



An Empirical Analysis of the Commercial VPN Ecosystem

Mohammad Taha Khan, Joe DeBlasio, Geoffrey M. Voelker, Alex C. Snoeren, Chris Kanich and Narseo Vallina-Rodriguez

Commercial VPN Services

- VPNs services are a **primary tool** used by Internet users to:
 - Achieve online anonymity
 - Evade Internet censorship
 - Access geo-filtered content
- VPNs are currently a **15 billion** dollar industry which is expected to grow 
- Vastly preferred over free services like Tor due to **convenience reasons** 



The Problem

- These services make certain **security and privacy claims!**
- Regular users **lack** any **methodical** means to verify them
- There have been numerous instances of **traffic manipulation** and **leakage** in VPN services



Evaluation Methodology

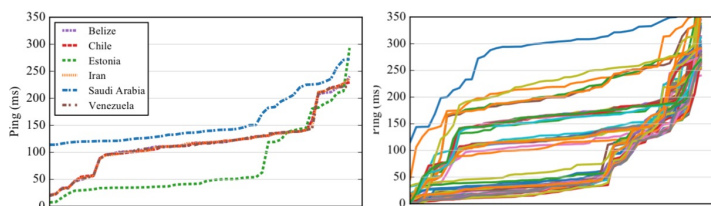
- Shortlisted **203 VPN services** on metrics of **usage** and **Internet popularity**
- Performed **data collection** from **websites** of the shortlisted VPN services
- Developed** a test suite of 3 categories to **evaluate** the VPN services
 - Leakage detection
 - Traffic manipulation/interception
 - Infrastructure/geolocation evaluation

VPN Ecosystem Insights

- VPNs are an **emerging industry**, 90% of services established since 2005
- Affiliate programs** are widely used by VPNs for **promotion** and **rankings**
- Less popular VPN services **do not follow standards** e.g. lack privacy policies
- VPNs tend to **maximize** coverage of **payment methods** and **OS platforms**.

Evaluation Results

- Executed tests on **62 VPN clients** across **1046 vantage locations**
- Out of the 62 VPNs, **12 VPNs** leaked any **IPv6** and **2 VPNs** leaked **DNS** traffic
- We did not observe **traffic manipulation** and **TLS interception** in the tested VPNs
- VPNs **share infrastructure** due to sharing **cloud hosting** or **partnerships**
- Ping tests demonstrate VPNs **falsely** claim the **geolocation** of their vantage points



The Way Forward

- Results will be published online on [vpnselection.guide](#) for public reference
- Future Investigations**
 - Network based VPN exploits
 - VPN policies and data monetization