Vulnerabilities in the Internet

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Disclaimer

- Simplistic generalizations
  - Not a network architecture course
  - Not a DNS course
- Touching only some points
  - Broad overview, not limited to 11th Sept events
- More analysis needed
  - Especially on details
- Terminology Internet related

Overview

- Two perceptions of the event
- Effects of the network damage
- ISP experiences
- TLD DNS vulnerabilities
- Closing remarks

Personal experience

- Sister in Manhattan (Houston)
- Was impossible to reach by phone
- E-mail took less then 7 minutes
  - 2 minutes to provider, 5 to my inbox
    - Clock skew?
      - *Everything is ok*
- Big failure: Phone system

Honeyman's Experience

- University of Michigan
  - Networking, cryptography, smart cards
- Got called
- No www.cnn.com or similar
- No Television, used Radio
- Big failure: Internet

What was going on?

- The network was out?
  - Cnn.com is an end point
    - Much more traffic then usual
    - http is transaction oriented
  - E-Mail is lightweight
    - Easy to route
- Phone was out?
  - Not really (8 hours)
- Perception

Measurements

- Matrix.net (MIDS) monitors continuously
  - Last 14 years
- View of the world from Austin Texas
  - 60,000 sites every 15 minutes
  - beacon list contains over 10,000 entries
  - ICMP ECHO (PING) and HTTP
  - probes from 100 points around the world
- Data supplied Peter Salus

Legenda

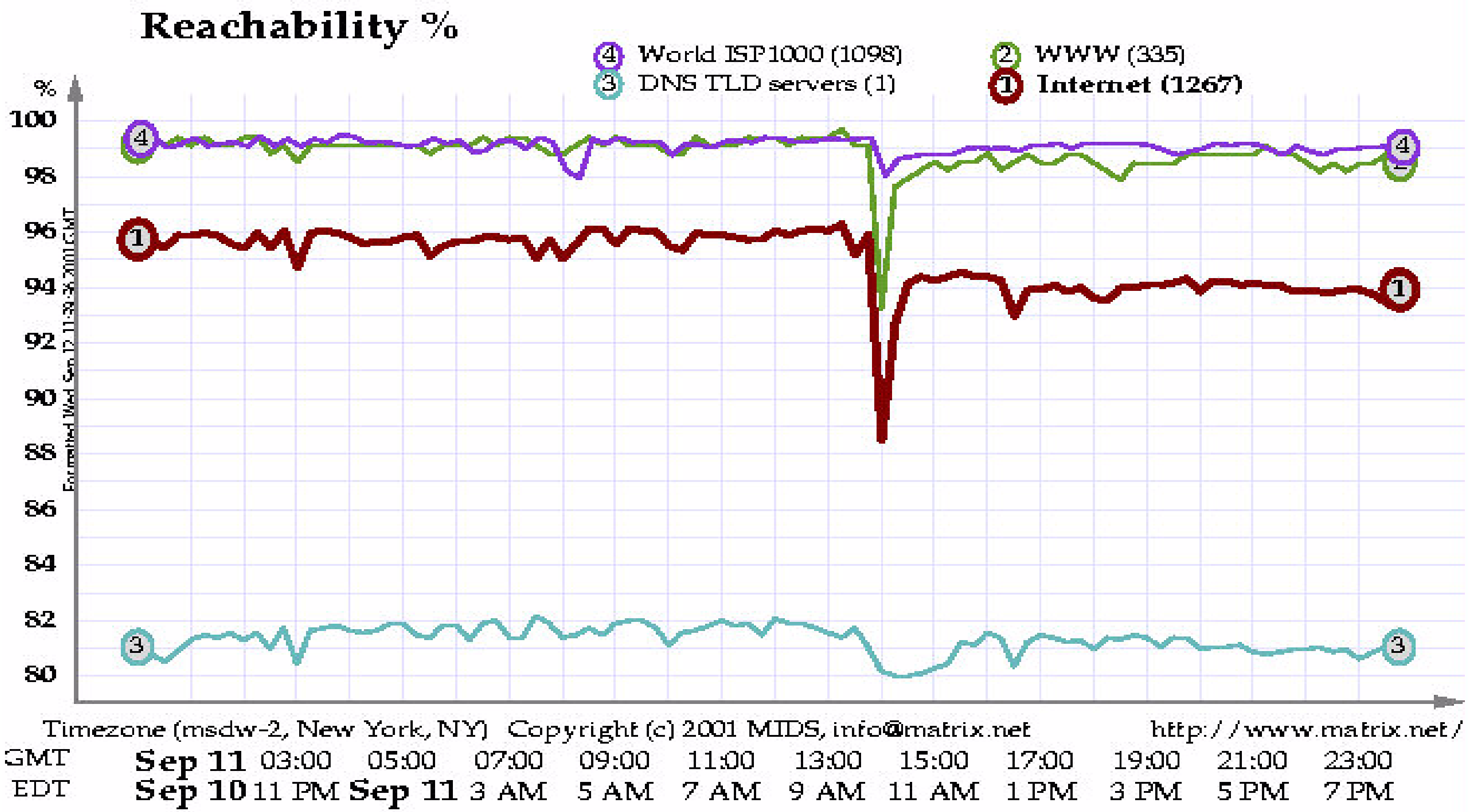
1: World ISP 1000

2:WEB

3: DNS TLD Servers

4: Internet

The Attack

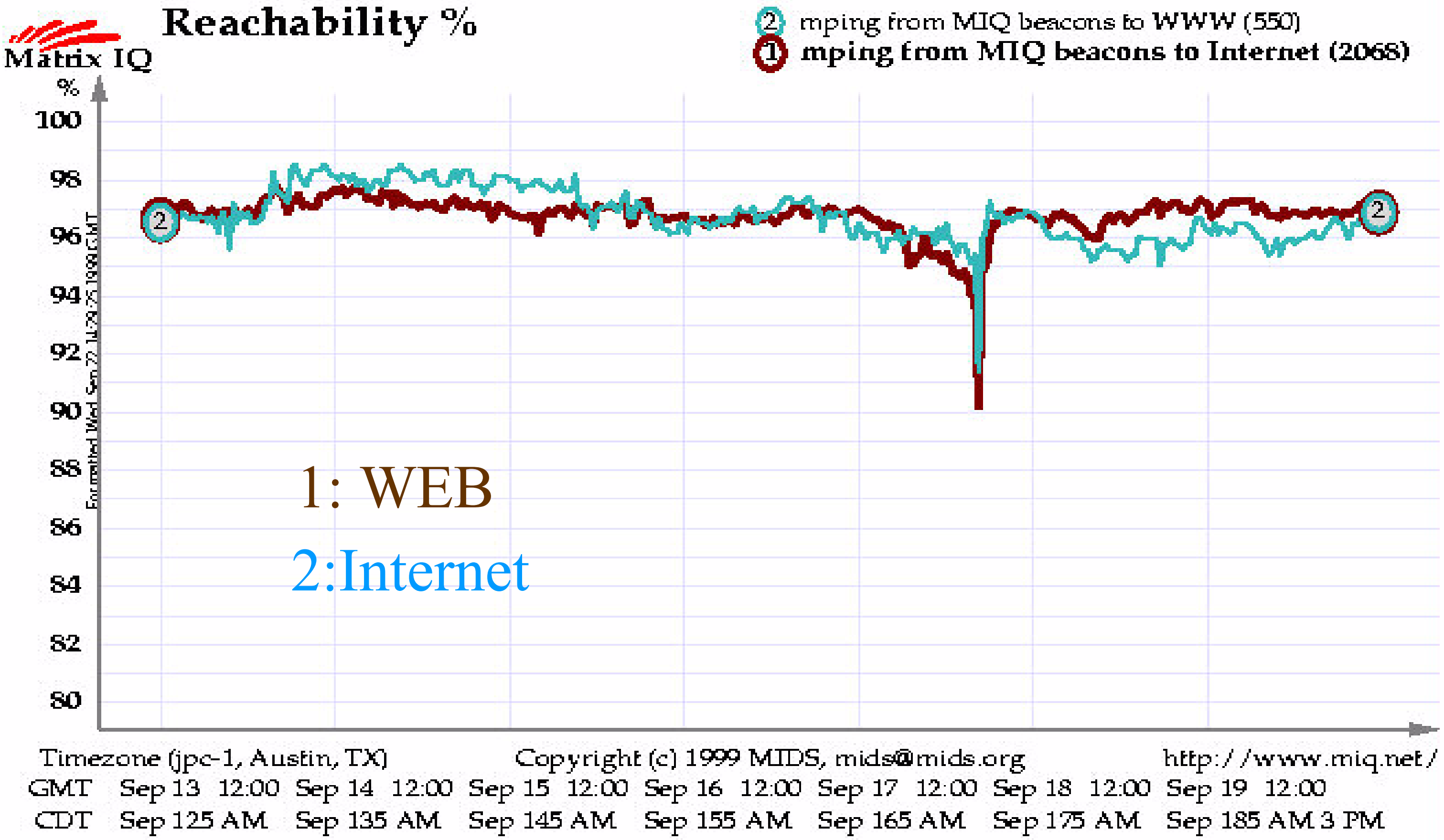


Reachability %
4 World ISP1000 (1098)
3 DNS TLD servers (1)
2 WWW (335)
1 Internet (1267)
%
100
98
96
94
92
90
88
86
84
82
80
Formatted Wed Sep 12 11:39:36 2001 GMT
Timezone (msdw-2, New York, NY) Copyright (c) 2001 MIDS, info@matrix.net
http://www.matrix.net/
GMT Sep 11 03:00 05:00 07:00 09:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00
EDT Sep 10 11 PM Sep 11 3 AM 5 AM 7 AM 9 AM 11 AM 1 PM 3 PM 5 PM 7 PM

Effects

- WTC was major communication hub
- Telehouse (NY IX) close to WTC
- Lots of lines went out
- Rerouting takes some time

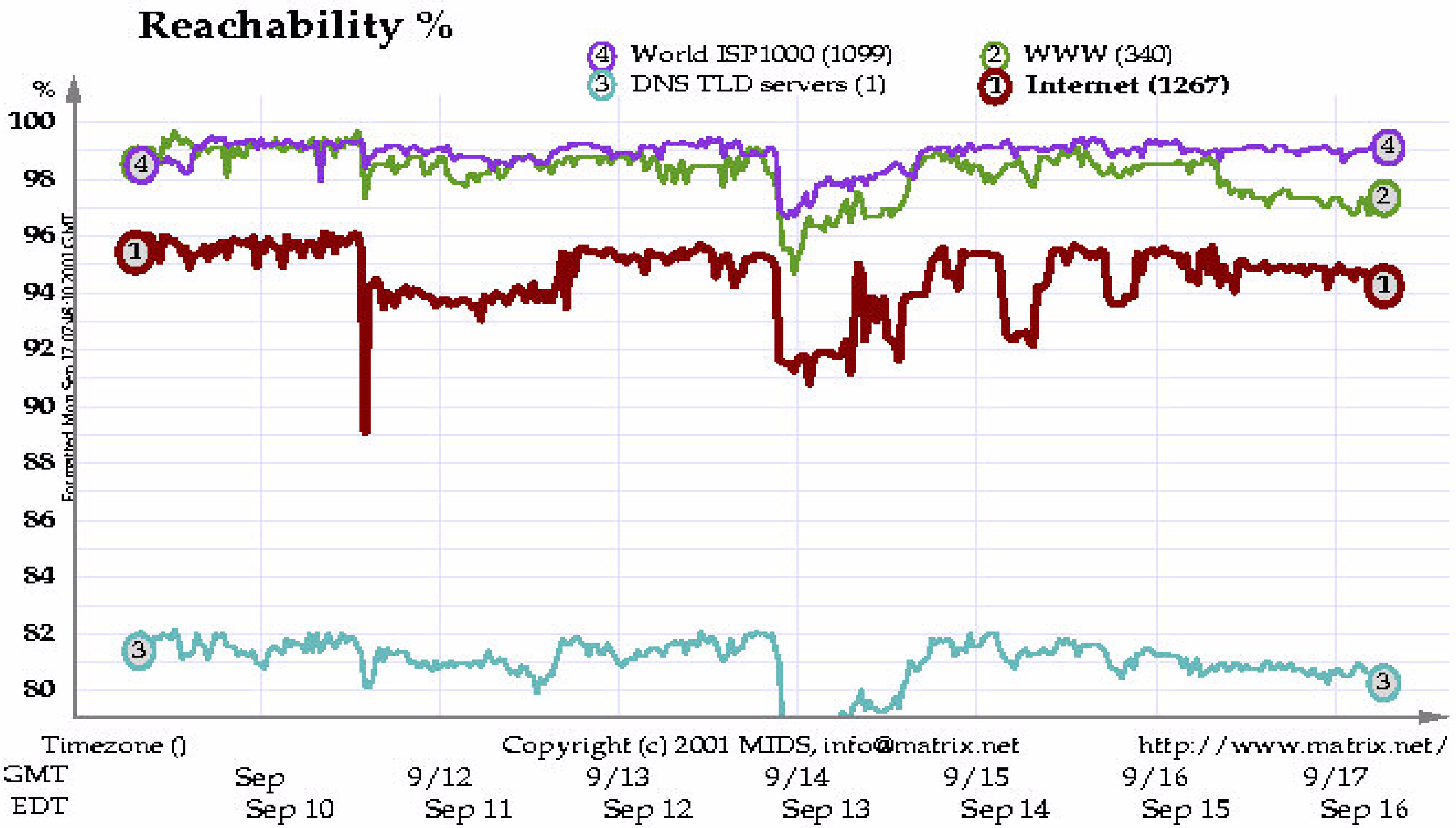
Hurricane Floyd



1: WEB

2:Internet

Events surrounding 11 Sept.



Events following 11th

- Anticipating power failure at Telehouse
  - ISPs set up extra peering at exchanges
  - Big operators helped out competitors
  - Extra multi homing by various ISPs

Comparable Outage: AMS-IX

- Amsterdam Internet Exchange (July 2001)
  - one of the major European IXs
- Problems
  - Two out of three locations broke down
- Hardware problems
  - Triggered by specific multi vendor combinations
- Took about a week to solve

Phenomena in Europe

- Medium sized Dutch ISP
- Big international ISP

Experiences ISP–W

- Description of operation
  - Medium sized Dutch ISP
  - 10 year in business
  - Transit with Telehouse (Broadway 25)
  - Major peering as well
  - Hosting farm at Telehouse
  - Minor peering at AMS-IX

Experiences ISP–W

- Extra measures
  - More peering & alternative transit
- Result
  - Transit OK
  - Hosting farm 1 week out

Experiences ISP–W

- Lessons learned
  - Network designed with redundancy
  - Need to think about more then the network security
- Transatlantic cable cut (3 weeks ago) was worse
  - 56 hours down

Reflections by *BIG* ISP on 11th

- Lots of extra transit
  - Need to be flexible
  - Strong arm the CFO
- Lots of multi homing set up
  - Grow of routing tables (20%)
- Not always effective
  - Routing policies of other ISPs
  - Router memory exhaustion

Reflections by *BIG* ISP

- Costs of redundancy policies
  - Threefold redundancy in transatlantic cables
    - *In the end, it's all economics*
- Transit at internet exchanges
  - Single point of failure
- Routing aggregations policies (Ripe NCC)
  - Trims size of routing tables
  - Uses more IP address space

TLD DNS Vulnerabilities

- DNS: Hierarchical distributed structure and name resolving
- Specific examples are neutral
  - using .nl, .de, .uk, .be, se. to protect the innocent
- Results, needs further study:
  - *useless statistics*

Root zone file analysis

- Resource Records: 1859
  - 1 SOA record
  - 1 TXT record
- 255 TLDs
  - 1216 Name server (delegation) records
    - Example: NL. 172800 IN NS SUNIC.SUNET.SE.
  - 5 Records per tld
  - 641 Glue records
    - SUNIC.SUNET.SE. 172800 IN A 192.36.125.2
  - Less then 3 per tld

Root zone analysis (cont.)

- No. of root servers: 13
- TLDs sharing in root name servers
  - ARPA. 172800 IN NS A.ROOT-SERVERS.NET.

```
.       13
ARPA.    9
EDU.     9
GOV.     9
MIL.     5
SE.      1
```

TLDs with specific Name Servers

NL. 172800 IN NS SUNIC.SUNET.SE.

#TLD in	#name servers
1	10
3	13
14	8
22	7
30	4
44	3
45	5
45	2
48	6

of Name Servers for TLDs

#NS	serving	#TLD
1		69
1		62
1		44
1		40
1		27
1		24
1		23
1		17
2		9
3		6
4		8
4		7
5		5
13		4
28		3
56		2
495		1

Closing Remarks

Supported by de. and nl.

- The packet switched internet network works
  - Control structure distributed by nature
  - Don't fix problems by adding central control
  - Strengthen the distributed control
- More risk analysis needed
  - Network level
  - DNS implementation

Questions?