VIPROY

Sense of Security

# VoIP Wars : Return of the SIP


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# # whois

- Security Consultant @ Sense of Security (Australia)
- 10+ Years Experience in Penetration Testing
- 800+ Penetration Tests, 40+ Focused on NGN/VoIP
  - SIP/NGN/VoIP Systems Penetration Testing
  - Mobile Application Penetration Testing
  - IPTV Penetration Testing
  - Regular Stuff (Network Inf., Web, SOAP, Exploitation...)
- Author of Viproy VoIP Penetration Testing Kit
- Author of Hacking Trust Relationships Between SIP Gateways
- Blackhat Arsenal USA 2013 – Viproy VoIP Pen-Test Kit

- So, that's me

# Viproy in Action

http://www.youtube.com/watch?v=1vDTujNVKGM

# # traceroute

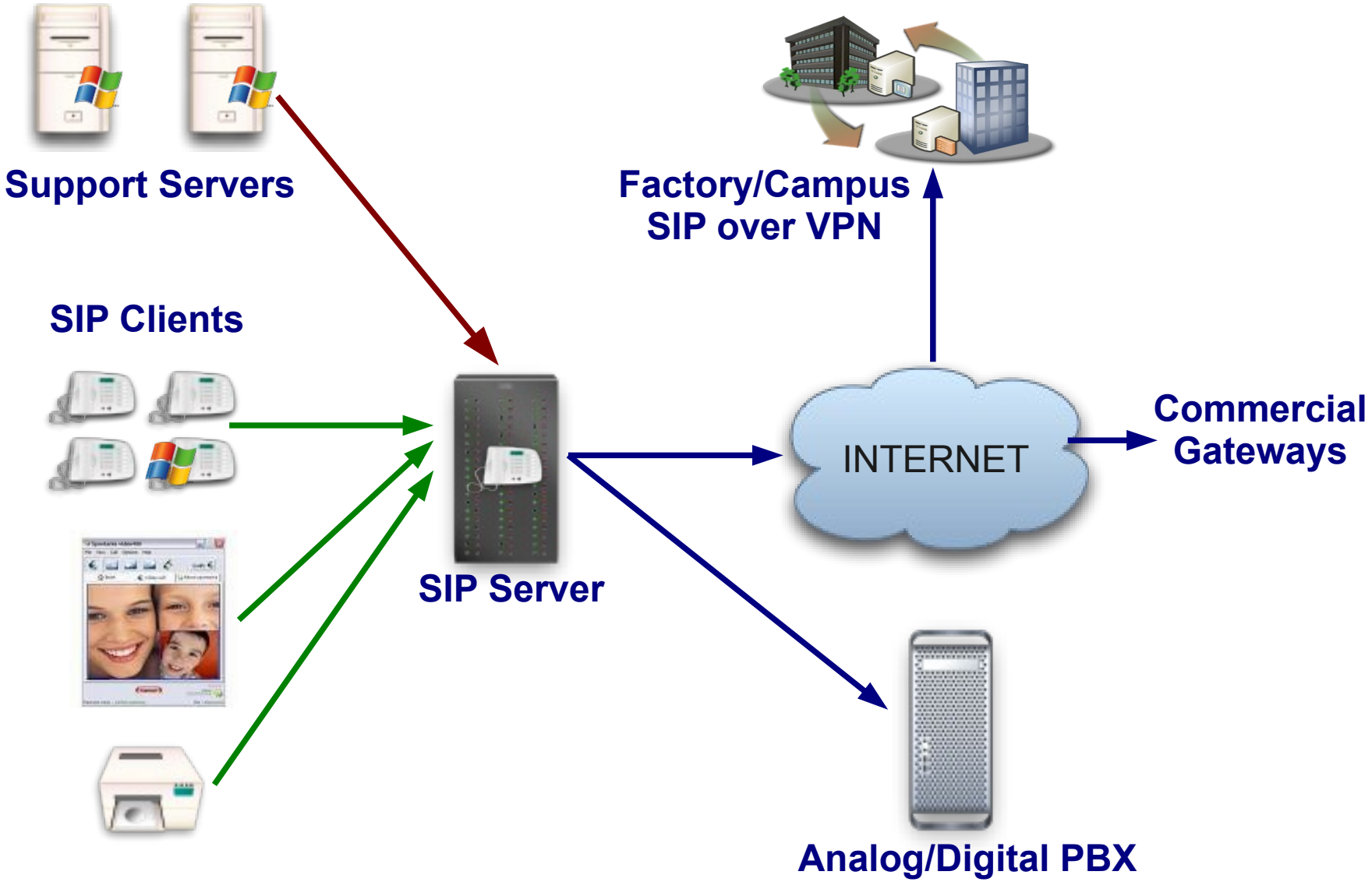
- VoIP Networks are Insecure, but Why?
- Basic Attacks
  - Discovery, Footprinting, Brute Force
  - Initiating a Call, Spoofing, CDR and Billing Bypass
- SIP Proxy Bounce Attack
- Fake Services and MITM
  - Fuzzing Servers and Clients, Collecting Credentials
- (Distributed) Denial of Service
  - Attacking SIP Soft Switches and SIP Clients, SIP Amplification Attack
- Hacking Trust Relationships of SIP Gateways
- Attacking SIP Clients via SIP Trust Relationships
- Fuzzing in Advance

- Out of Scope
  - RTP Services and Network Tests, Management
  - Additional Services
  - XML/JSON Based Soap Services

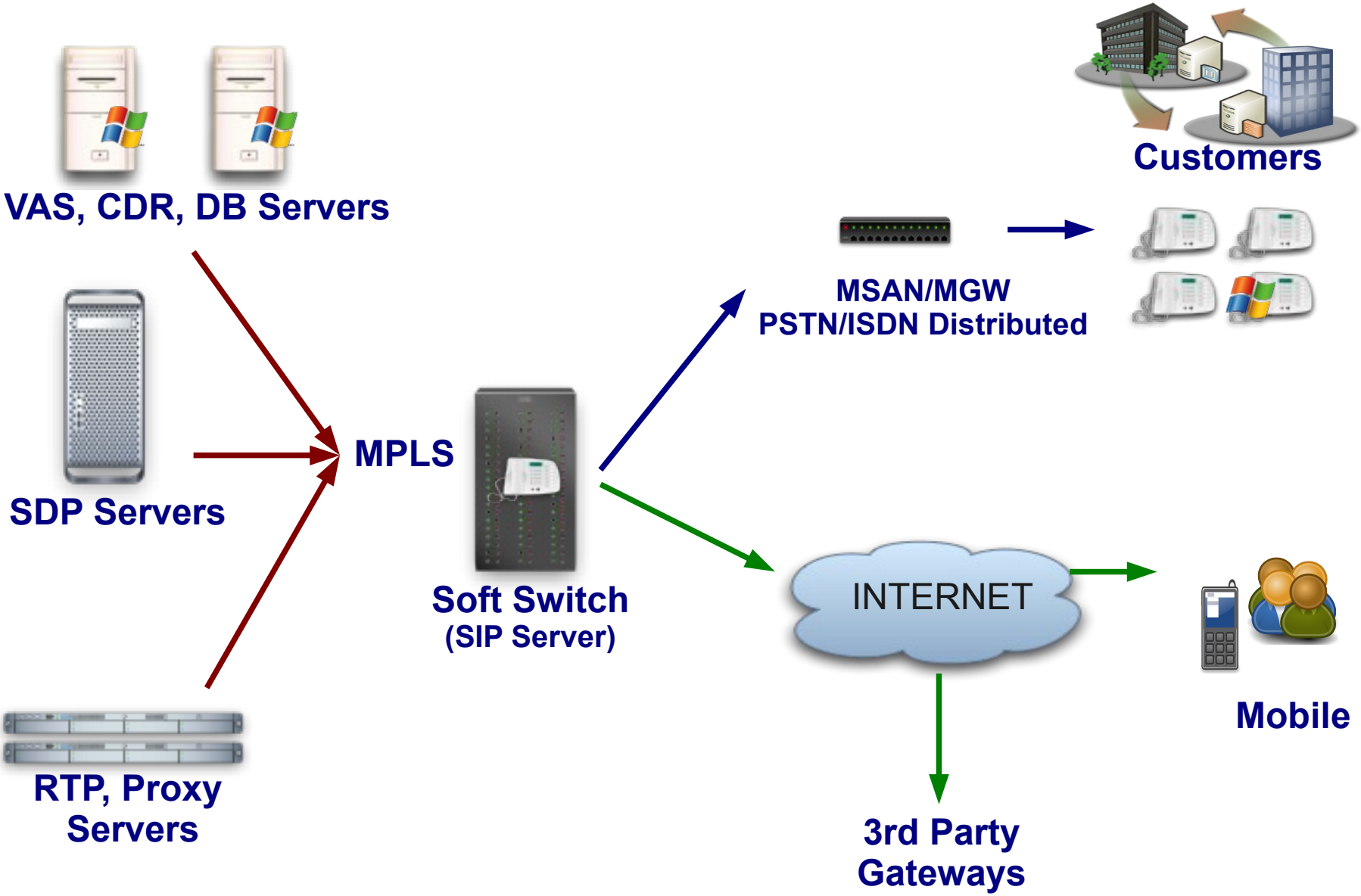
# # info

- SIP – Session Initiation Protocol
  - Only Signalling, not for Call Transporting
  - Extended with Session Discovery Protocol
- NGN – Next Generation Network
  - Forget TDM and PSTN
  - SIP, H.248 / Megaco, RTP, MSAN/MGW
  - Smart Customer Modems & Phones
  - Easy Management
  - Security is NOT a Concern?!
- Next Generation! Because We Said So!

# # SIP Services : Internal IP Telephony



# # SIP Services : Commercial Services



# # Administrators Think... Root Doesn't!

- Their VoIP Network Isolated
  - Open Physical Access, Weak VPN or MPLS
- Abusing VoIP Requires Knowledge
  - With Viproy, That's No Longer The Case!
- Most Attacks are Network Based or Toll Fraud
  - DOS, DDOS, Attacking Mobile Clients, Spying
  - Phishing, Surveliance, Abusing VAS Services
- VoIP Devices are Well-Configured
  - Weak Passwords, Old Software, Vulnerable Protocols

# # Viproy What?

- Viproy is a Vulcan-ish Word that means "Call"
- Viproy VoIP Penetration and Exploitation Kit
  - Testing Modules for Metasploit, MSF License
  - Old Techniques, New Approach
  - SIP Library for New Module Development
  - Custom Header Support, Authentication Support
  - New Stuff for Testing: Trust Analyzer, Bounce Scan, Proxy etc
- Modules
  - Options, Register, Invite, Message
  - Brute Forcers, Enumerator
  - SIP Trust Analyzer, Service Scanner
  - SIP Proxy, Fake Service, DDOS Tester

# # Basic Attacks

- We are looking for...
  - Finding and Identifying SIP Services and Purposes
  - Discovering Available Methods and Features
  - Discovering SIP Software and Vulnerabilities
  - Identifying Valid Target Numbers, Users, Realm
  - Unauthenticated Registration (Trunk, VAS, Gateway)
  - Brute Forcing Valid Accounts and Passwords
  - Invite Without Registration
  - Direct Invite from Special Trunk (IP Based)
  - Invite Spoofing (After or Before Registration, Via Trunk)

- Viproy Pen-Testing Kit Could Automate Discovery

# # Basic Attacks

## Discovery

**OPTIONS / REGISTER / INVITE / SUBSCRIBE**

100 Trying
200 OK
401 Unauthorized
403 Forbidden
404 Not Found
500 Internal Server Error

**Clients**

**Gateways**

**Soft Switch**
**(SIP Server)**

**Collecting Information from Response Headers**

- User-Agent
- Server
- Realm
- Call-ID
- Record-Route
- Warning
- P-Asserted-Identity
- P-Called-Party-ID
- P-Preferred-Identity
- P-Charging-Vector

## Register

**REGISTER / SUBSCRIBE (From, To, Credentials)**

200 OK
401 Unauthorized
403 Forbidden
404 Not Found
500 Internal Server Error

**Clients**

**Gateways**

**Soft Switch**
**(SIP Server)**

**RESPONSE Depends on Informations in REQUEST**

- Type of Request (REGISTER, SUBSCRIBE)
- FROM, TO, Credentials with Realm
- Via

**Actions/Tests Depends on RESPONSE**

- Brute Force (FROM, TO, Credentials)
- Detecting/Enumerating Special TOs, FROMs or Trunks
- Detecting/Enumerating Accounts With Weak or Null Passwords
- ….

# # Basic Attacks

- this isn't the call you're looking for
- We are attacking for...
  - Free Calling, Call Spoofing
  - Free VAS Services, Free International Calling
  - Breaking Call Barriers
  - Spoofing with...
    - Via Field, From Field
    - P-Asserted-Identity, P-Called-Party-ID, P-Preferred-Identity
    - ISDN Calling Party Number, Remote-Party-ID
  - Bypass with...
    - P-Charging-Vector (Spoofing, Manipulating)
    - Re-Invite, Update (Without/With P-Charging-Vector)
- Viproy Pen-Testing Kit Supports Custom Headers

# Invite, CDR and Billing Tests

**INVITE/ACK/RE-INVITE/UPDATE (From, To, Credentials, VIA ...)**

100 Trying
183 Session Progress
180 Ringing
200 OK

401 Unauthorized
403 Forbidden
404 Not Found
500 Internal Server Error

**Clients**

**Gateways**

**Soft Switch**
**(SIP Server)**

**RESPONSE Depends on Informations in INVITE REQUEST**

- FROM, TO, Credentials with Realm, FROM <>, TO <>
- Via, Record-Route
- Direct INVITE from Specific IP:PORT (IP Based Trunks)

**Actions/Tests Depends on RESPONSE**

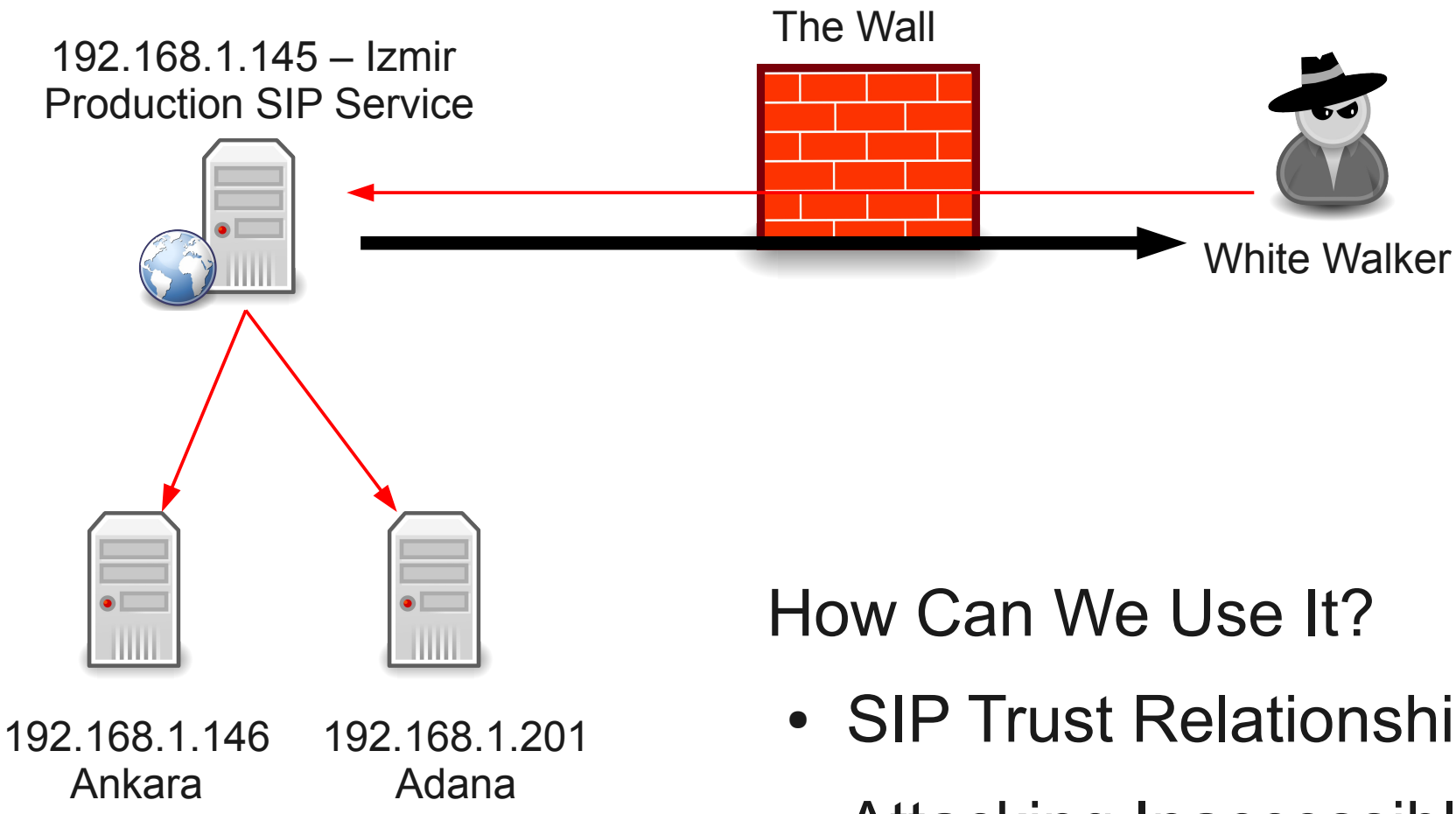
- Brute Force (FROM&TO) for VAS and Gateways
- Testing Call Limits, Unauthenticated Calls, CDR Management
- INVITE Spoofing for Restriction Bypass, Spying, Invoice
- ….

# # SIP Proxy Bounce Attack

- SIP Proxies Redirect Requests to Other SIP Servers
  - We Can Access Them via SIP Proxy then We Can Scan
  - We Can Scan Inaccessible Servers
  - URI Field is Useful for This Scan
- Viproy Pen-Testing Kit Has a UDP Port Scan Module

```
msf auxiliary(vsipportscan-options) > run

[+] 192.168.1.146:5060 is Open
    Server       : FPBX-2.11.0beta2(11.2.1)

[+] 192.168.1.145:5070 is Open
    User-Agent   : sipXecs/4.7.0 sipXecs/registry (Linux)

[+] 192.168.1.201:5061 is Open
    Server       : sipXecs/xxxx.yyyy sipXecs/sipxbridge (Linux)

[+] 192.168.1.203:5060 is Open
    User-Agent   : 3CXPhoneSystem 11.0.28976.849 (28862)
```

# # SIP Proxy Bounce Attack




## How Can We Use It?

- SIP Trust Relationship Attacks
- Attacking Inaccessible Servers
- Attacking SIP Software
  - Software Version, Type

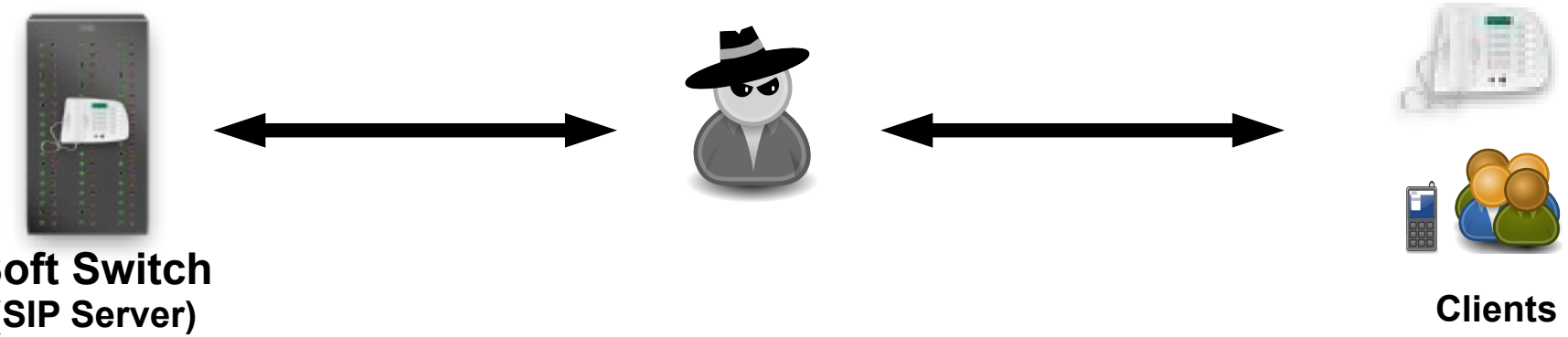
# # Fake Services and MITM

- We Need a Fake Service
  - Adding a Feature to Regular SIP Client
  - Collecting Credentials
  - Redirecting Calls
  - Manipulating CDR or Billing Features
  - Fuzzing Servers and Clients for Vulnerabilities
- Fake Service Should be Semi-Automated
  - Communication Sequence Should be Defined
  - Sending Bogus Request/Result to Client/Server

- Viproy Pen-Testing Kit Has a SIP Proxy and Fake Service
- Fuzzing Support of Fake Service is in Development Stage

# # Fake Services and MITM

## Usage of Proxy & Fake Server Features




- Use ARP Spoof & VLAN Hopping & Manual Config
- Collect Credentials, Hashes, Information
- Change Client's Request to Add a Feature (Spoofing etc)
- Change the SDP Features to Redirect Calls
- Add a Proxy Header to Bypass Billing & CDR
- Manipulate Request at Runtime to find BOF Vulnerabilities

# # DOS – It's Not Service, It's Money


- Locking All Customer Phones and Services for Blackmail
- Denial of Service Vulnerabilities of SIP Services
  - Many Responses for Bogus Requests → DDOS
  - Concurrent Registered User/Call Limits
  - Voice Message Box, CDR, VAS based DOS Attacks
  - Bye And Cancel Tests for Call Drop
  - Locking All Accounts if Account Locking is Active for Multiple Fails
- Multiple Invite (After or Before Registration, Via Trunk)
  - Calling All Numbers at Same Time
  - Overloading SIP Server's Call Limits
  - Calling Expensive Gateways,Targets or VAS From Customers

- Viproy Pen-Testing Kit Has a few DOS Features

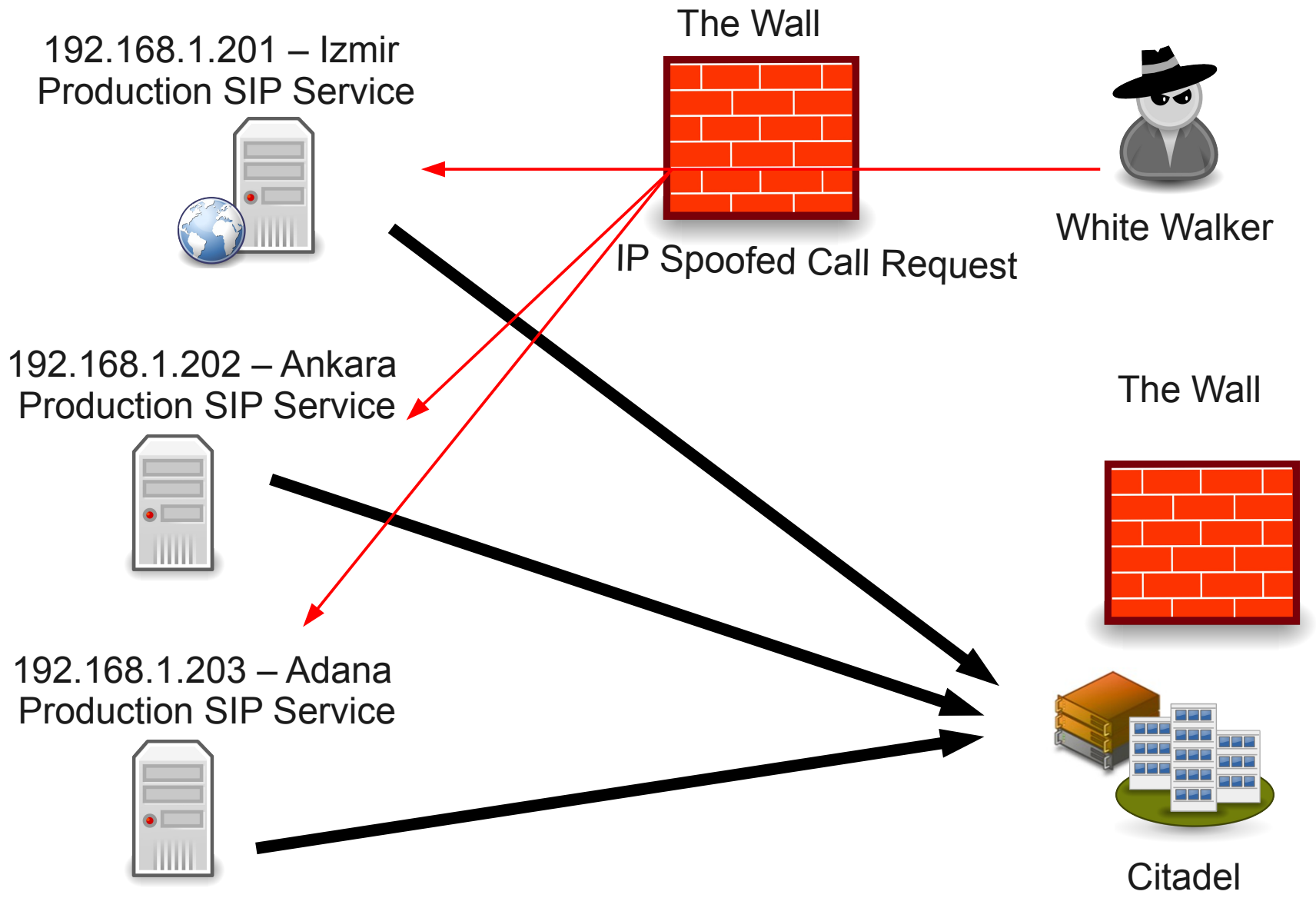
# # DDOS – All Your SIP Gateways Belong to Us !

- SIP Amplification Attack
  - + SIP Servers Send Errors Many Times (10+)
  - + We Can Send IP Spoofed Packets
  - + SIP Servers Send Responses to Victim
  - => 1 packet for 10+ Packets, ICMP Errors (Bonus)

| No. | Time | Source | Destination | Protocol | Length | Info |
|---|---|---|---|---|---|---|
| 2 | 8.315312000 | 192.168.1.100 | 192.168.1.145 | SIP/SDP | 938 | Request: INVITE sip:701@viproy.com, with s |
| 3 | 8.324730000 | 192.168.1.145 | 192.168.1.100 | SIP | 358 | Status: 100 Trying |
| 4 | 8.325086000 | 192.168.1.145 | 192.168.1.100 | SIP | 587 | Status: 407 Proxy Authentication Required |
| 5 | 8.430072000 | 192.168.1.145 | 192.168.1.100 | SIP | 587 | Status: 407 Proxy Authentication Required |
| 6 | 8.638928000 | 192.168.1.145 | 192.168.1.100 | SIP | 587 | Status: 407 Proxy Authentication Required |
| 7 | 9.040660000 | 192.168.1.145 | 192.168.1.100 | SIP | 587 | Status: 407 Proxy Authentication Required |

- Viproy Pen-Testing Kit Has a PoC DDOS Module
- Can we use SIP Server's Trust ? -wait for it-

# # DDOS – All Your SIP Gateways Belong to Us!



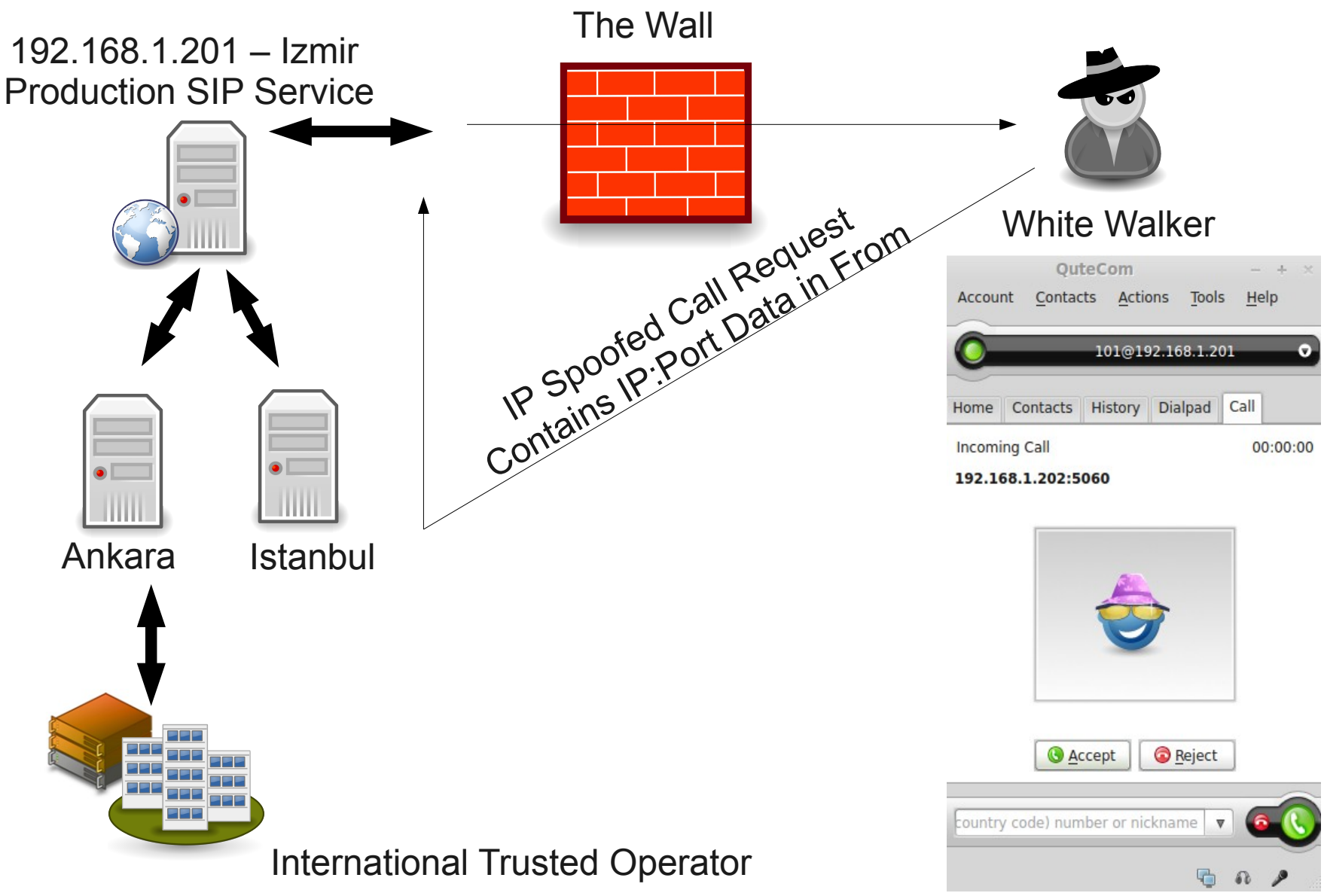
# # Hacking SIP Trust Relationships

- NGN SIP Services Trust Each Other
  - Authentication and TCP are Slow, They Need Speed
  - IP and Port Based Trust are Most Effective Way
- What We Need
  - Target Number to Call (Cell Phone if Service is Public)
  - Tech Magazine, Web Site Information, News

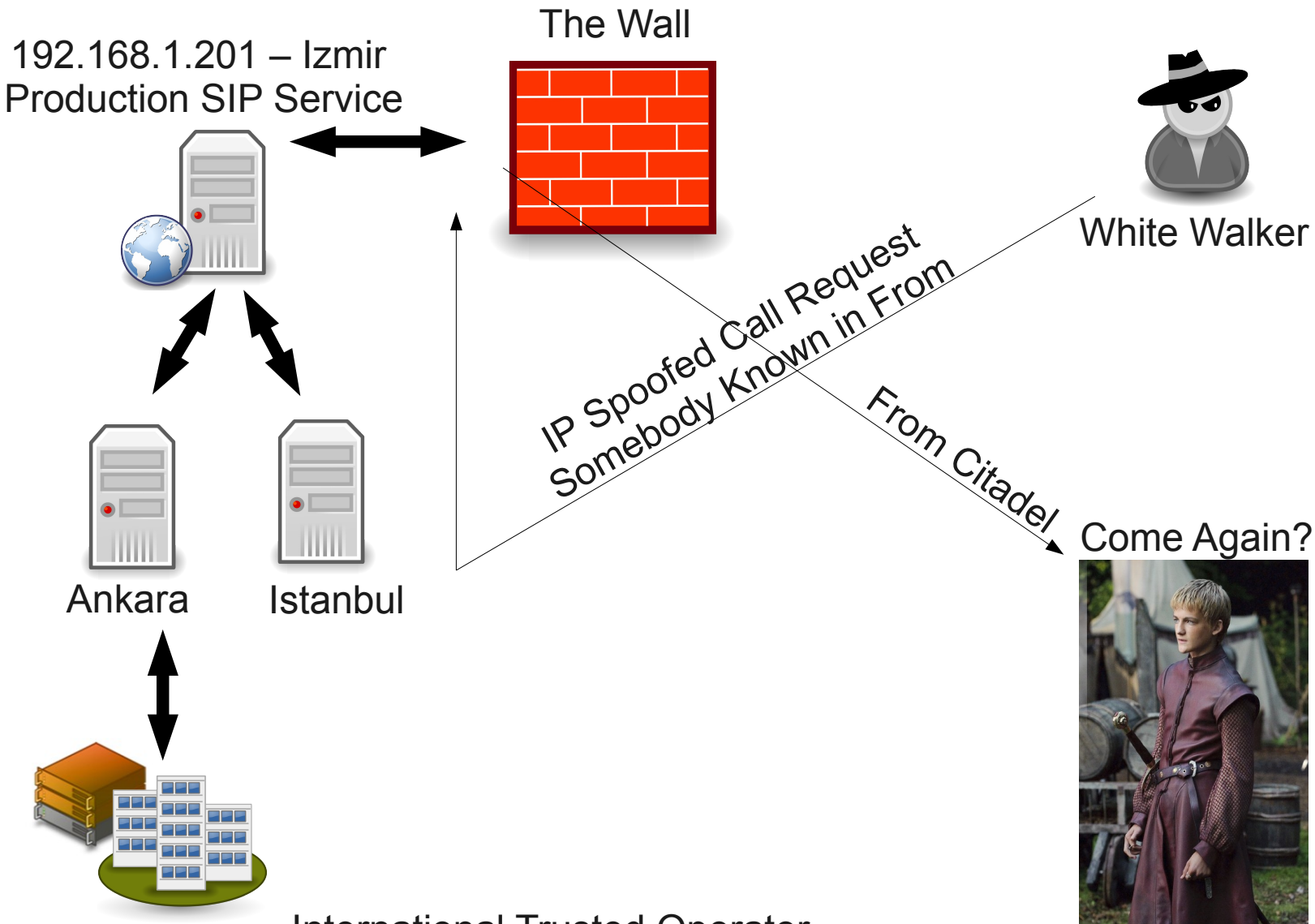
- Baby Steps
  - Finding Trusted SIP Networks (Mostly B Class)
  - Sending IP Spoofed Requests from Each IP:Port
  - Each Call Should Contain IP:Port in "From" Section
  - If We Have a Call, We Have The Trusted SIP Gateway IP and Port
  - Brace Yourselves The Call is Coming

# # Hacking SIP Trust Relationships

## Slow Motion



## Brace Yourselves, The Call is Coming




- Billing ?
- CDR ?
- Log ?

# # Hacking SIP Trust Relationships – Business Impact

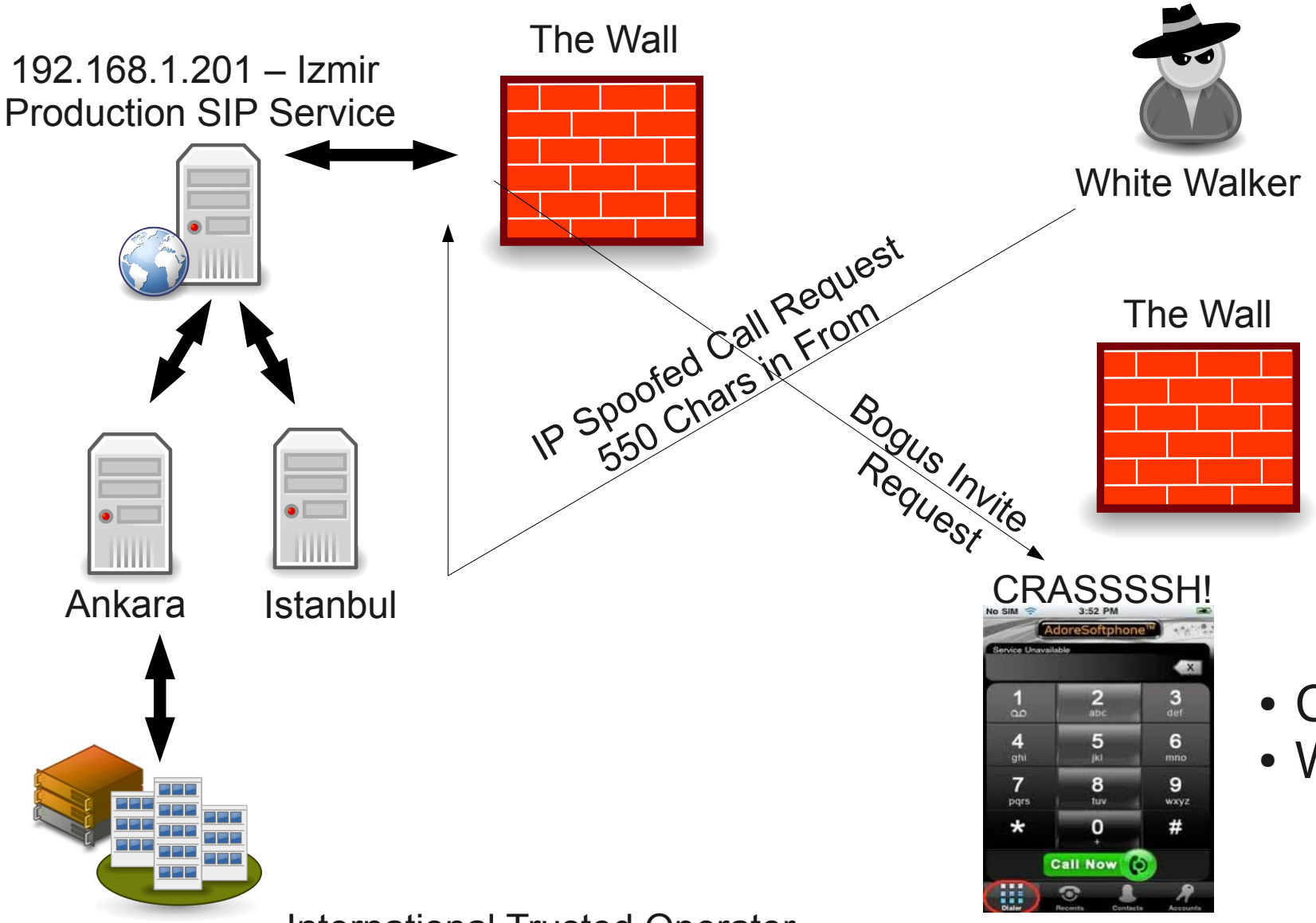
- Denial of Service
  - Short Message Service and Billing
  - Calling All Numbers at Same Time
  - Overloading SIP Server's Call Limits
  - Overloading VAS Service or International Limits
  - Overloading CDR Records with Spoofed Calls
- Attacking a Server Software
  - Crashing/Exploiting Inaccesible Features
  - Call Redirection (working on it, not yet :/)
- Attacking a Client?
  - Next Slide!

# # Attacking a Client via SIP Trust Relationships

- SIP Server Redirects a few Fields to Client
  - FROM, FROM NAME, Contact
  - Other Fields Depend on Server (SDP, MIME etc)
- Clients Have Buffer Overflow in FROM?
  - Send 2000 Chars to Test it !
  - Crash it or Execute your Command if Available
- Clients Trust SIP Servers and Trust is UDP Based
  - This module can be used for Trust Between Client and Server
- Viproy Pen-Testing Kit SIP Trust Module
  - Simple Fuzz Support (FROM=FUZZ 2000)
  - You Can Modify it for Further Attacks

# # Attacking a Client via SIP Trust Relationships

## Brace Yourselves 550 Chars are Coming



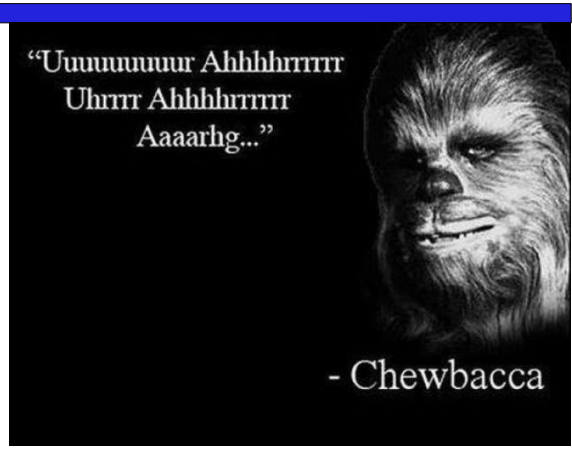

- Command?
- Why Not!

# # Fuzz Me Maybe

- Fuzzing as a SIP Client | SIP Server | Proxy | MITM
- SIP Server Software
- SIP Clients
  - Hardware Devices, IP Phones, Video Conference Systems
  - Desktop Application or Web Based Software
  - Mobile Software
- Special SIP Devices/Software
  - SIP Firewalls, ACL Devices, Proxies
  - Connected SIP Trunks, 3rd Party Gateways
  - MSAN/MGW
  - Logging Software (Indirect)
  - Special Products: Cisco, Alcatel, Avaya, Huawei, ZTE...

# # Old School Fuzzing

- Request Fuzzing
  - SDP Features
  - MIME Type Fuzzing
- Response Fuzzing
  - Authentication, Bogus Messages, Redirection
- Static vs Stateful
- How about Smart Fuzzing
  - Missing State Features (ACK,PHRACK,RE-INVITE,UPDATE)
  - Fuzzing After Authentication (Double Account, Self-Call)
  - Response Fuzzing (Before or After Authentication)
  - Missing SIP Features (IP Spoofing for SIP Trunks, Proxy Headers)
  - Numeric Fuzzing for Services is NOT Memory Corruption
  - Dial Plan Fuzzing, VAS Fuzzing



# # How Viproy Pen-Testing Kit Helps Fuzzing Tests

- Skeleton for Feature Fuzzing, NOT Only SIP Protocol
- Multiple SIP Service Initiation
  - Call Fuzzing in Many States, Response Fuzzing
- Integration With Other Metasploit Features
  - Fuzzers, Encoding Support, Auxiliaries, Immortality etc.
- Custom Header Support
  - Future Compliance, Vendor Specific Extensions, VAS
- Raw Data Send Support (Useful with External Static Tools)
- Authentication Support
  - Authentication Fuzzing, Custom Fuzzing with Authentication
- Less Code, Custom Fuzzing, State Checks
- Some Features (Fuzz Library, SDP) are Coming Soon

# # Fuzzing SIP Services

## Request Based

**OPTIONS/REGISTER/SUBSCRIBE/INVITE/ACK/RE-INVITE/UPDATE....**

100 Trying
183 Session Progress
180 Ringing
200 OK

401 Unauthorized
403 Forbidden
404 Not Found
500 Internal Server Error

**Clients**

**Gateways**

**Fuzzing Targets, REQUEST Fields**

- Request Type, Protocol, Description
- Via, Branch, Call-ID, From, To, Cseq, Contact, Record-Route
- Proxy Headers, P-*-* (P-Asserted-Identity, P-Charging-Vector...)
- Authentication in Various Requests (User, Pass, Realm, Nonce)
- Content-Type, Content-Lenth
  - SDP Information Fields
  - ISUP Fields

**Soft Switch**
**(SIP Server)**

# # Fuzzing SIP Services

## Response Based

OPTIONS

MALICOUS RESPONSE

Clients

INVITE Myself / INVITE I'm Proxy

INVITE/ACK

MALICOUS RESPONSE

Gateways

**Soft Switch**
**(SIP Server)**

**Potential RESPONSE Types for Fuzzing**

| | |
|---|---|
| 100 Trying | 401 Unauthorized |
| 183 Session Progress | 403 Forbidden |
| 180 Ringing | 404 Not Found |
| 200 OK | 500 Internal Server Error |

# SIP Bounce Attack, Hacking SIP Trust, Attacking Mobile Apps

http://www.youtube.com/watch?v=bSg3tAkh5gA

# References

- Viproy VoIP Penetration and Exploitation Kit

  Author : http://viproy.com/fozavci

  Homepage : http://viproy.com/voipkit

  Github : http://www.github.com/fozavci/viproy-voipkit

- Attacking SIP Servers Using Viproy VoIP Kit (50 mins)

  https://www.youtube.com/watch?v=AbXh_L0-Y5A

- Hacking Trust Relationships Between SIP Gateways (PDF)

  http://viproy.com/files/siptrust.pdf

- VoIP Pen-Test Environment – VulnVoIP

  http://www.rebootuser.com/?cat=371

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Q ?

# Thanks