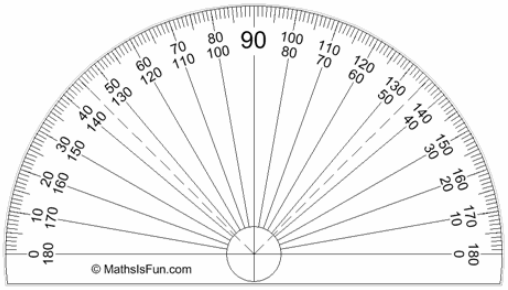

Ontologies for Modeling Enterprise Level Security Metrics

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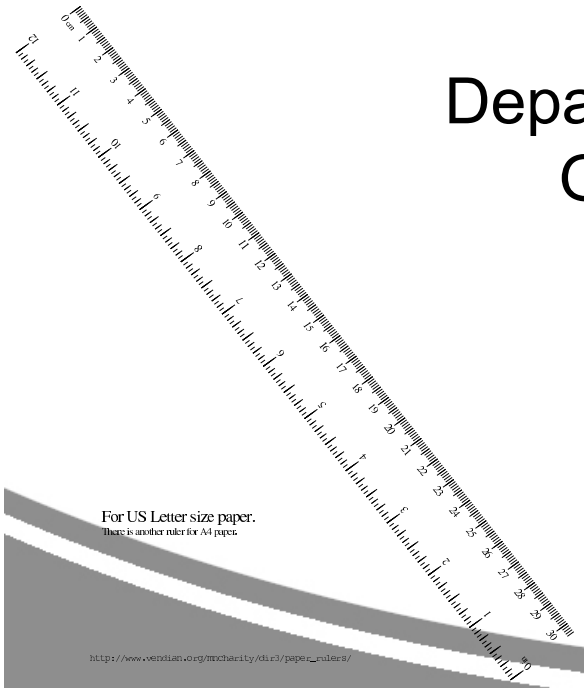

with assistance from
Paul Ngo, DHS
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Why Security Metrics?

- How can I plan on security investments so the system can achieve a certain level of security?
- What Risk postures am I willing to endure at what cost?
  - What are my perceived threats?
  - How secure are system with given configurations?
  - How much security does a new configuration provide?
  - Which countermeasures or controls provide the greatest risk reduction?
- We need a common nomenclature (ontology) to discuss Enterprise Level Security Metrics.

Challenges in Creating Security Metrics

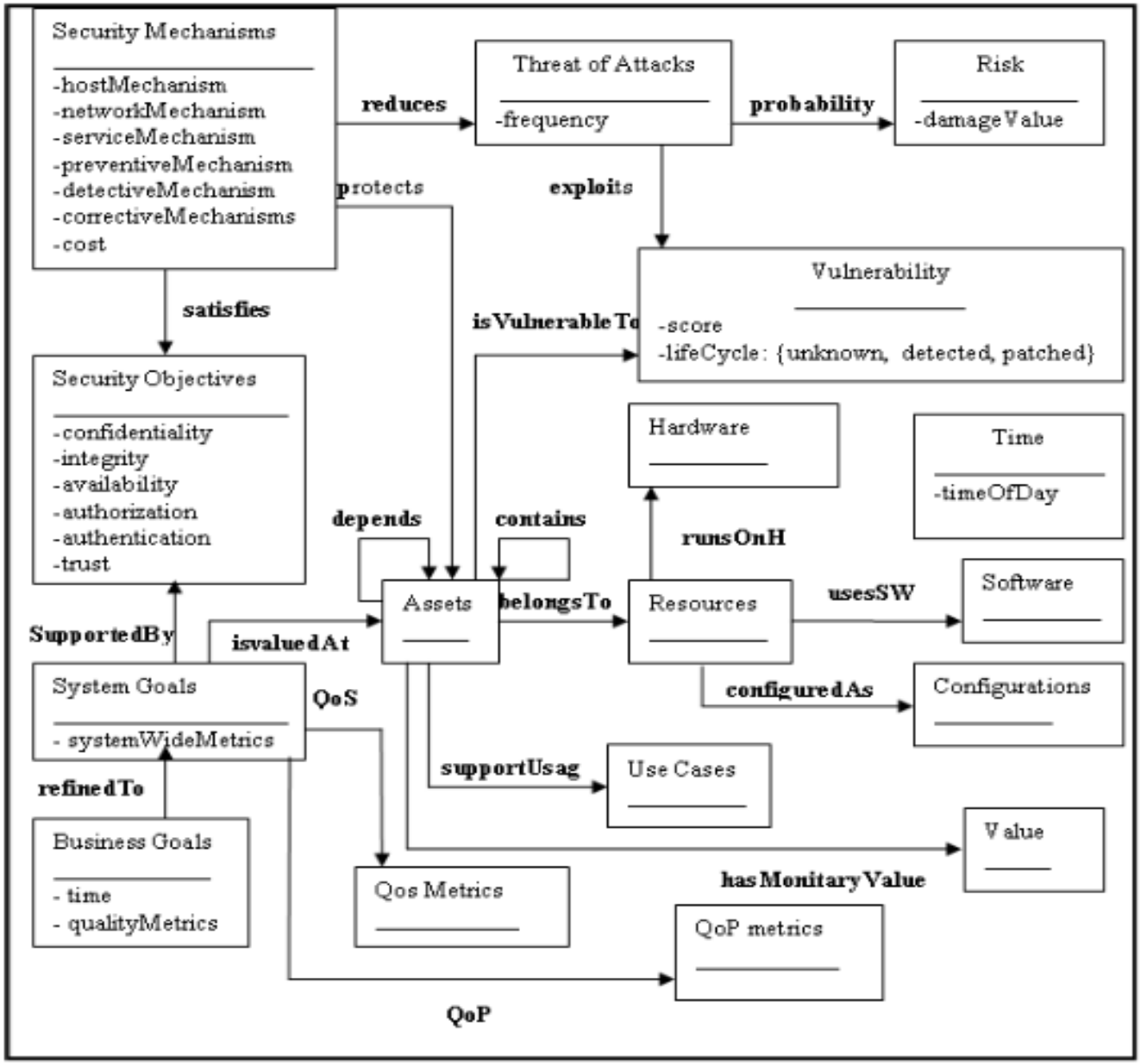
- Metric for individual vulnerabilities already exists
  - Impact, exploitability, temporal, environment, etc.
  - E.g., the Common Vulnerability Scoring System (CVSS) v2 released on June 20, 2007*
- How to we compose individual measures for the overall security of a system?

* Common Vulnerability Scoring System (CVSS-SIG) v2, http://www.first.org/cvss/

Common Terms used in Security Metrics

- Threats
- Vulnerabilities
- Countermeasures
- Assets
- Risks
- Security Objectives
  - Business Goals
  - Use Cases to be provided
  - Misuse Cases to be avoided
- Tredeoffs

An Ontology for Security Metrics (cont.)



Properties of Asset Class

```
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   <rdfs:domain  rdf:resources="Asset"/>
   <rdfs:range      rdf:resources=&xsd:integer/>
</rdf:Property>
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   <rdfs:domain  rdf:resources="Asset"/>
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</rdf:Property>
<rdf:Property rdf:ID="contains">
   <rdfs:domain  rdf:resources="Asset"/>
   <rdfs:range      rdf:resources="Asset"/>
<rdf:Property rdf:ID="isVulnerableTo">
   <rdfs:domain  rdf:resources="Asset"/>
   <rdfs:range      rdf:resources="Vulnerability"/>
<rdf:Property rdf:ID="belongsTo">
   <rdfs:domain  rdf:resources="Asset"/>
   <rdfs:range      rdf:resources="Resource"/>
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   <rdfs:domain  rdf:resources="Assets"/>
   <rdfs:range      rdf:resources="Value"/>
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   <rdfs:domain  rdf:resources="Assets"/>
   <rdfs:range      rdf:resources="Use Cases"/>
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```
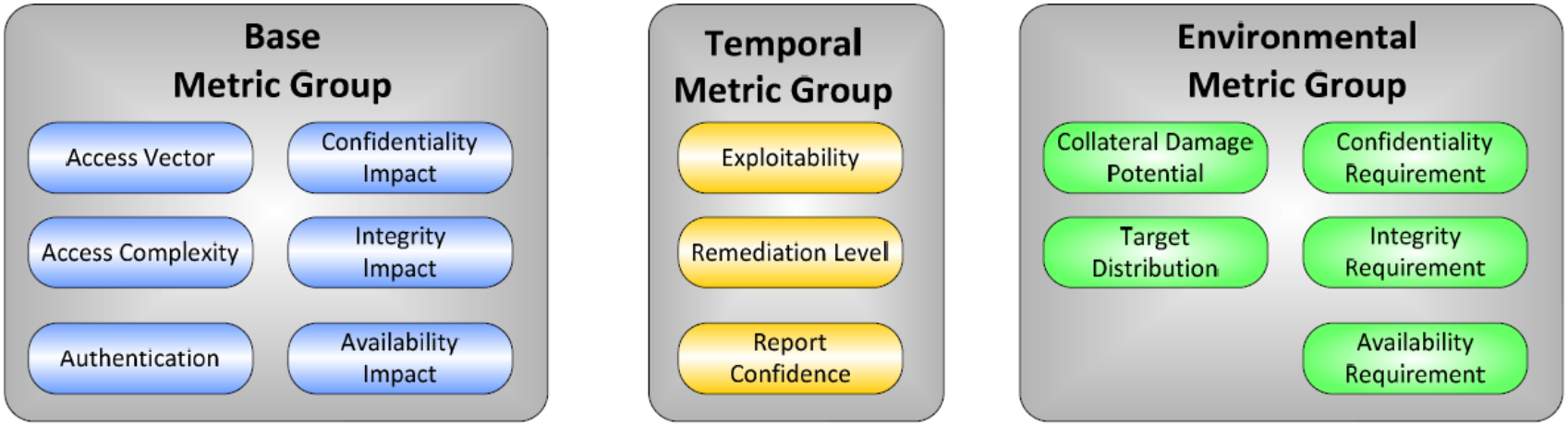

CVSS

- Stands for Common Vulnerability Scoring System
- An open framework for communicating characteristics and impacts of vulnerabilities
- Consist three metric groups: Base, Temporal, and Environment
  - Base metric: constant over time used environment
  - Temporal metric: change over time, constant w.r.t. environment
  - Environmental metric: unique to user environment

CVSS



- Each metric group has sub-matrices
- Each metric group has a score associated with it
- Score is normalized to the range of 0 to 10

Access Vector

This metric measures how the vulnerability is exploited

- Local
- Adjacent Network
- Network
- Remote

Access Complexity

This metric measures the complexity of the attack required to exploit the vulnerability

- High: Specialized access conditions exist
- Medium: The access conditions are somewhat specialized
- Low: Specialized access conditions do not exist

Authentication

Measures the number of times / ways in which an attacker must authenticate to a target to exploit a vulnerability

Number:

- Multiple: The attacker needs to authenticate two or more times
- Single: One instance of authentication is required
- None: No authentication is required

Ways:

- Login /password/
- must solve a puzzle/ biometric
- Need remote attestation

Confidentiality Impact

This metric measures the impact on confidentiality due to the exploitation.

- None: No Impact
- Partial: There is a consideration information disclosure
- Complete: There is a total information disclosure

- Similar things for the Integrity and Availability Impacts.

Base Score

Base Score = roundTo1Decimal(((0.6*Impact +(0.4*Exploitability)-1.5)*f(Impact))

Impact = 10.41*(1-(1-ConImp)*(1-IntImp)*(1-AvailImpact))

Exploitability =

20*AccessV*AccessComp*Authentication

F(Impact) = 0 if Impact=0, 1.176 otherwise

Base Score Example CVE-2002-0392

Apache Chunked Encoding Memory Corruption

BASE METRIC	EVALUATION	SCORE
Access Vector	[Network]	(1.00)
Access Complex.	[Low]	(0.71)
Authentication	[None]	(0.704)
Availability Impact	[Complete]	(0.66)

Impact = 6.9

Exploitability = 10.00

Base Score = (7.8)