Policy Scripts to Detect Network Intrusions

Sanmeet Kaur, Maninder Singh

Abstract — Security is a big issue for all networks in today's enterprise environment. Hackers and intruders have made many successful attempts to bring down high-profile company networks and web services. Many methods have been developed to secure the network infrastructure and communication over the Internet, among them the use of firewalls, encryption, and virtual private networks. Intrusion detection is a relatively new addition to such techniques. Intrusion detection methods started appearing in the last few years. In this paper Intrusion Detection System called Bro is discussed. The major emphasis is on the design and development of the policy scripts to detect various network intrusions. These scripts are written using the scripting language of Bro, which supports various special data types to support network level activities. It also has signature-matching features to make threat signatures to match against various attacks and detect them later.

Index Terms- Intrusion, Intrusion Detection, Bro, Policy Scripts, HTTP, NIDS

1 INTRODUCTION

oday's network is very complex and the whole world is focusing on ease of use and functionality. This is making us more insecure. For hackers, these well-traveled paths make networks more vulnerable than ever before and with relatively little expertise hackers have significantly impacted the networks of leading brands or government agencies. Cyber crime is also no longer the prerogative of lone hackers or random attackers. Today disgruntled employees, unethical corporations, even terrorist organizations all look to the Internet as a portal to gather sensitive data and instigate economic and political disruption. With networks more vulnerable and hackers equipped to cause havoc, it's no surprise that network attacks are on the rise. So there is a huge need of detecting the threats and intrusion. For this purpose number of solutions is there, IDS is one of them. BRO is the most effective NIDS which can be used to detect these threats. However, no IDS can detect all the intrusions. So we need a combination of various techniques.

There are a number of well-known techniques for detecting network intrusions. Some of these are:

- Signatures or pattern matching
- Content analysis and parsing
- Statistical analysis
- Anomaly detection
- Bayesian methods

Each of these techniques has their relative pros and cons. Some are easy to use and quick to implement, but lead to a high number of false-positives. Others are hard to understand and are complex, but at the same time may be very effective in detecting desired flows.

The objective is to analyze these techniques and develop patterns (not in the regular expression sense but in the software patterns one) that direct us in writing effective intrusion detection modules for a variety of network traffic classes. The types of traffic which are of interest are:

- Web traffic, usually sent over HTTP [4] protocol.
- E-mail traffic, using one of the well known e-mail protocols like SMTP, POP3 and IMAP [5].
- Webmail traffic. This is placed in a separate category because this combines properties of both web and e-mail traffic.

In this paper, these techniques are implemented by developing Policy Scripts using Bro IDS. Both Bro analyzers and scripts are used to achieve the goal.

2. IMPLEMENTATION DETAILS AND EXPERI-MENTAL RESULTS

In this part the policy scripts of Bro to detect various network intrusions are discussed. Various kind of traffic is captured by using Bro and analyzed offline. Some of the scripts are experimented on the live traffic also.

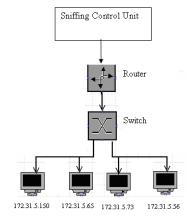


Figure 1: Implementation setup Diagram

The following steps are performed while implementing Policy Scripts:

1. First the traffic is captured by using wireshark [12] (earlier Ethreal) or by using libpcap feature inbuilt in Bro. This will be captured in a binary file with extension *.tcpdump* or *.out*,

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for example trace.out.

2. Second, the policy script is written using Bro Scripting language. This file is having an extension *.bro* like *s_http.bro* and is placed in */usr/local/bro/policy* or */user/local/bro/site* directory.

3. Third, this script is run against the captured trace file to detect the required intrusion by using the following syntax:

bro -r tracefile scriptfile

4. If the traffic is live instead of captured one then also bro can analyze it by using -i used for interface instead of -r for read mode like:

bro -i scriptfile

The following are various tasks and milestones completed and their results. One of the traffic files were taken from the Bro Workshop 2007 [2]. This was modified using wireshark and later used in some of the experiments. The name of this traffic file is mail.trace.

3.1 Reporting all the HTTP URLs in the traffic

In this milestone all the URLs which are visited by a particular machine are reported by the Bro[1]. A script has been written to report all HTTP URLs in the traffic. The trace.out generated by the system is shown below.

Trace File: trace.out

This is the captured traffic file against which s_ httpheader.bro policy script will run.

The following is the command to see the results:

bro -r trace.out s_http-header.bro

Result:

1					root@sanmeet-	lesktop: /usr/local/b	ro/policy	
<u>F</u> ile	<u>E</u> dit <u>V</u> ie	w <u>T</u> erminal	Ta <u>b</u> s	<u>H</u> elp				
oot(@sanmeet	desktop:/	usr/lo	cal/bro	policy# bro -r tra	e.out s_http-heade	r.bro	
RL:	mail.g	ogle.com/	'mail/o	hannel/	est?at=xn3j32dzg05	gwu734b4efcj29tg5x	&VER=6⁢=550&MODE=in:	it&zx=q4fhniva0d39&t=1
RL:	mail.g	ogle.com/	mail/i	Lmages/c	eardot.gif?zx=okf1	sbwe2zf		
RL:	mail.g	ogle.com/	'mail/d	hannel/	est?at=xn3j32dzg05	gwu734b4efcj29tg5xi	&VER=6&1t=3563&TYPE=xr	nlhttp&zx=lv0u9n98yp2y&t
RL:	www.br	-ids.org/						
RL:	www.br	-ids.org/	style.	CSS				
RL:	www.br	-ids.org/	images	s/NSF.pn				
RL:	www.br	-ids.org/	images	s/bro.pn				
RL:	www.br	-ids.org/	images	s/ICSI.p	g			
RL:	www.br	-ids.org/	images	s/lbl-lo	o.png			
RL:	www.br	-ids.org/	favic	on.ico				
RL:	www.yo	utube.com/						
RL:	s.ytim	.com/yt/c	ss/bas	se_all-v	l35110.css			
RL:	s.ytim	.com/yt/f	avicor	n-vfl112	.ico			
RL:					h_bidi-vfl35825.js			
RL:	s.ytim	.com/yt/i	.mg/pi)	cel-vfl7	.gif			
RL:	s.ytim	.com/yt/i	.mg/mas	ster-vfl	4196.gif			
RL:	i.ytim	.com/vi/w	AQTL-8	BszLI/de	ault.jpg			
RL:	i.ytim	.com/vi/G	Y1BiZ/	AV6XA/de	ault.jpg			
RL:	www.yo	itube.com/	active	_sharin	.swf			
RL:	s3.yti	ng.com/v1/	rspY0)	cnaTk/d	fault.jpg			
RL:	s2.yti	ig.com/vi/	Mz8Cyl	Jxj60U∕d	fault.jpg			
RL:	s3.yti	ng.com/vi/	2WmFd\	/ASQ1s/d	fault.jpg			
RL:	s2.yti	ig.com/vi/	ePyEer	JApbs/d	fault.jpg			
RL:	s1.yti	ig.com/v1/	PpPoq	dgtH4/d	fault.jpg			
RL:	s4.yti	ig.com/vi/	kTCuj!	lbodMU/d	fault.jpg			
RL:	s1.yti	ig.com/vi/	BLIdE)	(BlejE/d	fault.jpg			
RL:	s4.yti	ng.com/vi/	733HT1	tx6C48/d	fault.jpg			
RL:	s.ytim	.com/yt/i	.mg/pic	_home_m	bile_30x37-vfl2249	.gif		
RL:	www.yo	tube.com/	buzz v	/ideos				
RL:	i.ytim	.com/vi/k	IOLPI	omM3s/de	ault.jpg			
RL:	i.ytim	.com/vi/S	KvvKqr	nHJvE/de	ault.jpg			
RL:	s.ytim	.com/yt/i	.mg/pio	_home_w	rp_30x37-vfl32672.	if		
RL:	s.ytim	.com/yt/i	.mg/pic	home r	s_30x37-vfl32672.g	1		
RL:	n4061a	.doublecl	ick.ne	et/adj/c	m.ythome/_default;	z=399x299;tile=1;d	copt=ist;ord=965419902	20441660?
RL:	s1.yti	ng.com/vi/	dSCLB	59KeX4/d	fault.jpg			
RL:	s4.yti	.com/vi/	SKvvK	nHJvE/d	fault.jpg			
RL:	s.ytim	.com/yt/i	.mg/pic	yellow	top 300x1000-vfl34	78.qif		

Figure 2: Reporting HTTP URLs visited by a host.

3.2 Reporting all the connections which are accessing www.youtube.com using HTTP

In this milestone all the connections which are accessing www.youtube.com using HTTP are reported by Bro. A script has been written and trace.out generated by the system is shown below. Trace file: trace.out

The above is the captured traffic file against which s_h httpheader1.bro policy script will run. The following is the command to see the results:

bro -r trace.out s_http-header1.bro

Result:



Figure 3: Reporting all the connections which are accessing www.youtube.com using HTTP

3.3 Reporting all the connections that includes emails directed to a particular email server

In this milestone all the connections that have a particular text like "@beta.banana.edu" in them are reported by Bro.

The intention is to find out all emails that might be addressed to this account. SMTP [13] protocol support is required in this task. The trace.out generated by the system is shown below.

Trace File: mail.trace [Bro workshop 2007]

The above is the captured mail traffic file against which s_ smtp.bro policy script will be experimented . The following is the command to see the results:

bro -r mail.trace s_smtp.br

Result:

<pre>pro: problem with trace file mail.trce - mail.trce: No such file or directory poot@sanmeet-desktop:/usr/local/bro/policy# bro -r mail.trace s_smtp.bro prig_h=192.168.114.50, orig_p=4692/tcp, resp_h=135.8.60.182, resp_p=25/tcp] prig_h=192.168.114.207, orig_p=10511/tcp, resp_h=135.8.60.182, resp_p=25/tcp] prig_h=192.168.112.194, orig_p=10969/tcp, resp_h=135.8.60.182, resp_p=25/tcp]</pre>	File Edit View Terminal Tabs Help bro: problem with trace file mail.trce - mail.trce: No such file or directory root@sanmeet-desktop:/usr/local/bro/policy# bro -r mail.trace s_smtp.bro orig_h=192.168.114.50, orig_p=4692/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.114.207, orig_p=10511/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.112.194, orig_p=10969/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.113.105, orig_p=33003/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.113.204, orig_p=1356/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.113.204, orig_p=1366/tcp, resp_h=135.8.60.182, resp_p=25/tcp]
<pre>root@sanmeet-desktop:/usr/local/bro/policy# bro -r mail.trace s_smtp.bro orig_h=192.168.114.50, orig_p=4692/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.114.207, orig_p=10511/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.112.194, orig_p=10969/tcp, resp_h=135.8.60.182, resp_p=25/tcp]</pre>	<pre>root@sanmeet-desktop:/usr/local/bro/policy# bro -r mail.trace s_smtp.bro orig_h=192.168.114.50, orig_p=4692/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.114.207, orig_p=10511/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.112.194, orig_p=10969/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.112.50, orig_p=33003/tcp, resp_h=135.8.60.182, resp_p=25/tcp] orig_h=192.168.113.105, orig_p=13356/tcp, resp_h=135.8.60.182, resp_p=25/tcp]</pre>
JIII HEIJZ.100.112.30, UIIU PEJJ00J/(CP, TESP HEIJJ.0.00.102, TESP PEZJ/(CP)	orig_h=192.168.113.105, orig_p=13356/tcp, resp_h=135.8.60.182, resp_p=25/tcp]

Figure 4: Reporting all the connections that have text "@beta.banana.edu"

3.4 Reporting all the connections that have a particular text like "@beta.banana.edu" or "@finch.eyrie.af.mil" in them

In this milestone all the connections that have a particular text like "@beta.banana.edu" or "@finch.eyrie.af.mil" in them are reported by Bro. The intention is to find out all emails that might be addressed to any of these accounts. SMTP protocol support is required in this task. The trace.out generated by the system is shown below. **Result:** Trace File: mail.trace [Bro workshop 2007]

The above is the captured mail traffic file against which s_ smtp.bro policy script will be experimented. The following is the command to see the results:

bro -r mail.trace s_smtp1.bro

				10.0	koosen maak d	a alista a su du	or the coll three to officer.
				100	r@sammeer-d	esktop: /u	sr/local/bro/policy
<u>F</u> ile <u>E</u> o	dit <u>∨</u> iew	<u>T</u> erminal	Ta <u>b</u> s	<u>H</u> elp			
oot@sa	anmeet-d	esktop:/u	ısr/lo	cal/bro/policy#	bro -r mail.	.trace s_s	mtpl.bro
ONNECT	TION 15:	194.7.24	8.153	:8254/tcp -> 19	2.168.114.168	8:25/tcp	<pre>Io:<rexn@tinch.eyrie.at.mil></rexn@tinch.eyrie.at.mil></pre>
ONNECT	TION IS:	192.168.	114.5	0:4692/tcp -> 1	35.8.60.182:2	25/tcp T	o: <gwendolv@beta.banana.edu></gwendolv@beta.banana.edu>
ONNECT	TION IS:	192.168.	114.2	07:10511/tcp ->	135.8.60.182	2:25/tcp	To: <margeryj@beta.banana.edu></margeryj@beta.banana.edu>
ONNECT	TION IS:	192.168.	112.1	94:10969/tcp ->	135.8.60.182	2:25/tcp	To: <giovanng@beta.banana.edu></giovanng@beta.banana.edu>
ONNECT	TION IS:	192.168.	112.5	0:33003/tcp ->	135.8.60.182	:25/tcp	To: <giovanng@beta.banana.edu></giovanng@beta.banana.edu>
ONNECT	TION IS:	192.168.	113.1	05:13356/tcp ->	135.8.60.182	2:25/tcp	To: <catrinr@beta.banana.edu></catrinr@beta.banana.edu>
ONNECT	TION IS:	197.218.	177.6	9:8310/tcp -> 1	92.168.114.10	58:25/tcp	To: <rachaelc@finch.eyrie.af.mil></rachaelc@finch.eyrie.af.mil>
ONNECT	TION IS:	192.168.	113.2	04:14869/tcp ->	135.8.60.182	2:25/tcp	To: <corall@beta.banana.edu></corall@beta.banana.edu>
ONNECT	TION IS:	194.7.24	8.153	:8818/tcp -> 19	2.168.114.168	3:25/tcp	To: <toddm@finch.eyrie.af.mil></toddm@finch.eyrie.af.mil>
ONNECT	TION IS:	194.7.24	8.153	:8818/tcp -> 19	2.168.114.168	3:25/tcp	To: <rondat@finch.eyrie.af.mil></rondat@finch.eyrie.af.mil>
ONNECT	FION IS:	194.27.2	51.21	:8925/tcp -> 192	2.168.114.168	8:25/tcp	To: <triav@finch.eyrie.af.mil></triav@finch.eyrie.af.mil>
ONNECT	FION IS:	192.168.	114.2	97:17605/tcp ->	135.8.60.182	2:25/tcp	To: <faithl@beta.banana.edu></faithl@beta.banana.edu>
ONNECT	FION IS:	135.13.2	16.19	1:10023/tcp -> 1	192.168.114.1	68:25/tcp	To: <rexn@finch.eyrie.af.mil></rexn@finch.eyrie.af.mil>
ONNECT	FION IS:	194.7.24	8.153	:10655/tcp -> 19	02.168.114.16	68:25/tcp	To: <kiaraa@finch.eyrie.af.mil></kiaraa@finch.eyrie.af.mil>
ONNECT	FION IS:	195.115.	218.1	98:10663/tcp ->	192.168.114.	168:25/tc	p To: <kiaraa@finch.eyrie.af.mil></kiaraa@finch.eyrie.af.mil>
ONNECT	FION IS:	195.115.	218.1	98:10802/tcp ->	192.168.114.	168:25/tc	p To: <barneyk@finch.eyrie.af.mil< p=""></barneyk@finch.eyrie.af.mil<>
ONNECT	FION IS:	192.168.	112.1	94:12488/tcp ->	135.8.60.182	2:25/tcp	To: <mairie@beta.banana.edu></mairie@beta.banana.edu>
oot@sa	anmeet-de	esktop:/u	sr/lo	cal/bro/policy#			

Figure 5: Reporting connections that have "@beta.banana.edu" or "@finch.eyrie.af.mil" in them

3.5 Detect if somebody is trying to access a particular website like "pic.geocities.com" using HTTP, log all further connection attempts by that host

In this milestone we have captured HTTP and other network traffic from multiple clients. Once it is detected that somebody is trying to access a particular website like "pic.geocities.com" using HTTP, all further connection attempts by that host are logged. The trace.out generated by the system is shown below.

Trace File : mail.trace

The above is the captured traffic file against which s_{-} excercise5.bro policy script will be experimented. The following is the command to see the results:

bro -r mail.trace s_excercise5.bro

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Result:	

							root@sar	mee	t-deskte	op:/	usr/lo	cal/br	o/polii	cy
Eile	<u>E</u> dit	: <u>V</u> iew	Terminal	Ta <u>b</u> s	Help									
00	t@san	meet-o	desktop:/	usr/lo	cal/br	o/poli	cy# bro	r ma	ill.trac	e s	exerc	1se5.	bro	more
			01:6315/t											
			91:6316/t											
			01:6380/t											
			91:6382/t											
			01:6419/t											
			01:6420/t											
			01:6421/t											
			01:6422/t 01:6484/t											
			91:6485/t											
			01:6486/t											
			01:6549/t											
			01:6613/t											
			01:6675/t											
92	. 168.	116.20	91:6677/t	cp ->	209.67	.29.11	80/tcp							
			4:18636/1											
			4:18638/1											
			4:18675/1											
			4:18679/1											
			4:18680/1											
			4:18683/1											
			4:18722/1											
			4:18784/1											
			4:18785/1											
			4:18786/1											
			4:18849/1											
			4:18912/1											
			4:18913/1											
92.	168.	116.19	4:18982/1		209.1	.224.1	9080/tcp							
92.	168.	116.19	4:18983/1	cp ->	209.1	.224.1	9080/tcp							
			4:18985/1											
			4:19712/1											
			4:19717/1											
			4:19768/1											
92.	168.	116.19	4:19774/1	cp ->	207.2	5.71.1	4180/tcp							

Figure 6: Logging all connections that attempts to access pic.geocities.com

3.6: Logging connections those attempt to access pic.geocities.com in a file instead of stdout

In this task we have captured HTTP and other network traffic from multiple clients. Once it is detected that somebody is trying to access pic.geocities.com using HTTP, all further connection attempts by that host are logged and written to a file, instead of stdout. The trace.out generated by the system is shown below.

Trace File : mail.trace

Result:

					root@sanmeet-desktop: /usr/local/bro/policy
Eile	<u>E</u> dit	⊻iew	Terminal	Ta <u>b</u> s	Help
					209.67.29.1180/tcp
					134.205.165.12080/tcp
					209.1.224.1580/tcp
					209.1.224.19080/tcp
					209.1.224.19080/tcp
					209.1.224.19080/tcp
					209.1.224.19080/tcp 209.1.224.19080/tcp
					209.1.224.19080/tcp 209.1.224.19080/tcp
					209.1.224.19080/tcp
					209.1.224.19080/tcp 209.1.224.19080/tcp
					209.1.224.19080/tcp
					209.1.224.1580/tcp
					> 209.1.224.19080/tcp
					- 209.1.224.19080/tcp
0.2	168.1	16.19	4:18675/	tcn ->	> 209.1.224.19080/tcp

Figure 7: Logging connections those attempt to access pic.geocities.com in a file instead of stdout

3.7 Detecting all GTalk traffic in a captured file using a script

In this task Gtalk traffic is detected out of the captured traffic. There is no event for this. Here signatures are used. We have detected this with a captured traffic in some trace File.

Trace File: gtalk1.trace

The above is the captured traffic file against which $s_{gtalkcap.bro}$ policy script will be experimented. The full packets can't be captured by this approach. Only contents of headers will be captured. Those contents are stored in a file called s1.trace.The following are the commands to see the results:

root@sanmeet-desktop: /usr/local/bro/policy	bro -r
Eile Edit ⊻iew Terminal Tabs Help	gtalk1.t
root@sanmeet-desktop:/usr/local/bro/policy# bro -r gtalk1.trace s_gtalkcap.bro GMAIL TRAFFIC	race
umali Inarii [rig_h=l72.3.1.5.65, orig_p=39958/tcp, resp_h=209.85.143.83, resp_p=00/tcp] GTALK Response TRAFFIC GTALK Response TRAFFIC root@sammeet-desktop:/usr/local/bro/policy#	s_gtalk cap.bro
_	Result:

The above is the captured traffic file against which s_ excercise6.bro policy script will be experimented. The following

are the commands to see the results:

1) bro -r mail.trace s_exercise6.bro

2) less http.log

Figure 8: Output showing Gtalk traffic

To see the captured content file less command can be used like below:

less s1.trace

Result:

POST /mail/channel/bind7at=xm3j34s9gsm5bi63e2y4c9fxf199f56/ER=66it=7300365ID=77C408F0#735F59CGARD=468586zx=3looxtn16xt56t=1 H
TTP/1.1
Nost: mail.gongle.com
User-Agent: Mexzilla/5.0 (XI1: U; Linux 1686; en-US; rv:1.8.1.3) Gecko/20061201 Firefox/2.0.0.3 (Ubuntu-feisty)
Accept:-Language: en-us_en;q=0.5
Accept:-Language: en-us_en;q=0.5
Accept-Language: en-us_en;q=0.5
Accept-Language: en-us_en;q=0.5
Accept-Linux 1008E (Comparison (Com

Figure 9: Tracefile with content information of packet headers

3.8 Detect all packets of live GTalk traffic using a script

In the previous exercise not all information about packets but only headers information is stored. Detect all packets of live GTalk traffic using a script.

In this task no trace file is there as we have experiment it on live traffic. So *bro* -i will be used. Following is the complete command to capture the packets in a trace file:

bro -i eth0 -w a.trace s_gtalklive.bro

To see the output captured in the tracefile a.trace we can not simply use *less* command because it's a binary file. However, we can use *tcpdump* command to see the captured packets. Command to See the Captured gtalk Traffic:

tcpdump -r a.trace

Result:

root@sammeet-desktop://ust/local/bro/poicy	القالعا ا
Ele Edit View Terminal Tabs Help	
root@sanmeet-desktop:/usr/local/bro/policy# tcpdump -r a.trace	
reading from file a trace, link-type EN10MB (Ethernet)	
11:30:38.626720 IP 172.31.5.136.bootpc > 255.255.255.255.bootps: BOOTP/DHCP, Request from 00:08:a1:92:4c:a6 (oui Unkni	own), le
ngth 300	
1:30:30.630528 IP 172.31.5.1.bootps > 255.255.255.255.bootpc: BOOTP/DHCP, Reply, length 300	
11:30:33.223076 IP ti-in-f83.google.com.www > sanmeet-desktop.local.41223: F 1641305083:1641305083(0) ack 869471641 w	in 14600
11:30:33.262312 IP sanmeet-desktop.local.41223 > t1-in-f83.google.com.www: . ack 1 win 8576	
11:30:33.953530 IP 172.31.5.159.1684 > JINI-ANNOUNCEMENT.MCAST.NET.4160: UDP, length 51	
11:30:35.164100 IP 172.31.5.136.netbios-ms > 172.31.5.255.netbios-ms: NBT UDP PACKET(137): QUERY; REQUEST; BROADCAST	
11:30:35.913975 IP 172.31.5.136.netbios-ns > 172.31.5.255.netbios-ns: NBT UDP PACKET(137): QUERY; REQUEST; BROADCAST	
11:30:36.174575 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 612879342:612879515(173) ack 41	2980195
win 62920	
11:30:36.530661 IP kc-in-f125.google.com.xmpp-client > sanmeet-desktop.local.60900: . ack 173 win 19296	
11:30:36.663890 IP 172.31.5.136.netbios-ns > 172.31.5.255.netbios-ns: NBT UDP PACKET(137): QUERY; REQUEST; BROADCAST	
11:30:36.676177 IP kc-in-f125.google.com.xmpp-client > sanmeet-desktop.local.60900: P 1:129(128) ack 173 win 19296	
11:30:36.676204 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: . ack 129 win 62920	
11:30:37.483694 IP ti-in-f18.google.com.www > sanmeet-desktop.local.44813: P 1505122206:1505122374(168) ack 738050178	win 876
11:30:37.483727 IP sanmeet-desktop.local.44813 > ti-in-f18.google.com.www: . ack 168 win 10020	
11:30:37.757500 IP ti-in-f18.google.com.wew > sanmeet-desktop.local.44813: P 168:401(233) ack 1 win 8760	
11:30:37.757529 IP sanmeet-desktop.local.44813 > ti-in-f18.google.com.www: . ack 401 win 11690	
11:30:40.570419 IP sanneet-desktop.local.41223 > ti-in-f83.google.com.www: F 1:1(0) ack 1 win 8576	
11:30:40.570825 IP ti-in-f83.google.com.www > sanmeet-desktop.local.41223: . ack 2 win 14600	
11:30:41.254329 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 173:195(22) ack 129 win 62920	
11:30:41.610050 IP kc-in-f125.google.com.xmpp-client > sanmeet-desktop.local.609000: . ack 195 win 19296	
11:30:41.610097 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 195:697(502) ack 129 win 62920	
ll:30:41.965544 IP kc-in-fl25.google.com.xmpp-client > sanmeet-desktop.local.60900: . ack 697 win 20368	
11:30:42.137160 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 697:870(173) ack 129 win 62920	
11:30:42.491518 IP kc-in-f125.google.com.xmpp-client > sammeet-desktop.local.60900: . ack 870 win 21440	
11:30:47.215932 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 870:1194(324) ack 129 win 62920	
11:30:47.571840 IP kc-in-f125.google.com.xmpp-client > sammeet-desktop.local.60900: . ack 1194 win 22512	
11:30:47.571877 IP sammet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: P 1194:1364(170) ack 129 vin 6292	3
11:30:47.598591 IP 172.31.5.190.netbios-ns > 172.31.5.255.netbios-ns: NBT UDP PACKET(137): QUERY; REQUEST; BROADCAST	
11:30:47.927450 IP kc-in-f125.google.com.xmpp-client > sanmeet-desktop.local.60900: . ack 1364 win 23584	
11:30:50.201466 IP kc-in-f125.google.com.xmpp-client > sammeet-desktop.local.60900; P 129:460(331) ack 1364 win 23584	
11:30:50.201501 IP sanmeet-desktop.local.60900 > kc-in-f125.google.com.xmpp-client: . ack 460 win 62920 11:30:50.203390 IP kc-in-f125.google.com.xmpp-client > sanmeet-desktop.local.60900: P 460:947(487) ack 1364 win 23584	
11:39:50.203390 JP KC-In-T125.google.com.xmpp-client > sammeet-desktop.iocal.b09001 P 4b01947(487) ack 1364 win 23584 11:30:50.203437 JP sammeet-deskton.local.60900 > Kc-in-T125.google.com.xmpp-client: , ack 947 win 62920	
11:30:50.203437 IP sanmeet-desktop.tocat.60900 > Kc-in-fi25.googte.com.xmpp-client: . ack 947 win 62920	

Figure 10: Captured packets with Gtalk traffic

3.9 A Bro script, where the user can maintain a list of URLs, if any of the URLs are hit, log the connection to a file

Trace File: trace.out

The above file is captured traffic file against which the script s_connlog.bro will be experimented. The following command will be used to run the script:

bro -r trace.out s_connlog.bro

The output is logged in a file instead of stdout. The following command is used to see that log file.

less http.log

Result:

							ree	t@sai	imeet	-des	RE	op: /u	sr/loc.	al/bro/p
Eile		and the second s	Terminal		Help									
			esktop:/						http	log	I.	more		
			547/tcp											
			548/tcp											
			549/tcp											
			151/tcp											
172.	31.5.	65:36	152/tcp	-> 13	1.243.	2.19	180/tc	р						
			151/tcp											
			152/tcp											
172.	31.5.	65:36	152/tcp	-> 13	1.243.	2.19	180/tc	р						
			151/tcp											
			152/tcp											
			417/tcp											
172.	31.5.	65:53	417/tcp	-> 20	8.65.1	53.2	5380/t	ср						
			417/tcp											
			570/tcp											
			583/tcp											
172.	31.5.	65:43	187/tcp	-> 20	2.54.1	57.1	5280/t	ср						
			188/tcp											
			188/tcp											
			189/tcp											
			189/tcp											
			189/tcp											
			189/tcp											
			188/tcp											
			189/tcp											
			188/tcp											
172.	31.5.	65:43	189/tcp	-> 20	2.54.1	57.1	5280/t	ср						
			188/tcp											
			189/tcp											
			188/tcp											
			189/tcp											
			188/tcp											
172.	31.5.	65:43	189/tcp	-> 20	2.54.1	57.1	5280/t	ср						
L72.	31.5.	65:43	188/tcp	-> 20	2.54.1	57.1	5280/t	ср						
			189/tcp											
			188/tcp											
			189/tcp											
172.	31.5.	65:43	188/tcp	-> 20	2.54.1	57.1	5280/t	ср						

Figure 11: Connections attempting to access restricted URLs

4. CONCLUSION AND FUTURE WORK

Computer networks have brought the world together by bridging the information gap among people. Network technology has undergone a revolution with better and faster ways of sending information between computers. Unfortunately security systems and policies to govern these networks have not progressed as rapidly. Today's network is very complex and the whole world is focusing on ease of use and functionality. This is making us more insecure. For hackers, these welltraveled paths make networks more vulnerable than ever before and with relatively little expertise hackers have significantly impacted the networks of leading brands or government agencies. Cyber crime is also no longer the prerogative of lone hackers or random attackers. Today disgruntled employees, unethical corporations, even terrorist organizations all look to the Internet as a portal to gather sensitive data and instigate economic and political disruption. With networks more vulnerable and hackers equipped to cause havoc, it's no surprise that network attacks are on the rise. So there is a huge need of detecting the threats and intrusion. For this purpose number of solutions is there, IDS is one of them. Bro is the most popular and effective IDS which can be used to detect these threats.

In this paper we have explored and designed the policy scripts of Bro to detect various kinds of traffic like web traffic, mail traffic, web mail traffic etc. The scripts are experimented against captured traffic as well as live traffic. However no IDS can detect all the intrusions. So we need a combination of various techniques.

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