# Ignoring the Great Firewall of China

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# Summary

- Content blocking system taxonomy
- The “Great Firewall of China”
- Ignoring the Chinese firewall
- Denial of Service attacks
- Chinese firewall design
- Firewall SYN/ACK confusion
- Conclusions

# Content blocking methods

- Blackhole routeing of IP addresses
  - fine for major sites, but collateral damage possible & have to keep database updated
- DNS poisoning (do not provide IP address)
  - fine for major sites, updating also a problem
- Use web proxy to filter if URL match
  - expensive at country scale, at a time when web proxy caches are going out of fashion

# Keyword filtering

- Chinese firewall shuts connections if it spots specific keywords passing by
  - for example `GET /?falun HTTP/1.0`
- Keywords spotted as they pass by in both directions (dealing with requests & results)
- ***CAUTION:*** parts of Chinese system DO use other blocking methods, and the academic network isn’t currently using the scheme, and other protocols are blocked at the application level!

# Actual mechanism

```
cam(54190)  → china(http)[SYN]
china(http)→ cam(54190) [SYN, ACK] TTL=39
cam(54190)  → china(http)[ACK]
cam(54190)  → china(http) GET /?falun HTTP/1.0<crlf><crlf>
china(http)→ cam(54190) [RST] TTL=47, seq=1, ack=1
china(http)→ cam(54190) [RST] TTL=47, seq=1461, ack=1
china(http)→ cam(54190) [RST] TTL=47, seq=4381, ack=1
china(http)→ cam(54190) HTTP/1.1 200 OK (text/html)<crlf>..
cam(54190)  → china(http)[RST] TTL=64, seq=25, ack zeroed
china(http)→ cam(54190) . . . more of the web page
cam(54190)  → china(http)[RST] TTL=64, seq=25, ack zeroed
china(http)→ cam(54190) [RST] TTL=47, seq=2921, ack=25
```

# Meanwhile…

- The other end of the connection is ***also*** seeing RST packets from the firewall!

# Ignoring the firewall

- **Q:** Since the packets pass through the firewall, what happens if the RST packets are ignored?
- **A:** Web page is transferred just fine (though you get a LOT more RSTs as well)
- NB: necessary to ignore RST packets at ***both*** ends of the connection

# Further connections

- Trying to connect again causes RST packets to be sent immediately (even if no “bad” keywords are transferred)

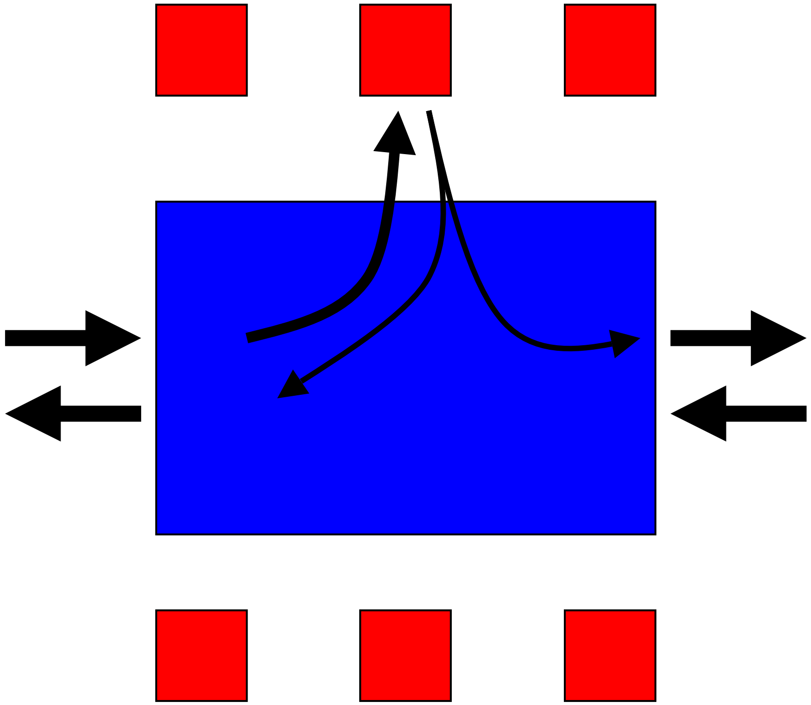
```
cam(54191)  → china(http)[SYN]
china(http)→ cam(54191) [SYN, ACK] TTL=41
cam(54191)  → china(http)[ACK]
china(http)→ cam(54191) [RST] TTL=49, seq=1
```

- Once again dropping RSTs allows transfer

# Denial of service attack

- Send single packets (containing `falun`) to Chinese firewall, forging source & destination
- Connection from source to destination blocked
- Single dialup connection can knock many hundreds of connection over
- NB: only pairs of addresses
- NB: only nearby port numbers ( ? NAT ? )

# Firewall design



**Evidence:**

- RST sometimes precedes & sometimes follows data
- RST values (+0, +n, +3n)
- Read the user manuals from (?)providers
- Shuffling of RSTs when a sudden burst of packets

**NB: NO STATE IN FIREWALL!**

# False SYN/ACKs

```
cam(38104)  → china(http)[SYN]
china(http)→ cam(38104) [SYN, ACK] TTL=105
cam(38104)  → china(http)[ACK]
cam(38104)  → china(http) GET / HTTP/1.0<crlf><crlf>
china(http)→ cam(38104) [RST] TTL=45, seq=1
china(http)→ cam(38104) [RST] TTL=45, seq=1
china(http)→ cam(38104) [SYN, ACK] TTL=37
cam(38104)  → china(http)[RST] TTL=64, seq=1
china(http)→ cam(38104) [RST] TTL=49, seq=1
china(http)→ cam(38104) [RST] TTL=45, seq=3770952438
china(http)→ cam(38104) [RST] TTL=45, seq=1
china(http)→ cam(38104) [RST] TTL=45, seq=1
china(http)→ cam(38104) [RST] TTL=45, seq=1
china(http)→ cam(38104) [RST] TTL=45, seq=1
```

# Fixing “blocking with confusion”

- Fake SYN/ACK does not confuse once real SYN/ACK has been accepted
- SYN/ACK ***currently*** easy to distinguish
- Real fix is for stack to hold alternative views of remote sequence value, avoid using a value until see further evidence
  - lack of state in firewall makes this easy(ish)

# Porn vs Politics

- Firewall capable of logging events
- No different from encryption/proxies – **but** firewall knows if you’re looking at porn or at politics: so may affect your sentence
- Special code is evidence on your machine
- Much better if stack vendors made special tools unnecessary; and there’s technical reasons to wish to drop fake resets

# Conclusions

- A key part of the Great Firewall of China relies on acquiescence by the end-points
  - more MitM (such as SYN/ACK) possible
- Evasion requires (in)action at both ends
- Firewall can still log exceptions
  - but can distinguish porn from politics
- Stack vendors could provide standard fix
- Other systems may be vulnerable (& to DDoS)

# Thanks

Assistance was provided for logging etc by a Chinese citizen [who was unaware of what we proposed to do]. Their site does NOT contain any material that should be censored and no censorable requests were made from the Chinese end of the connection.

# Ignoring the
# Great Firewall of China

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