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# Routing Security: an Oversimplification

## MENOG 3 / Salmiya

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<http://rip.psg.com/~randy/080415.menog-routesec.pdf>

# Not Router Security

- Go to any good Routing Ops Security Tutorial
- TCP/MD5 session protection
- ACLs on everything
- ssh, not telnet.  no http, …
- Route filtering (based on IRR),
- …

# What is Routing Security?

- The unique threat is attackers **using routing protocols**
  - To divert traffic
  - To alter traffic
- We have some ability to lessen the danger, but not enough!

# History of Routing Security

- Radia Perlman: Network Layer Protocols with Byzantine Robustness, 1988
- Bellovin: *Security Problems in the TCP/IP Protocol Suite*, 1989
- Work accelerates 1996
- Kent et alia two papers in 2000
- Endless talking in the IVTF

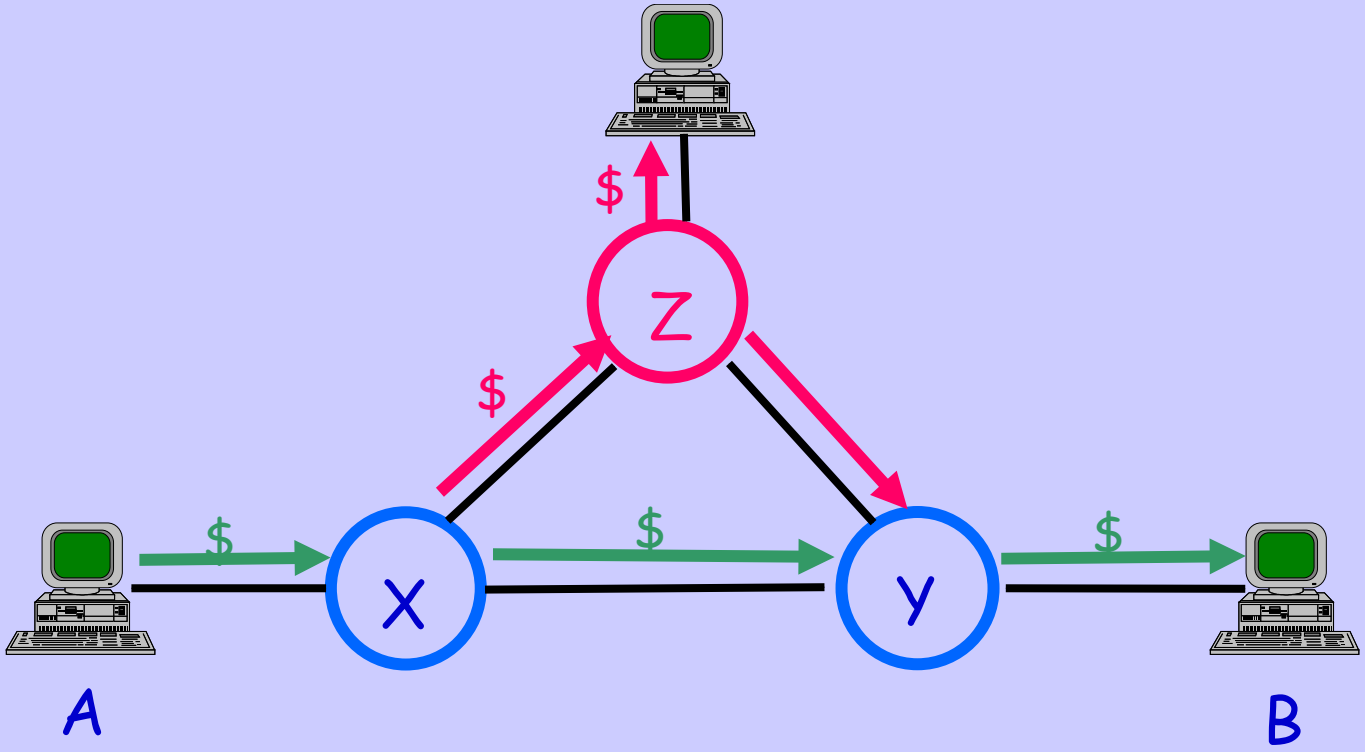
# Why so Little Progress

- The problems are technically very difficult
- Simple routing is already a very complex operational issue
- It is not traditional communications security
- Installed base & transition problem
- Unmotivated vendor$

# What is Different Here?

- Well-studied communication and host security issues are buggy code and/or bad protocol design
- Routing is vulnerable with good code and good protocols
- **The problem is a dishonest peer**
- Hop-by-hop authentication is not sufficient

# Diversion Attack



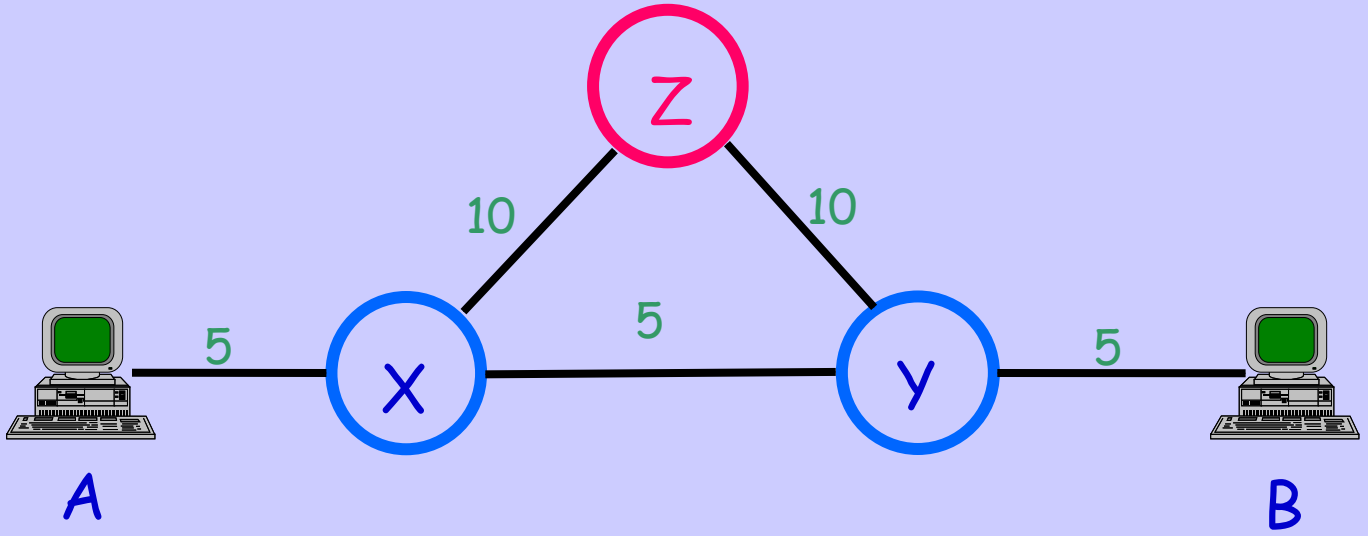

Expected Path - A->X->Y->B

Diverted Path - A->X->Z->Y->B

# How does Attacker Do It?

- Routers select lowest cost path toward destination on a hop by hop basis
- Attacker 'owned' router lies about cost
- And we must assume that random routers can be owned

# How Does Z Do It?




Y tells X and Z that costs are B:5

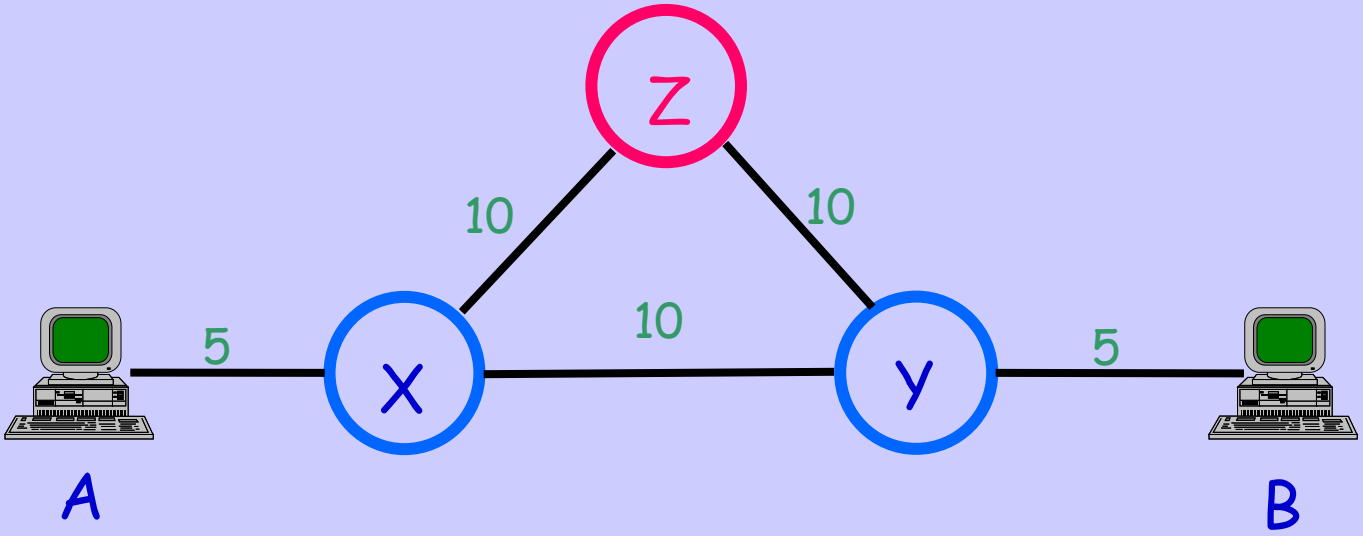
X tells A and Z that costs are Y:5 B:10

Z tells X that costs are Y:10 B:15

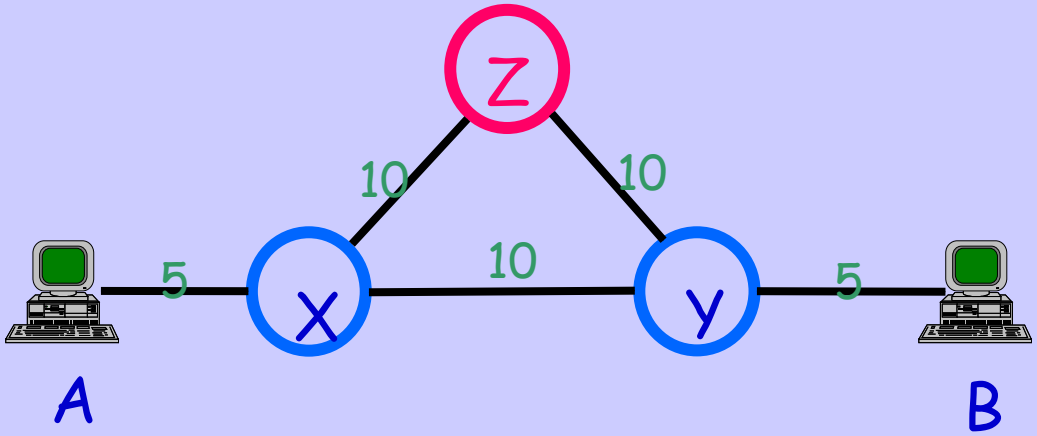
Z tells X that costs are Y:10 **B:4**

X now sends B's traffic to Z!!!

# Why is this a Hard Problem?

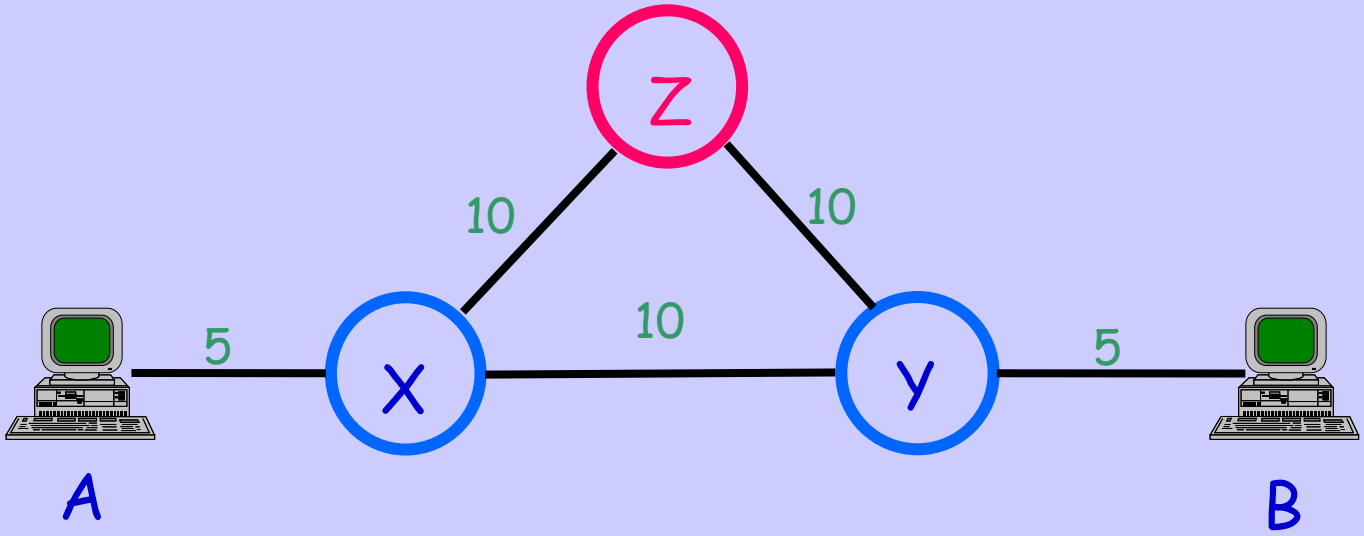



- X does not really know Z's links
- X does not really know Y's links
- They trust each other re costs!




- Validating IP prefix ownership does not help, as Z is not lying about B's owning it
- Using IRR-like peering map does not help, as Z is not lying about who connects to whom

# One Approach




- B cryptographically signs the message to Y Sb(Y->B=5)
- Y signs messages to X and Z encapsulating B's message

  Sy(X->Y=10 Sb(Y->B=5)) and Sy(Z->Y=10 Sb(Y->B=5))
- Z can only sign Sz(X->Z=10 Sy(Z->Y=10 Sb(Y->B=5)))
- Now X can verify paths and costs
- **Forward path signing** solves the 'simple' case

# Costs

- Crypto-CPU-intensive
  - Use caching
  - Use pre or delayed validation
  - Moore's 'Law' is our friend
  - Most announcements are boring
- Expense is highest when routing is changing, just when we need validation the most ☹

# Address Space Ownership

- Luckily, IP space delegation is a natural hierarchy
- IANA signs address allocations to RIRs using IANA certificate
- RIR signs address allocations to ISPs/LIRs using RIR certificate
- ISP/LIR signs allocations to sites using its ISP/LIR certificate

# In the Interim

- RPKI rolling out this year
- From RPKI, generate a pseudo instance of the IRR
- Configure that instance in front of the other IRR instances
- Build your prefix filters
- Improvement with no change in any software, registry, ...!

# Thanks


- Steve Bellovin, whose ideas and work I liberally stole

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- Internet Initiative Japan