Collaborative Intrusion Detection and Response

Limitations of Monolithic ID

- Single point of failure
- Limited access to data sources
- Only one perspective on transactions
- Some attacks are inherently distributed
  - Smurf
  - DDoS
- Conclusion: "Complete solutions" aren't

Sharing Information

- Benefits
  - Increased robustness
  - More information for all components
  - Broader perspective on attacks
  - Capture distributed attacks
- Risks
  - Eavesdroppers, compromised components

Sharing Information

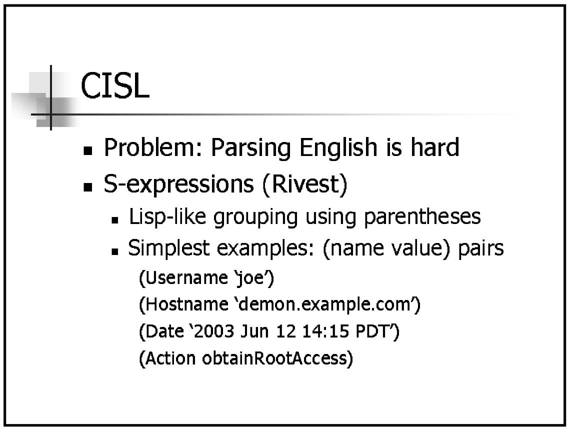
- Communication risks can be resolved cryptographically (at least in part)
- Defining appropriate level of expression
  - Efficiency
  - Expressivity
  - Specificity

CIDF

- Common Intrusion Detection Framework
  - Collaborative work of DARPA-funded projects in late 1990s
  - Task: Define language, protocols to exchange information about attacks and responses

CISL

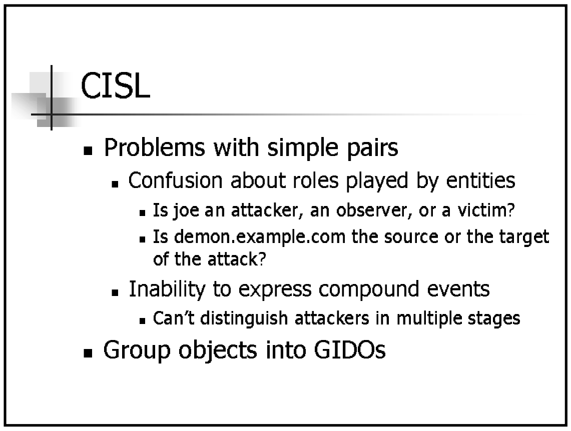
- Common Intrusion Specification Language
  - Conveys information about attacks using ordinary English words
  - E.g., User joe obtains root access on demon.example.com at 2003 Jun 12 14:15 PDT



CISL

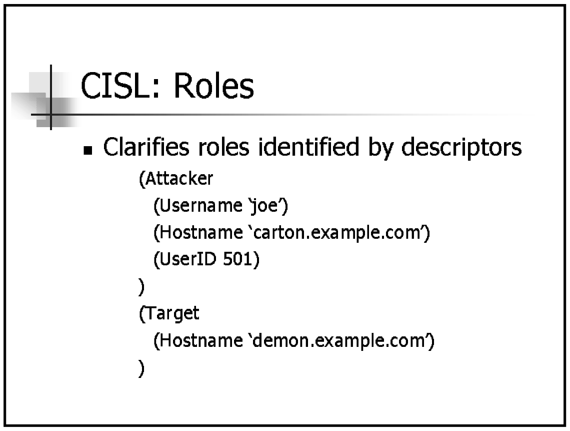
- Problem: Parsing English is hard
- S-expressions (Rivest)
  - Lisp-like grouping using parentheses
  - Simplest examples: (name value) pairs

```
(Username ‘joe’)
(Hostname ‘demon.example.com’)
(Date ‘2003 Jun 12 14:15 PDT’)
(Action obtainRootAccess)
```



CISL

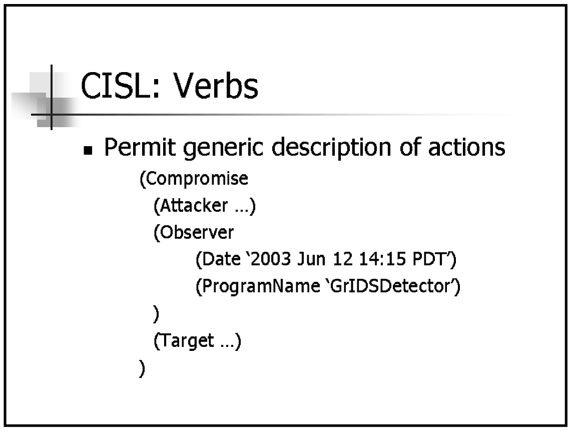
- Problems with simple pairs
  - Confusion about roles played by entities
    - Is joe an attacker, an observer, or a victim?
    - Is demon.example.com the source or the target of the attack?
  - Inability to express compound events
    - Can't distinguish attackers in multiple stages
- Group objects into GIDOs



CISL: Roles

- Clarifies roles identified by descriptors

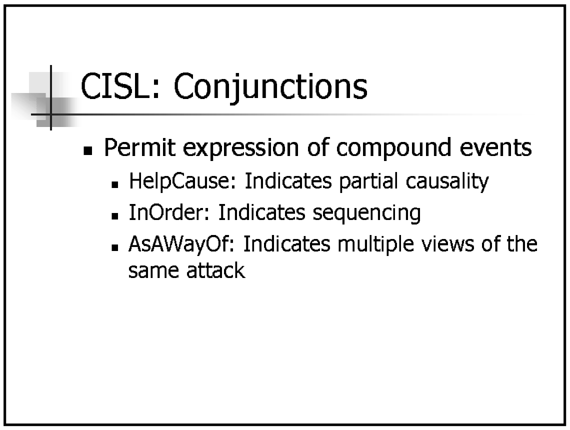
```
(Attacker
  (Username ‘joe’)
  (Hostname ‘carton.example.com’)
  (UserID 501)
)
(Target
  (Hostname ‘demon.example.com’)
)
```



CISL: Verbs

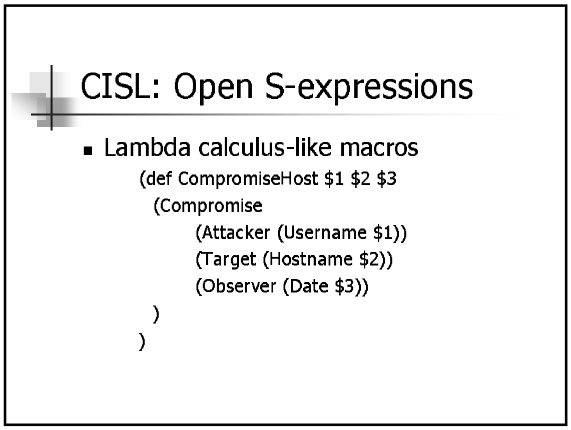
- Permit generic description of actions

```
(Compromise
  (Attacker …)
  (Observer
        (Date ‘2003 Jun 12 14:15 PDT’)
        (ProgramName ‘GrIDSDetector’)
  )
  (Target …)
)
```



CISL: Conjunctions

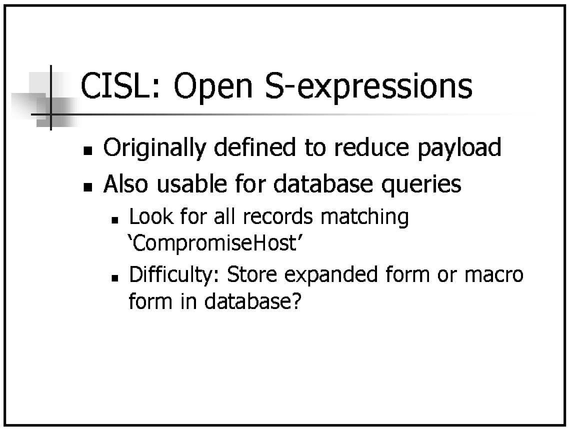
- Permit expression of compound events
  - HelpCause: Indicates partial causality
  - InOrder: Indicates sequencing
  - AsAWayOf: Indicates multiple views of the same attack



CISL: Open S-expressions

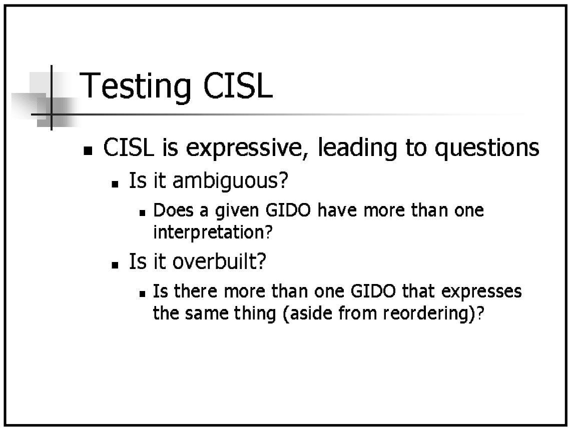
- Lambda calculus-like macros

```
(def CompromiseHost $1 $2 $3
  (Compromise
        (Attacker (Username $1))
        (Target (Hostname $2))
        (Observer (Date $3))
  )
)
```



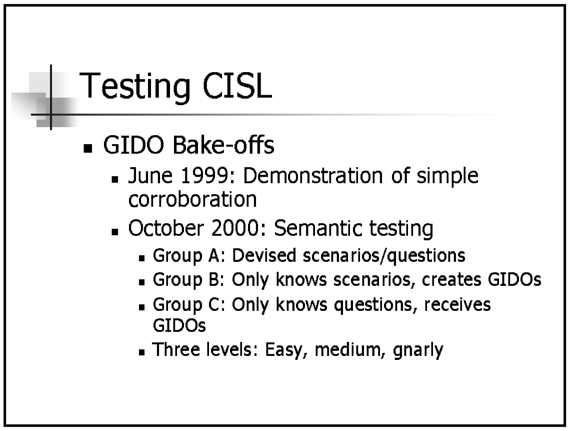
CISL: Open S-expressions

- Originally defined to reduce payload
- Also usable for database queries
  - Look for all records matching 'CompromiseHost'
  - Difficulty: Store expanded form or macro form in database?



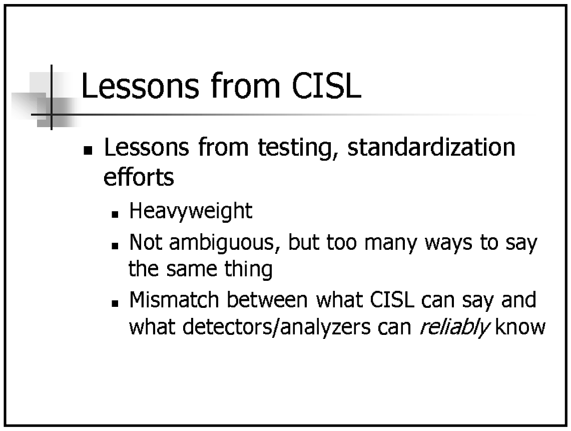
Testing CISL

- CISL is expressive, leading to questions
  - Is it ambiguous?
    - Does a given GIDO have more than one interpretation?
  - Is it overbuilt?
    - Is there more than one GIDO that expresses the same thing (aside from reordering)?



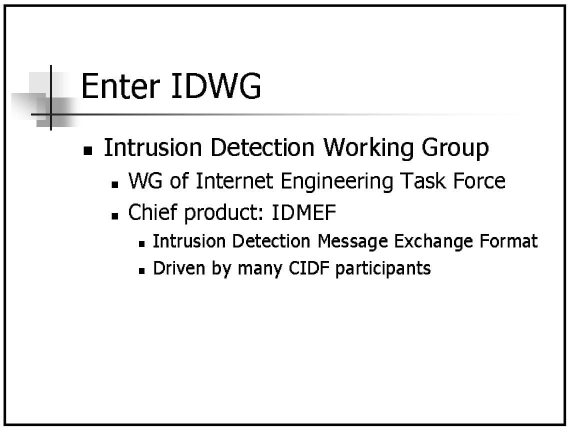
Testing CISL

- GIDO Bake-offs
  - June 1999: Demonstration of simple corroboration
  - October 2000: Semantic testing
    - Group A: Devised scenarios/questions
    - Group B: Only knows scenarios, creates GIDOs
    - Group C: Only knows questions, receives GIDOs
    - Three levels: Easy, medium, gnarly



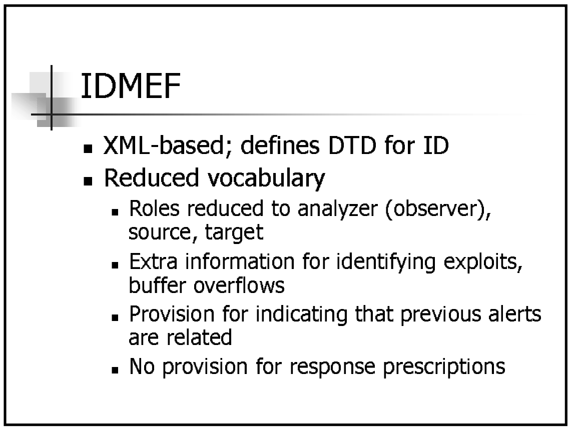
Lessons from CISL

- Lessons from testing, standardization efforts
  - Heavyweight
  - Not ambiguous, but too many ways to say the same thing
  - Mismatch between what CISL can say and what detectors/analyzers can *reliably* know



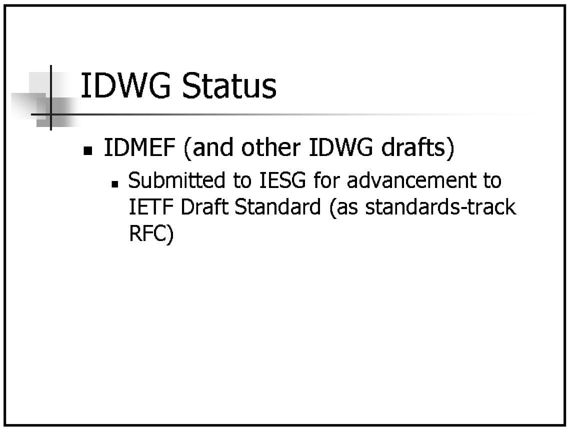
Enter IDWG

- Intrusion Detection Working Group
  - WG of Internet Engineering Task Force
  - Chief product: IDMEF
    - Intrusion Detection Message Exchange Format
    - Driven by many CIDF participants



IDMEF

- XML-based; defines DTD for ID
- Reduced vocabulary
  - Roles reduced to analyzer (observer), source, target
  - Extra information for identifying exploits, buffer overflows
  - Provision for indicating that previous alerts are related
  - No provision for response prescriptions



IDWG Status

- IDMEF (and other IDWG drafts)
  - Submitted to IESG for advancement to IETF Draft Standard (as standards-track RFC)