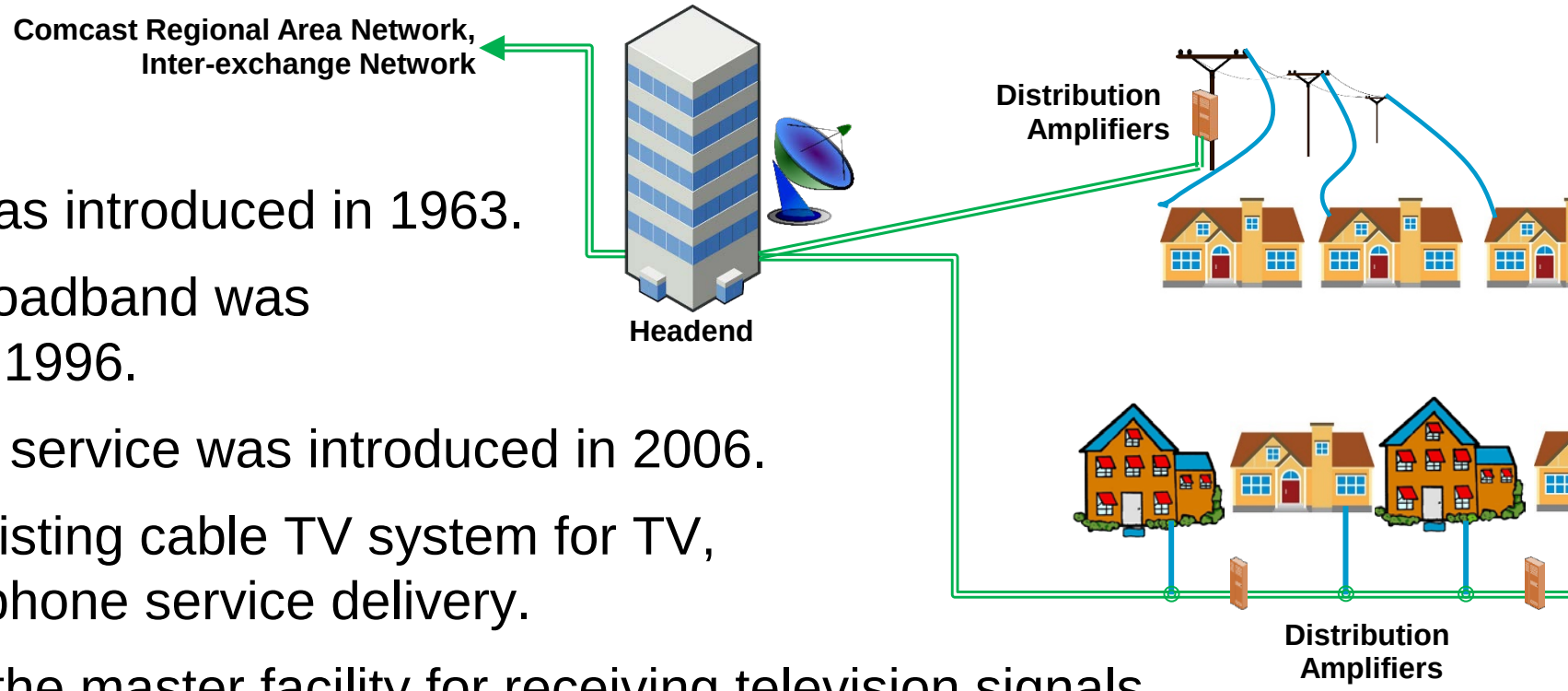
What could fail?



1. Cell service was introduced in the U.S. in 1983.
2. Each cell is typically sized at about 10 square miles.
3. Cell phones and base stations use low-power transmitters, thereby allowing the same frequencies can be reused in nonadjacent cells.
4. Most cell sites are powered by commercial power or generators at remote locations.
5. As of 2015, 48% of U.S. households had only wireless phones, up from 38 % in 2012.

Digital Telephone, Cable Data Network

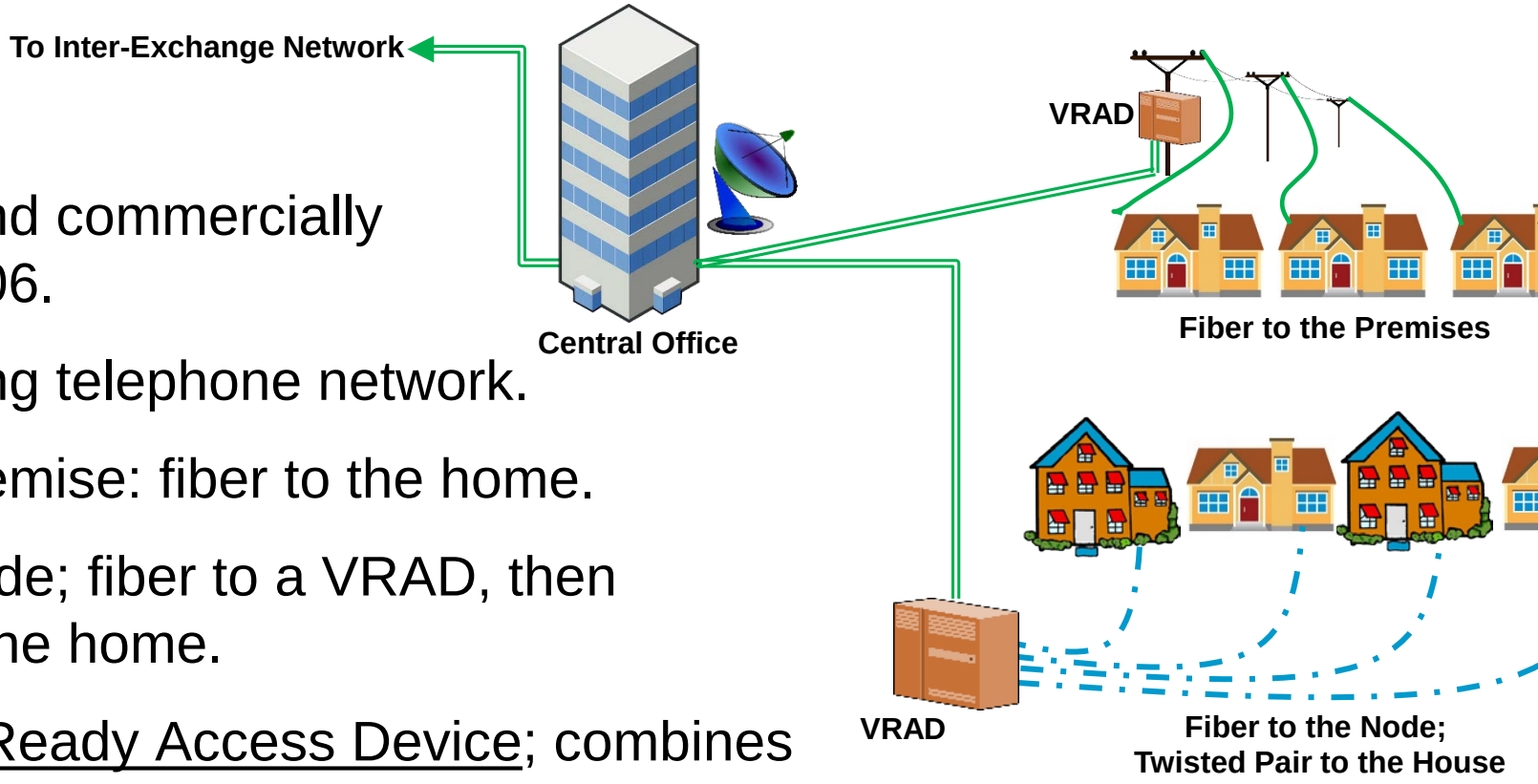
What could fail?



1. Cable TV was introduced in 1963.
2. Comcast broadband was launched in 1996.
3. VoIP phone service was introduced in 2006.
4. Uses the existing cable TV system for TV, data, VoIP phone service delivery.
5. **Headend:** the master facility for receiving television signals for processing and distribution over a cable television system.
6. **Distribution Amplifiers:** ensures a sufficient signal level down the path.
7. **Coax Splitter:** splits signal for TV, Internet, and Phone.

Digital Telephone, DSL Data Network

What could fail?



1. AT&T broadband commercially launched in 2006.
2. Uses the existing telephone network.
3. Fiber-to-the-Premise: fiber to the home.
4. Fiber-to-the-Node; fiber to a VRAD, then twisted pair to the home.
5. **VRAD**: Video Ready Access Device; combines voice and data (DSLAM) with the TV stream to the home.

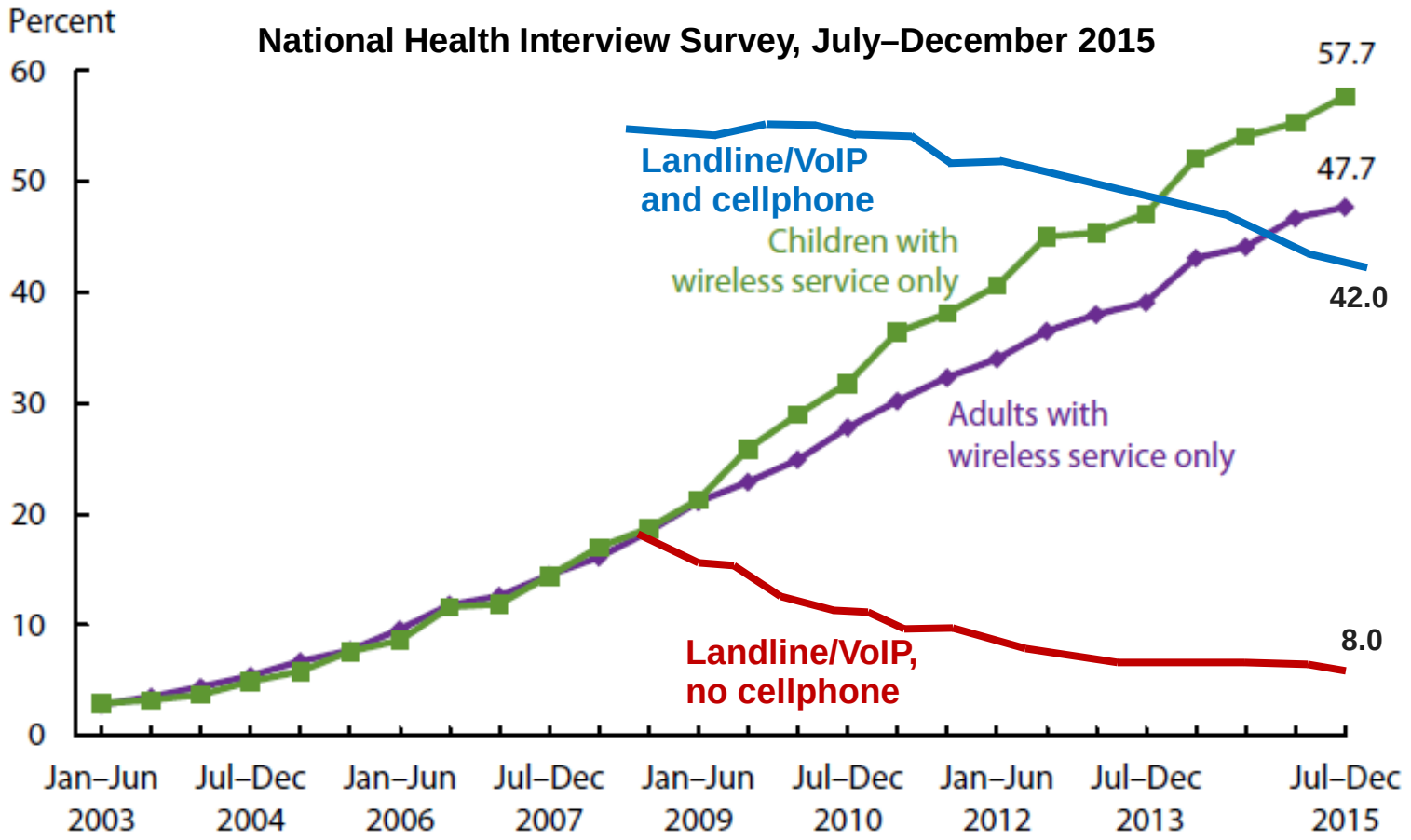
DSLAM: Digital Subscriber Line Access Multiplexer; combines end voice and data traffic into one signal; at the Central Offices or VRADs.

Telephone use… by the numbers

What could fail?

The Jan-Dec 2015 CDC/NHI Survey showed…

- nearly one-half of American homes have only wireless telephones.
- 7.2% have a POTS or VoIP phone only.



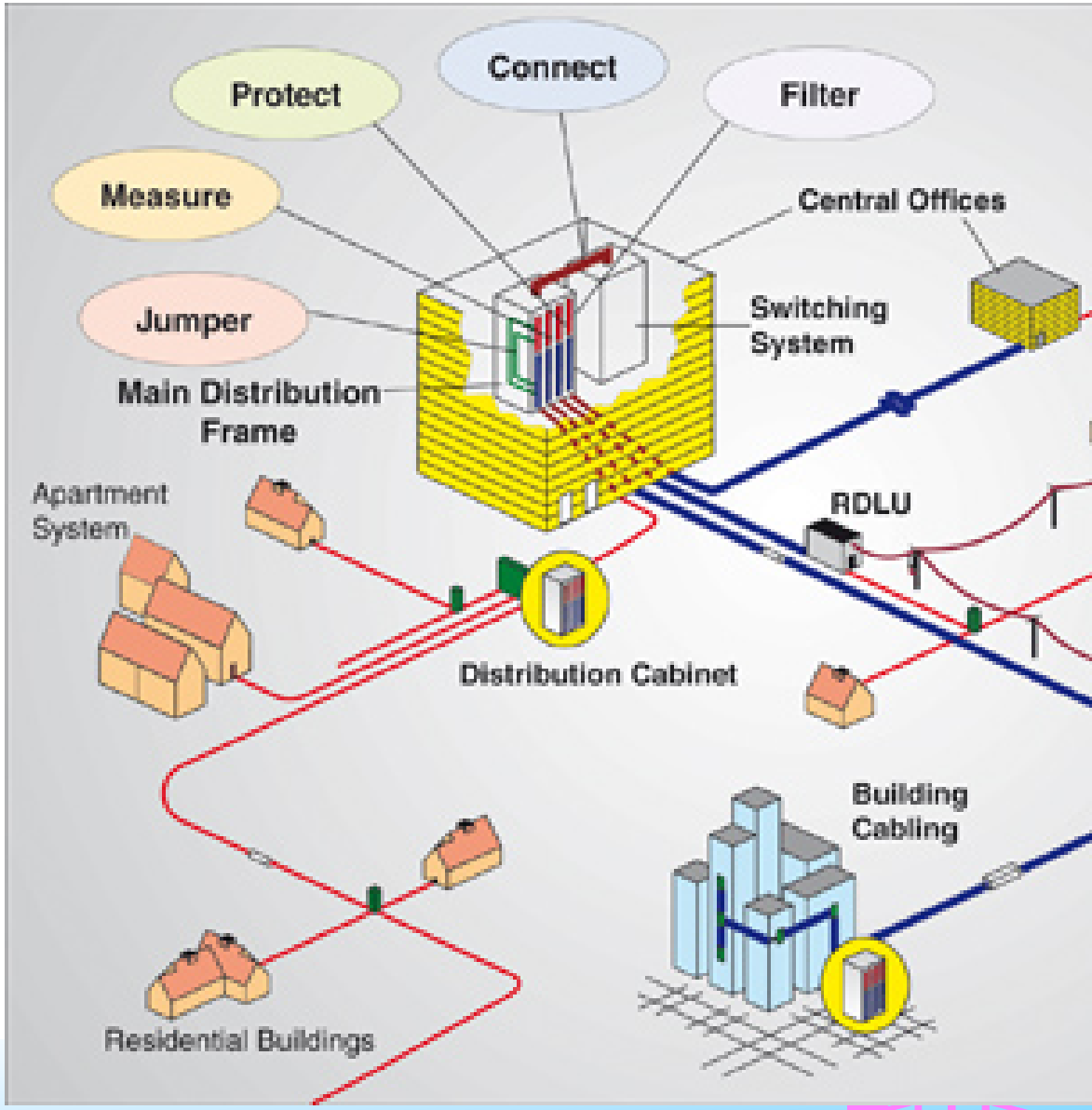
What do they all have in common?

What could fail?

1. Everything connects together

… in the physical world of wire, cable, or fiber sooner or later.

1. Wired Telephone
2. Cellular phone
3. AT&T, Comcast, Sprint, Verizon, other carriers



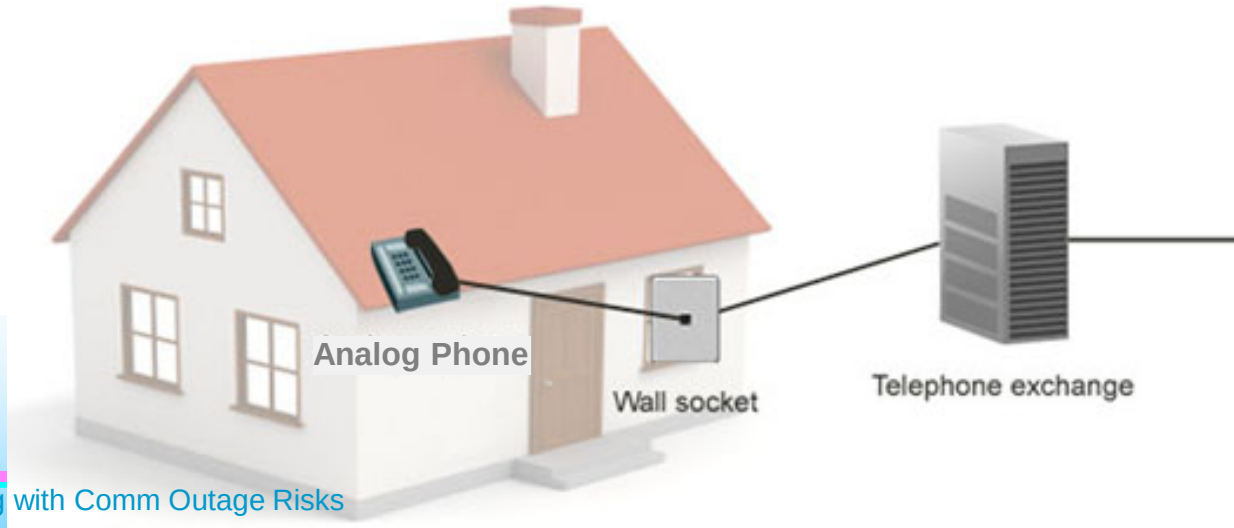
What do they all have in common?

What could fail?

2. All require power to operate

Landline Telephone Network

1. The *phone company powers your phone* with an extensive battery system with backup generators at Local Exchange offices.
2. Operates at 6 to 12 volts DC, ~30ma.
3. 90VAC for the ring signal, as provided by the Local Exchange.
4. During a power failure, wired phones will continue to work,
5. … provided at least one is a “corded” phone.



What do they all have in common?

What could fail?

2. All require power to operate

Cellular Telephone Network

1. Towers, controllers fed from commercial power.
2. Backup batteries are built into most standard power systems.
3. Batteries can last from 2 to 8 hours, depending on their configuration.
4. Generators are also used to avoid service interruption.

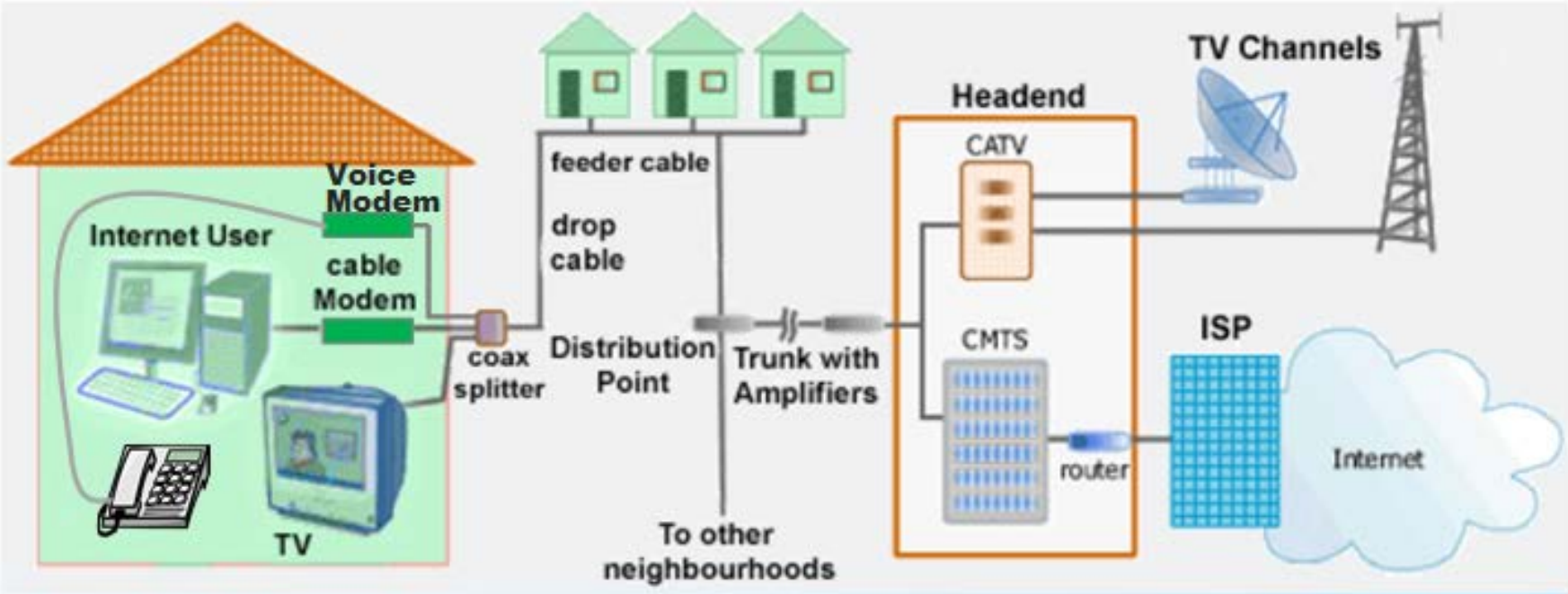
What do they all have in common?

What could fail?

2. All require power to operate

Comcast Digital Network

1. Central Office / Headend: backup generators, batteries.
2. The *voice phone modem* requires a ***backup battery*** to ensure telephone service remains operational during a power outage.

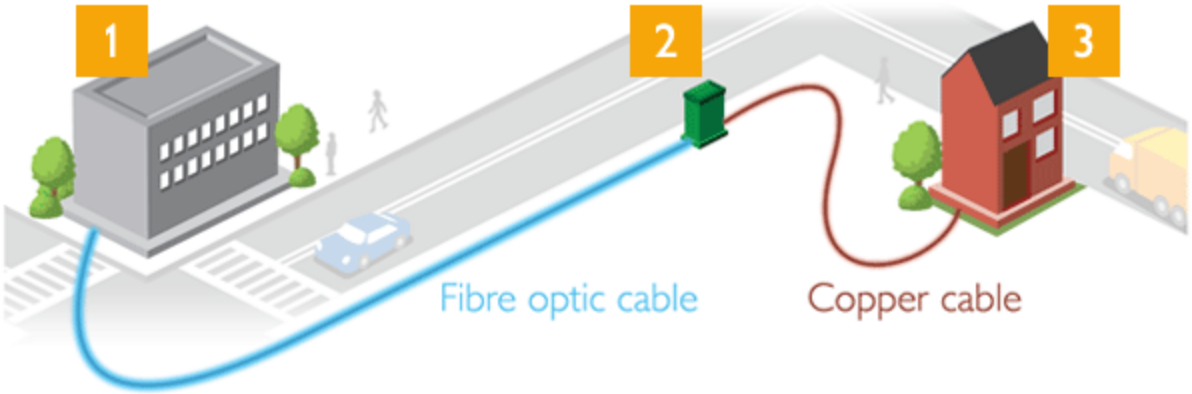


What do they all have in common?

What could fail?

2. All require power to operate

AT&T Digital Network



1. Central Office: gen & battery backup.
2. VRAD Neighborhood boxes; backup NiMH batteries, 2-4 days of power.
3. Wi-Fi Resident Gateway; with phone service, includes a Belkin 12V, 7Ah SLA.

What could cause a failure?

Impacting Events

- **Loss of Power**
  - Power failures – accidental, natural, intentional
- **Loss of Connectivity**
  - Cable breaks – accidental, natural, intentional
- **System Overload**
  - Some out-of-the-ordinary event that causes a lot of people to use the phone at the same time
- **Solar Storms, Solar Flares**

Power loss and Comm outages

What could cause a failure?

Date	Event	Duration	Impact (people)
Accidental			
November 1965	Northeast Blackout	13 hours	30,000,000
October 2003	Northeast Blackout	1-2 days	55,000,000
September 2011	Pacific Southwest	12 hours	7,000,000
Natural…			
October 1989	Loma Prieta Earthquake	2-3 days	1,400,000
January 1994	Northridge Earthquake	1 week	300,000
September 2005	Katrina	Weeks	3,900,000
Intentional…			
April 2013	Metcalf Sniper Attack	27 days	None
December 2015	Ukrainian Cyber Attack	6 hours	225,000

Power loss and Comm outages

What could cause a failure?

Intentional – Other Reports

- Parts of the U.S. power grid are attacked online or in person every 4 days.
- From 2011 to 2014: the U.S. Department of Energy received 362 reports from electric utilities of physical or cyber-attacks that interrupted power services.

Connectivity loss and Comm outages

What could cause a failure?

Date	Event	Duration	Impact (people)
Accidental			
March 2015	Arizona	12 hours	1,000's
2013	San Juan Islands, WA	10 days	1,000's
March 2012	Morgan Hill	1 day	1,000's

Connectivity loss and Comm outages

What could cause a failure?

Intentional – in the news

- ***April 2009, San Jose***
  Event: Underground fiber-optic cables were cut
  Impact: outage of landlines, cell, and Internet for 10,000's in 3 counties
- ***June 30, 2015, Sacramento***
  Event: three major fiber cables connecting the region were cut
  Impact: disrupted service to Sacramento, Rocklin; ~15 hour outage
- ***July 1, 2015, San Jose***
  Event: Break-in to an underground vault; vandals cut 3 fiber-optic cables belonging to Level 3 and Zayo.
- ***July 15, 2015, San Joaquin County***
  Event: Fiber optic line intentionally cut
  Impact: 9-1-1 outages; 10 hour outage.
- **September 3, 2015, CA North Coast**
  Event: Vandals cut AT&T fiber cable in Hopland
  Impact: disrupted Internet, landline and cellphone service.

Connectivity loss and Comm outages

What could cause a failure?

Intentional – and then the consolidated FBI report-out of even more cable cuts throughout the Bay Area

- July 6, 2014, 9:44 p.m., Berkley. Near 7th St. and Grayson St.
- July 6, 2014, 11:39 p.m., Fremont. Niles Canyon Blvd and Mission Blvd.
- July 7, 2014, 12:24 a.m., Walnut Creek. Jones Road and Iron Horse Trail.
- July 7, 2014, 12:51 a.m., Fremont. Niles Canyon Blvd. and Alameda Creek.
- July 7, 2014, 2:13 a.m., San Jose. Stockton Ave. and University Ave.
- Feb 24, 2015, 11:30 p.m., Fremont. Niles Canyon Blvd. and Mission Blvd.
- Feb 24, 2015 11:30 p.m., Fremont. Niles Canyon Blvd. and Alameda Creek.
- June 8, 2015, 11:00 p.m., Alamo. Danville Blvd. and Rudgear Road.
- June 8, 2015, 11:40 p.m., Fremont. Overacker Ave. and Mowry Ave.
- June 9, 2015, 1:38 p.m., Walnut Creek. Jones Road and Parkside Dr.

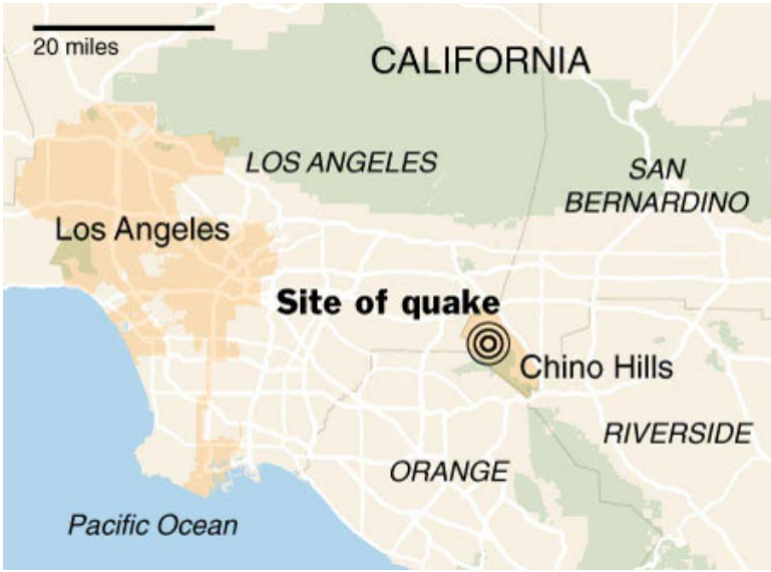

Date
of cuts
1 June 6-7, 2014 5
2 Feb. 24, 2015 2
3 June 8-9, 2015 5
4 June 30, 2015 2
Walnut Creek
Berkeley
Twitter
San Francisco
Oakland
San Francisco Bay
San Mateo
Fremont
Livermore
CALIFORNIA
Facebook
Google
Mountain View
San Jose
Apple
580
80
880
680
280
5 miles
Cut to Bits
A sabotage streak targeting northern California's Internet infrastructure is frustrating companies and cops alike. Shown here are sites of fiber optic cable vandalism identified by the FBI.
Source: FBI
THE WALL STREET JOURNAL.

System Overloads and Comm outages

What could cause a failure?

Natural *(2 examples)*

- July 30, 2008, Los Angeles.
  - 5.4 earthquake, San Bernardino County.
  - **Cell phone lines were jammed**.
  - No damage was reported to the network infrastructure.
- August 23, 2011, Washington DC.
  - 5.8 earthquake, central Virginia.
  - **Cell phone networks were jammed** in Manhattan, Washington D.C., other areas.
  - SMS could get through.
  - Major carriers reported no major problems with their network infrastructure.



Solar Storms and Comm outages

What could cause a failure?

Date	Event	Duration	Impact (people)
September 1859	Solar Storm (Carrington)	Unknown	Unknown
August 1972	Solar Flare, Illinois	Unknown	Unknown
March 1989	Solar Flare, Quebec	9 hours	6,000,000

- In 2012, NASA said the sun unleashed two massive plasma clouds that ***barely missed*** a catastrophic encounter with Earth.
  - "A direct strike could've caused widespread power outages and other damaging effects."
  - "If it had hit, we would still be picking up the pieces 2 years later."
  - NASA also cited research suggesting that there is a 12% chance of something like this happening in the next decade.

Takeaways

What could cause a failure?

- POTS will be gone within 5-10 years.
- Fewer fiber optic cable paths means wider impact when a cable break occurs.
- Intentional cable cuts are up.
- Communications is growing more dependent on distributed (versus central) power sources.
- Cyber attacks on the power grid are also increasing.
  - *The Ukraine cyber-attack pointed out the high degree of sophistication, coordination, and planning that occurred.*

Some light reading

1. *Inside the Cunning, Unprecedented Hack of the Ukraine's Power Grid*, 3/3/2016, Kim Zetter, Wired
2. *The National Power Grid Is Under Almost Continuous Attack, Report Says*, 3/25/2015, Sabrina Toppa, Time
3. *How America Could Go Dark*, 7/14/2016, Rebecca Smith, Wall Street Journal (at least watch the video, 4½ min)
4. *American Blackout 2013*, National Geographic, 1hr 27 min
5. *Lights Out: A Cyberattack, A Nation Unprepared, Surviving the Aftermath*, Ted Koppell, Crown Publishers

For an on-line list of links, go to…

www.cupertinoares.org/commoutage.html

Thank you!

Questions?