WebWatcher

A Lightweight Tool for Analyzing Web Server Logs

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PROJECT GOALS

- To automatically analyze web server logs
- To detect compromise attempts through HTTP requests
- To have a very small impact in terms of resources
- To monitor HTTP servers on as many platforms as possible
- To operate both in real time and batch modes
- To use our knowledge of malicious HTTP requests signatures
- To have a flexible and rich attack signature format
- To track hosts exhibiting malicious behavior
- To discover and learn new attack signatures
- To remove false alarms intelligently

ATTACKS TARGETED

- Penetration of the system via HTTP server vulnerabilities
  - Vulnerable CGI program requests
  - Password guessing
  - Access to sensitive information (guessing CGI names, accessing system files)
- Denial-of-service attacks
  - Repeated accesses to non-existing resources
  - Repeated accesses to resources that cause server errors
- Legal but undesirable activity
  - Borderline use of the HTTP protocol
    - e.g. % encoding of normal characters
  - Sensitive documents accesses
- Policy violation (when used on firewall HTTP proxy)
  - External / internal policies governing access to web sites.

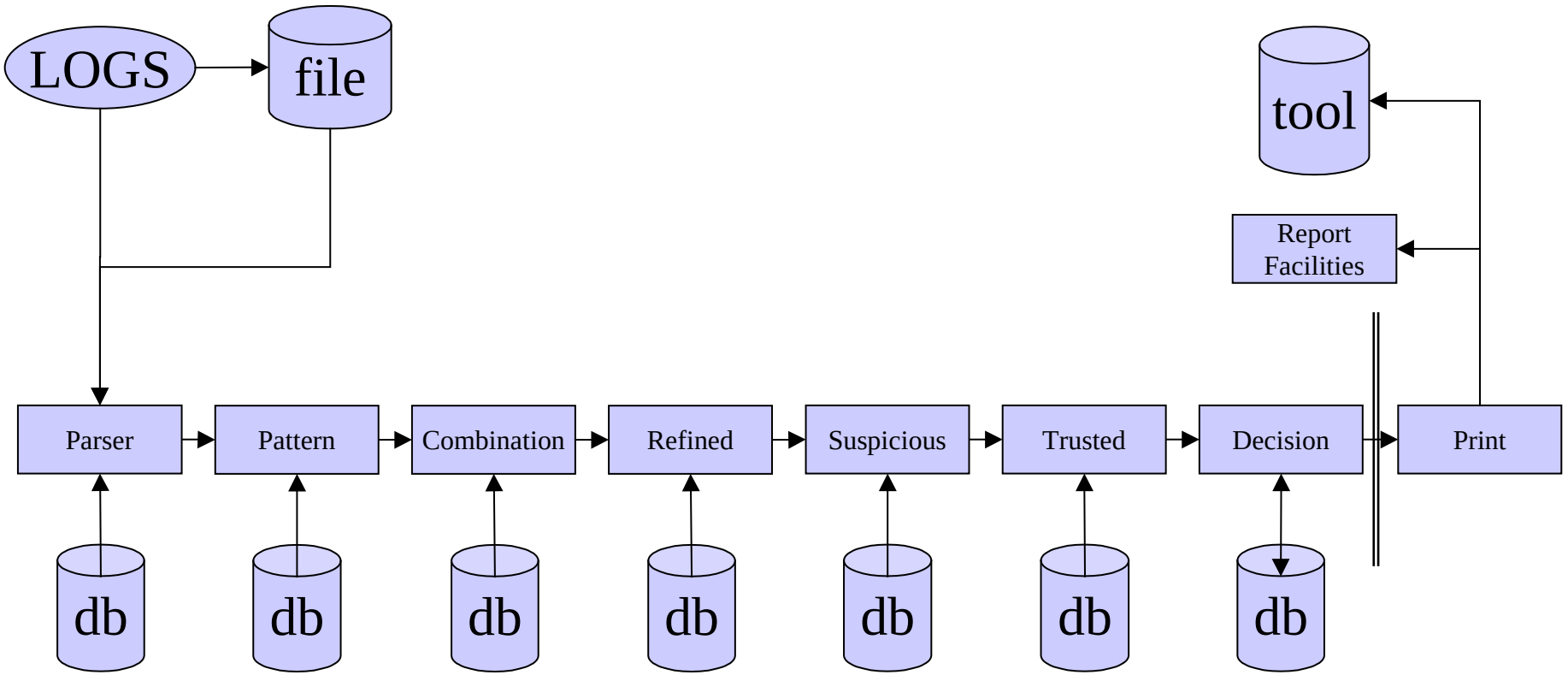
TECHNICAL CHOICES

- Input: CLF/ECLF format

```
host - authenticated_user [date] "request string" status bytes
```

- Implementation language: Perl5
  - Portable
  - Well accepted in web server environments
  - Regular expression matching
- Signature language: perl regular expressions
  - Easy to create simple signatures
  - Possible to create very complex ones to reduce false alarms
- Pipelined architecture
  - Each filter corresponds to a set of verifications

ARCHITECTURE



MODULES

- Parser
  - Reads the request
  - Breaks the log entry into its constituent parts and check integrity
  - Refines the URL into its parts and check the format / empty string
  - Decodes any encoded characters and verify appropriateness of % characters
- Pattern
  - Looks for signatures
  - Signatures are relevant to fields
  - Signatures are grouped into classes
  - Negative matching
- Combination
  - Logical combination of signatures (if sig1 and sig2 then sig3)
- Refined
  - Signature dependencies (if sig1 then match sig2)

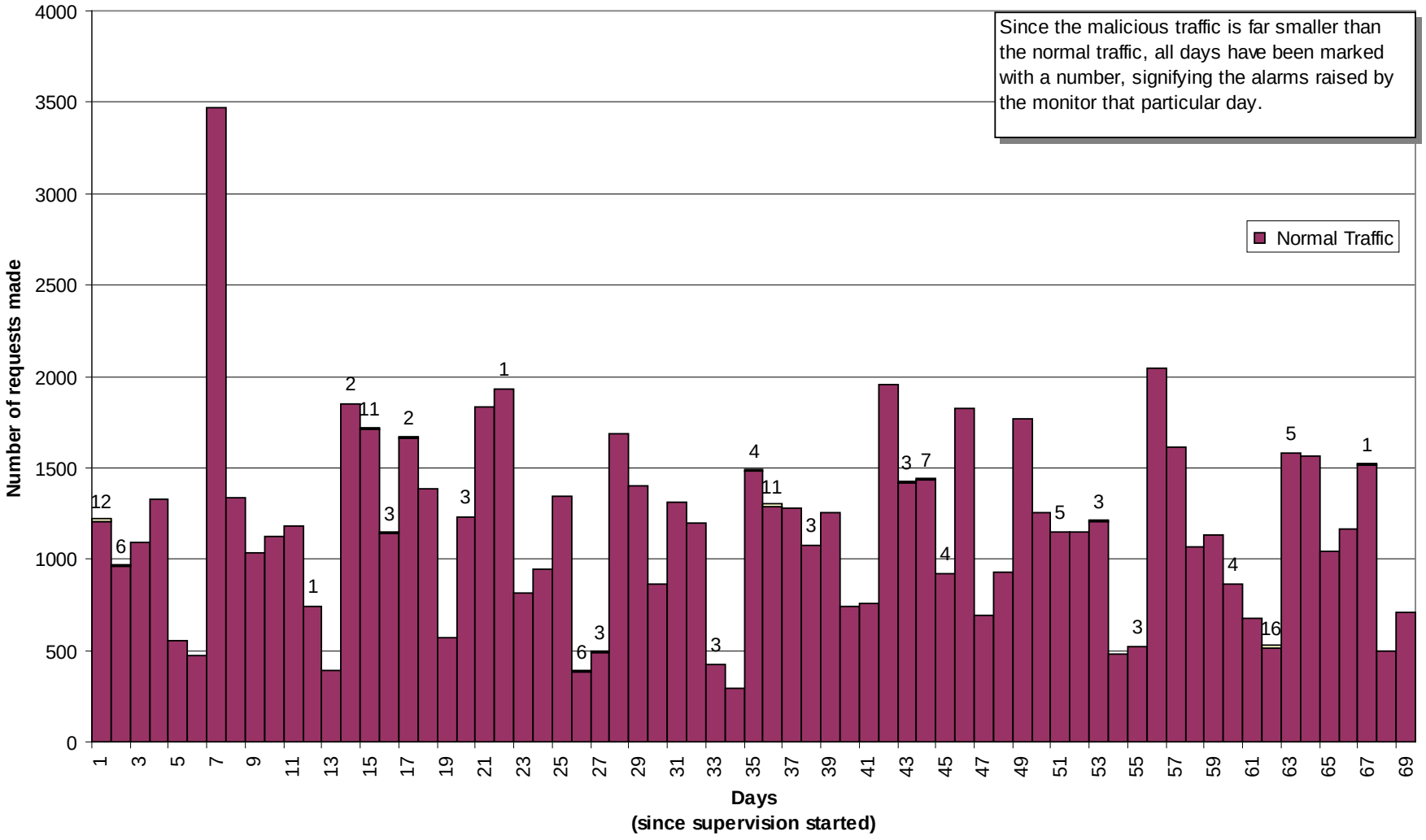
MODULES (2)

- Suspicious
  - Keeps track of suspicious hosts effectively (not signatures !)
- Trusted
  - Eliminates alerts based on signatures
- Decision
  - Ages and updates the tree of suspicious hosts
- Print module
  - Prints out the alert
    - Syslog
    - Internal format
- HTML Reporting facility
  - Overview of the results
  - Intended for batch processing

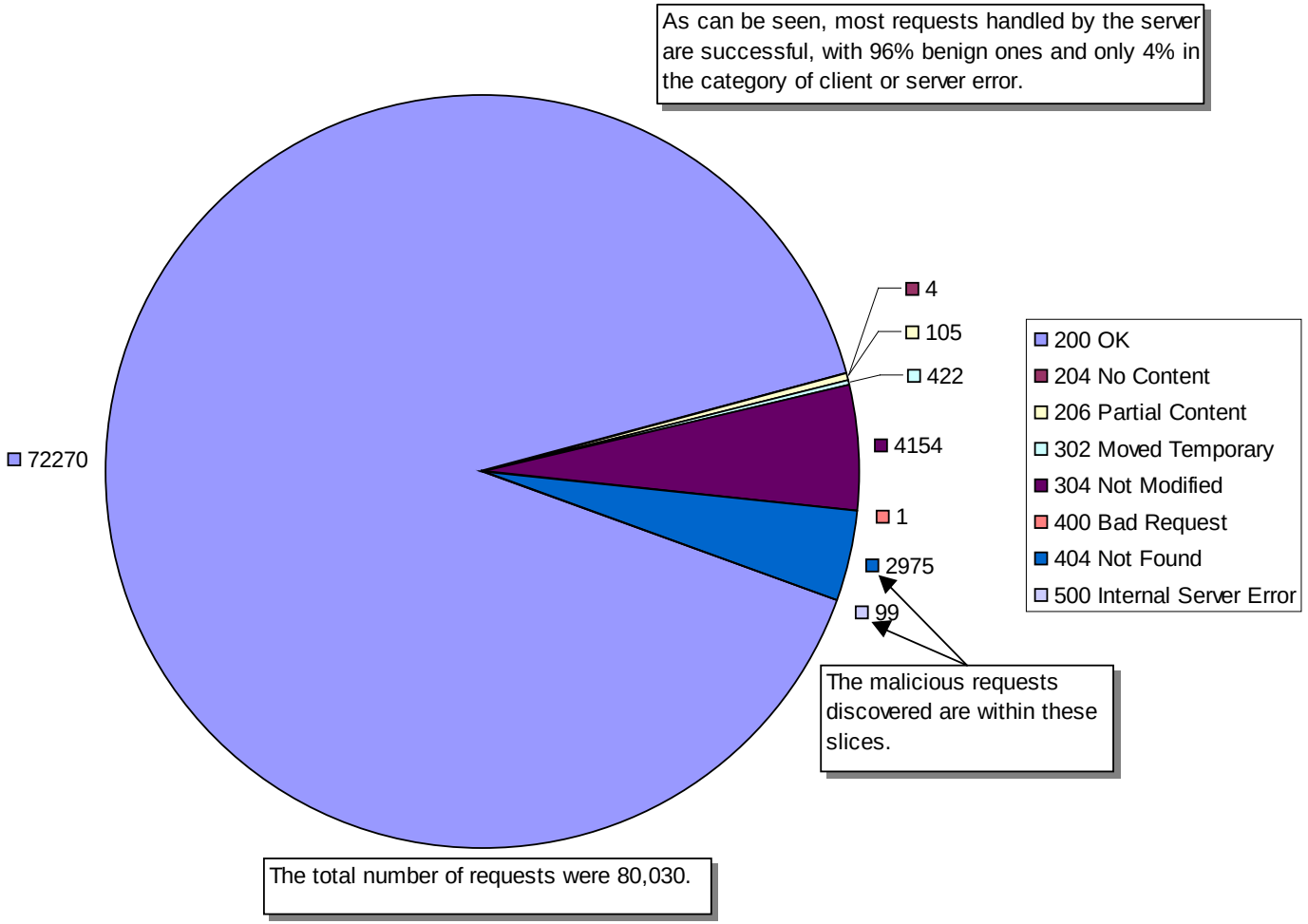
EXPERIMENTS

- Data collected from (batch runs)
  - 2 medium sized commercial sites
  - University logs
  - 1 day of the Nagano Olympics website (Courtesy of Jim Challenger)
- Data collected from an apache web server (Real time)
  - RS/6000 250 running apache 1.3.3
- Initial signature base
  - 50 vulnerable cgi programs (now 150)
  - Directory tricks
  - Interpreters in cgi-bin
  - Sensitive files
  - ...

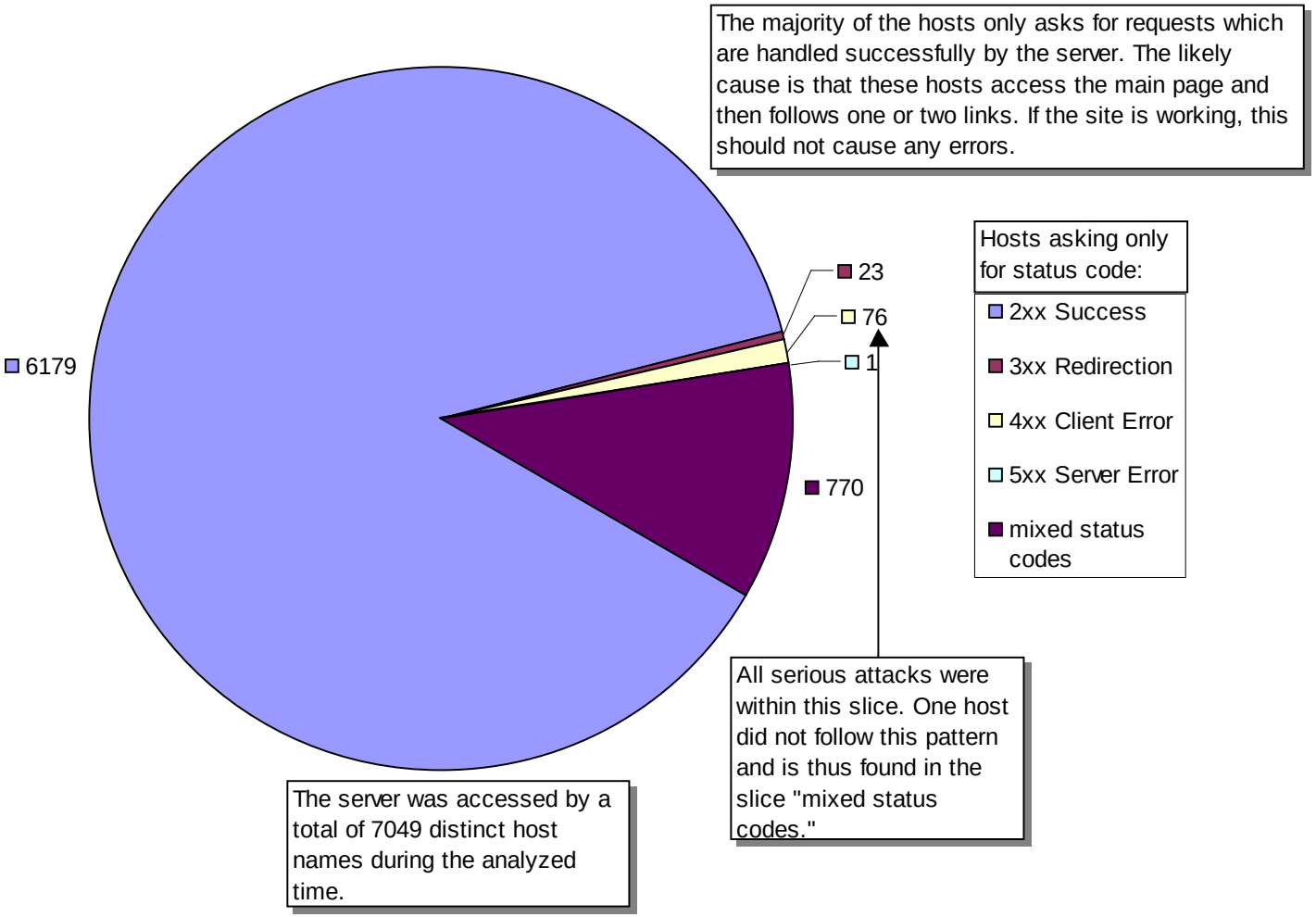
TRAFFIC ANALYSIS



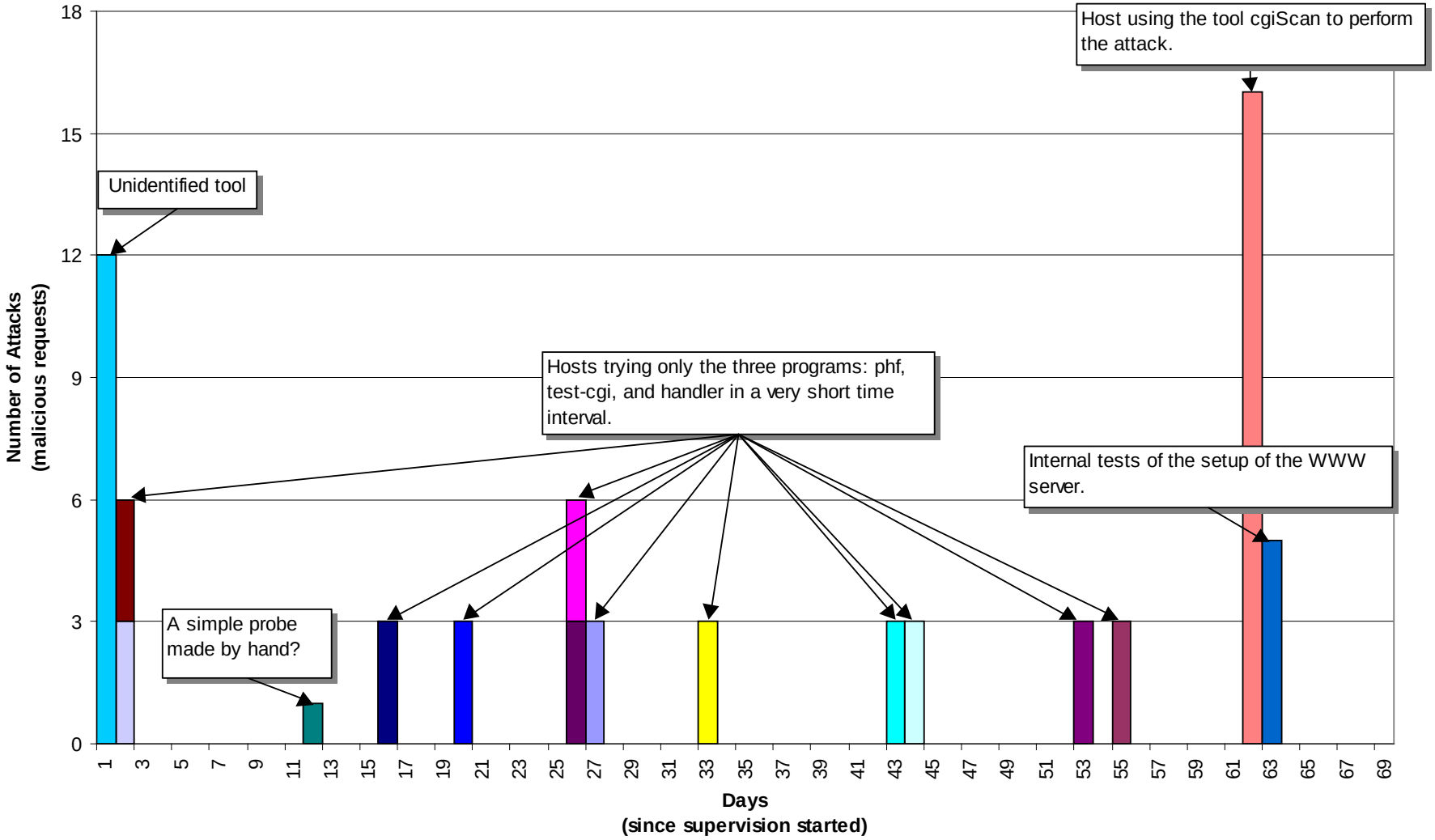
REQUEST TYPE DISTRIBUTION



HOSTS AND REQUEST TYPES



ATTACK PATTERNS



DEPLOYMENT

- WebWatcher is in operation for IBM customers
  - Batch processing
  - Weekly reporting
- Many attack attempts detected
  - Sites are highly visible and make attractive targets
  - WebWatcher signature database is growing richer ….
- WebWatcher interacts with the Tivoli Management Framework
  - Alerts are sent into the event correlation facility (TEC).
  - Alerts follow the IDWG data model definitions.
  - Alerts are correlated with ones coming other intrusion-detection systems (network-based).

File Edit View Go Communicator Help

[simple] [host] [url] [warning] [help]

pattern(cgi) (threshold 1) [Explanation]

(3) POST /_vti_bin/shtml.exe/_vti_rpc HTTP/1.0

(1) POST /_vti_bin/shtml.exe/_vti_rpc HTTP/1.0

decision(followup) (threshold 1) [Explanation]

(4) GET /_vti_inf.html HTTP/1.0

(3) POST /_vti_bin/shtml.exe/_vti_rpc HTTP/1.0

(1) POST _vti_bin/shtml.exe/_vti_rpc HTTP/1.0

pattern(file) (threshold 1) [Explanation]

(4) GET /_vti_inf.html HTTP/1.0

pattern(suspiciousCgi) (threshold 1) [Explanation]

(2) GET /phf?Qalias=x%0Aless%020/etc/passwd HTTP/1.1

pattern(cgi) (threshold 1) [Explanation]

(2) GET /phf?Qalias=x%0Aless%020/etc/passwd HTTP/1.1

decision(followup) (threshold 1) [Explanation]

(2) GET /phf?Qalias=x%0Aless%020/etc/passwd HTTP/1.1

207.71.2.61 – – [14/Aug/1999:21:28:01 +0000] "GET /_vti_inf.html HTTP/1.0" 404 207

	Name	Threshold	Information
warnings	pattern(file) decision(followup)	1 1	current level: 1.0
alerts	pattern(clientError) pattern(badStatus) pattern(file) decision(followup)		^404 ^[23] vti_inf\.html warnings

[simple] [host] [url] [warning] [help]

pattern(cgi) (threshold 1) [Explanation]

(1) GET /cgi-bin/test-cgi HTTP/1.0
(1) GET /carbo.dll HTTP/1.0
(1) GET /cgi-bin/rwwwshell.pl HTTP/1.0
(1) GET /iissamples/sdk/asp/docs/codebrws.asp HTTP/1.0
(1) GET /scripts/tools/newdsn.exe HTTP/1.0
(1) GET /cgi-bin/finger HTTP/1.0
(4) GET /cfdocs/expelval/openfile.cfm HTTP/1.0
(1) GET /cgi-bin/view-source HTTP/1.0
(1) GET /cgi-bin/bnbform.cgi HTTP/1.0
(1) GET /cgi-bin/textcounter.pl HTTP/1.0
(1) GET /cgi-bin/jj HTTP/1.0
(1) GET /cgi-bin/environ.cgi HTTP/1.0
(1) GET /cgi-bin/wrap HTTP/1.0
(1) GET /cgi-bin/websendmail HTTP/1.0
(1) GET /cgi-bin/rguest.exe HTTP/1.0
(1) GET /cgi-bin/unlg1.1 HTTP/1.0
(1) GET /iissamples/exair/howitworks/codebrws.asp HTTP/1.0
(1) GET /cgi-bin/classifieds.cgi HTTP/1.0
(1) GET /cgi-bin/edit.pl HTTP/1.0
(1) GET /cgi-bin/webgais HTTP/1.0
(1) GET /cgi-bin/survey.cgi HTTP/1.0
(1) GET /cgi-bin/handler HTTP/1.0
(1) GET /cgi-bin/info2www HTTP/1.0
(1) GET /cgi-bin/wwwboard.pl HTTP/1.0

	Name	Threshold	Information
warnings	pattern(file) decision(followup)	1 1	current level: 1.0
alerts	pattern(clientError) pattern(badStatus)		^404 ^[23]

FUTURE WORK

- Detect denial of service attacks through legitimate requests:
  - “The Slashdot effect”.
  - Distributed denial of service attacks can be carried out effectively nowadays.
  - This requires statistical tracking of legitimate requests -> quite costly.
- Deploy in distributed environment:
  - Challenge of distributed web servers (clusters, SP2, …).
  - The problem of sharing the suspicious hosts tree information is being studied.