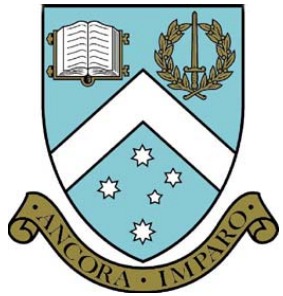

CSE468
Information Conflict

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Lecture 05

Compound Information Conflict Strategies

Reference Sources and Bibliography

- There is only a single reference covering compound information conflict strategies:
- Kopp, Carlo, The Analysis of Compound Information Warfare Strategies, Conference Paper, *Proceedings of the 6th Australian Information Warfare & Security Conference 2005*.

Compound Information Conflict Strategies?

- *A compound information conflict strategy is any strategy which comprises more than one canonical information conflict strategy, and in which some defined precedence relationships exist between these strategies.*
- Such strategies arise very frequently in biological and social contexts.
- Empirical study of examples indicates that such strategies can have very large numbers of components.
- The analysis of any such strategy can present difficulties in the absence of systematic techniques for analysis.
- The orthogonality property of the canonical strategies, and the existence of precedence relationships permit systematic analysis.

Problems?

- Understanding and analysing a complex compound deception strategy. Such a strategy can comprise a very larger number of canonical primitives.
- Properly understanding the structure of the strategy, and thus its underlying aims, can present difficulties.
- Example: an opponent is playing a very complex compound deception strategy. The aim of the defender is to determine whether gathered information is a deception or not, and what the specific aim of that deception might be. In the simplest of terms, ‘what does this opponent want me to think and why?’
- Detection of inconsistencies, mistakes or gaps in such a complex deception strategy may be the only method of unmasking such a deception, especially if the deception is carefully architected from the outset.

Problems? (Continued)

- Another problem which can frequently arise is that of countering an opponent's deceptive perception management strategy.
- Such deceptions can often be complex compound strategies in which multiple mutually reinforcing falsehoods are employed with a specific aim of shifting the perceptions of a victim audience.
- Often the only technique for defeating such a strategy is to unmask the deception before the audience.
- A well crafted compound strategy may present genuine difficulties in analysis and defeat.

Primitives , Precedence, Compound Strategies

- **The Attacker:** the player in an information warfare strategy who is executing the strategy against a victim player.
- **The Victim:** the player in an information conflict strategy who is being subjected to an attack by the attacking player.
- **Canonical Strategy:** defined as one of the four fundamental strategies. These strategies are atomic, in the sense that any compound strategy can be divided into a number of canonical strategies, but a canonical strategy cannot be further divided in any way.
- **Compound Strategy:** any strategy which comprises more than one canonical information conflict strategy, and in which some defined precedence relationships exist between these strategies.

Precedence Relationships

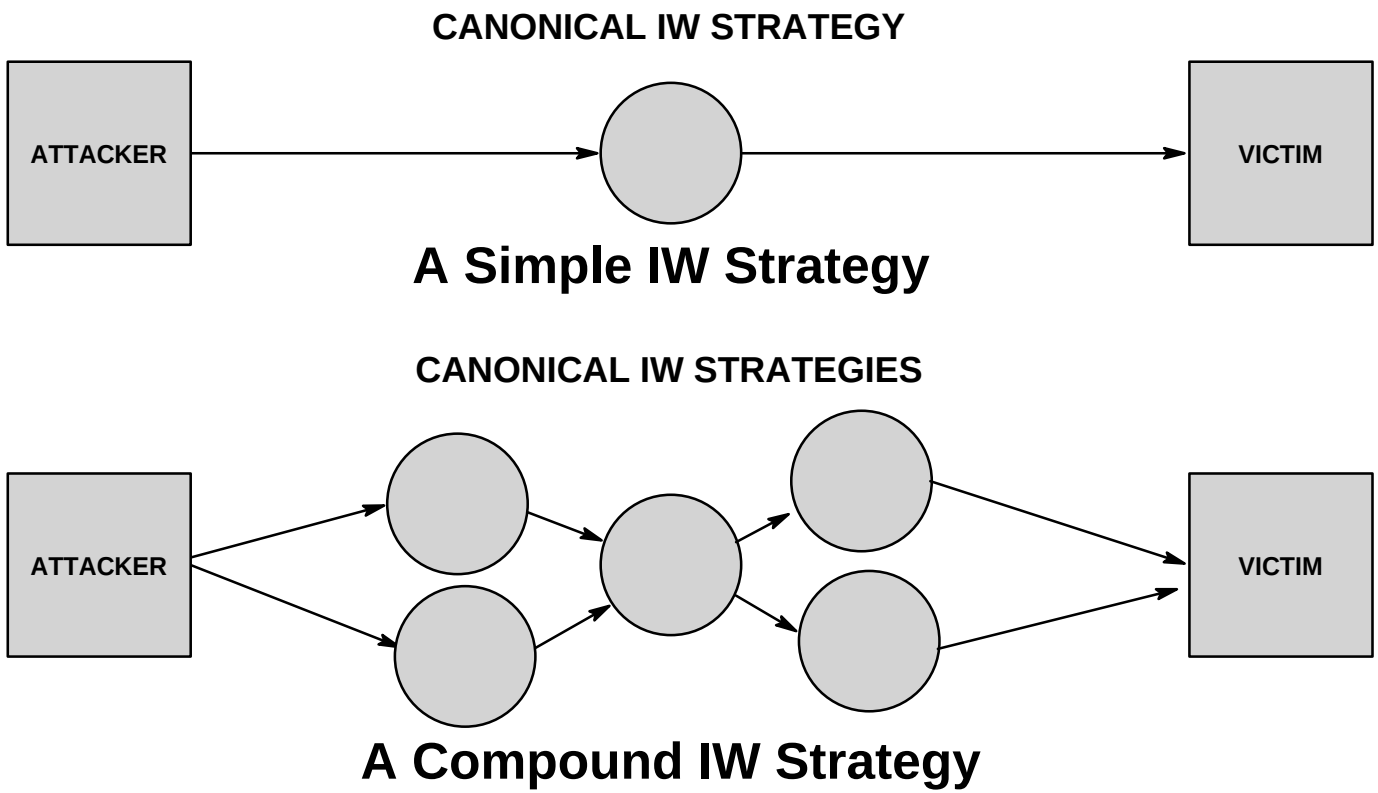
- **Precedence Relationships:** define the order or precedence which exists between more than one canonical information conflict strategy comprising a compound strategy:

1. **In practical terms, one canonical strategy can be a precedent to one or more canonical strategies.**
2. **The precedence relationship cannot be bidirectional since the time domain is not bidirectional.**
3. **It is only once the precedent strategy has achieved some effect, that the antecedent strategy can produce its effect.**
4. **There is no bound on the number of precedent strategies to any antecedent strategy.**

Precedence Relationships (Cont)

5. **Precedence is unidirectional in time, therefore any compound strategy forms a directed graph, which obeys the properties of directed graphs.**
6. **Precedence relationships arise due to the state of the victim in the attack. In a compound strategy, antecedent strategies may not be feasible until a specific state of misperception or false belief has been established in the victim. A strategy may only be successful if this state change has taken place.**
7. **An attacker may or may not perceive the state change in the victim's perception arising from an attack, compound or simple, and thus execute an antecedent strategy, compound or simple, after executing the precedent attack. This may or may not impair the success of the antecedent attack.**

Simple vs Compound IW Strategies



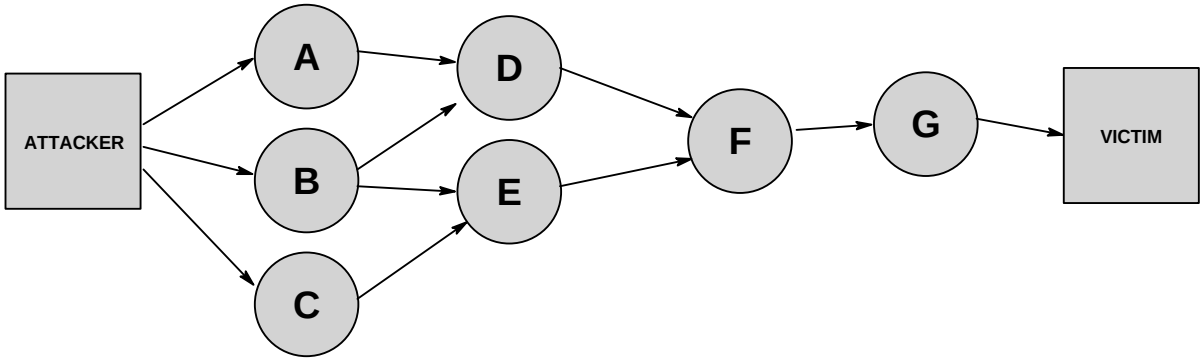
Primitives (Cont)

- **Concurrency:** Strategies between which no precedence relationship exists can be executed concurrently. There is no bound on the number of possible concurrent strategies.
- **Primary vs Supporting Strategies:** A strategy is said to be a supporting strategy if it supports the aim of another strategy, termed the primary strategy.
  1. **Supporting and primary strategies may or may not be concurrent.**
  2. **A non-concurrent supporting strategy is a strategy which must produce its effect before the primary strategy can be executed successfully.**

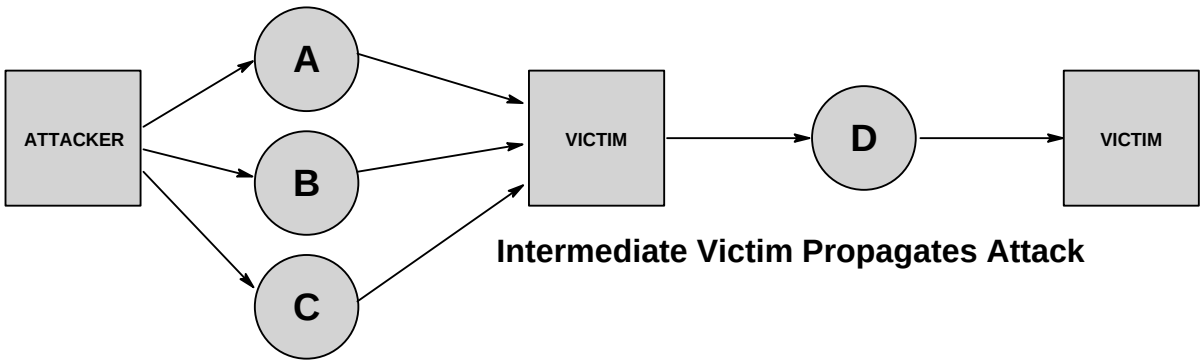
Primitives (Cont)

- **Chained or Sequential Strategies:** a compound strategy in which one or more intermediate victims are exploited. In such a strategy the first victim is employed as a conduit or proxy to propagate an information conflict attack, or its effect.
  - **Example: exploitation of media organizations by terrorist movements. The media organization is deceived into propagating a message targeted at a victim population, believing the message constitutes legitimate news.**
- **Victim State:** defined as the victim's belief at that point in time.
  - **A successful application of information conflict will effect an intended state change.**
  - **An unsuccessful application may not produce a state change, or may by alerting the victim, produce a state change in whatever other game the victim may be playing**.

Chained Compound vs Compound Strategies



A Compound IW Strategy



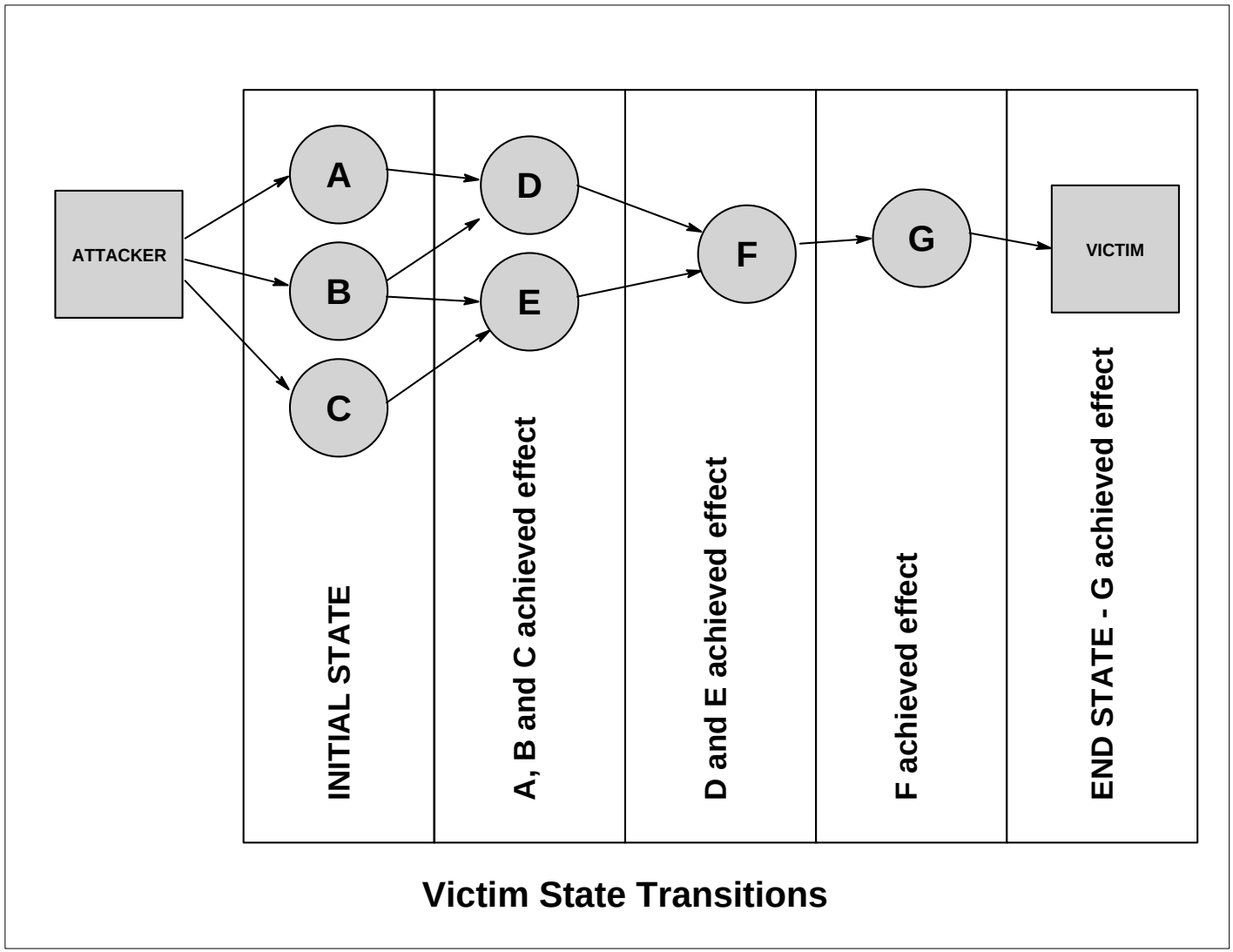
Intermediate Victim Propagates Attack

A Chained Compound IW Strategy

MODELLING COMPOUND STRATEGIES

- A model for a complex compound strategy is a directed graph, in which precedence relationships exist between component canonical strategies.
- The topology of this graph is dependent upon the structure of the compound strategy.
- The overall success of any complex compound strategy is measured by the end state of the victim. If the intended end state is not achieved, the strategy has failed.
- In terms of systematically constructing a compound information conflict strategy, the starting point is the end state of the victim, and the intermediate states the victim must transition between from its initial state.

State Transitions

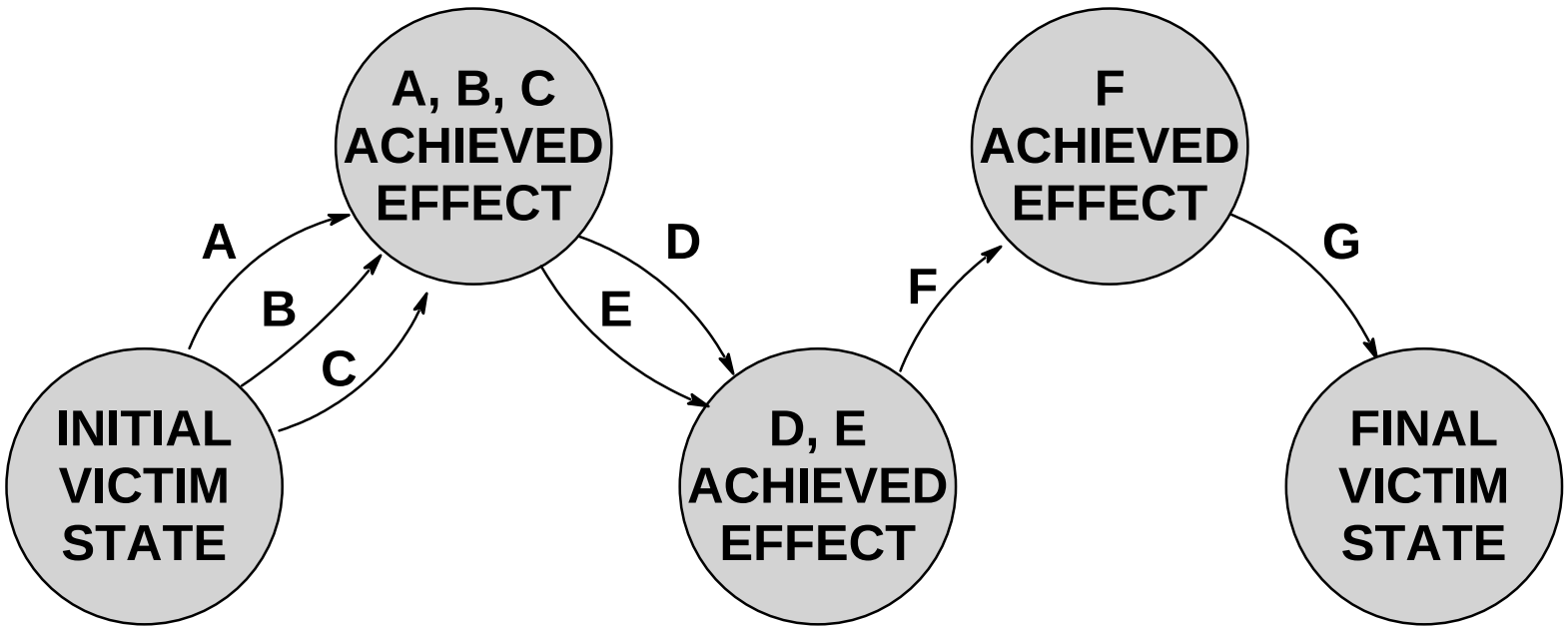


Victim State Transitions

STATE BASED MODELLING

- Alternate mappings for this modeling technique exist.
- A state based mapping is an alternative - attractive to users familiar with state transition diagrams, or project scheduling techniques such as PERT (Project Evaluation and Review Technique).
- In a state based representation, the graph comprises nodes which represent initial, intermediate and end states for the victim, and directed edges which represent the strategies required to effect a transition from a preceding state.
- Rather than searching for cut vertices in the directed graph, analysis requires that *bridges* be identified (Chartrand, 1977; Wilson, 1985).

State Based Representation



State Based Representation for Compound Strategies

Cut Vertices

- As compound information conflict strategies have the properties of directed graphs, the behaviour of the cut vertex is of particular interest.
- A cut vertex is such a vertex, the removal of which partitions the graph into two smaller graphs (Chartrand, 1977; Wilson, 1985).
- Any strategy, canonical or compound, which possesses the cut vertex property is a vulnerability within the overall compound information conflict strategy.
- The failure of this particular strategy, or its defeat by the victim, results in the total failure of the whole strategy.
- *Cut vertices are thus a critical vulnerability in compound Information Conflict strategies.*

Robustness of Compound Strategies

- The attacker can assess the robustness of the strategy at each state transition, by identifying whether the required strategies to effect that state transition have the cut vertex property, and thus represent a single point of failure for the strategy.
- Robustness could be improved by executing two or more concurrent compound strategies, all of which effect the same end state in the victim.
- This is an application of the established reliability engineering technique of ‘parallel redundancy’ (Bazovsky, 1961).
- Example: 1944 Fortitude operation (Ministry of Defence, 2004; Ricklefs, 1996).

Defining a Metric for Robustness

- In defining a metric for calculating robustness we require a measure which can capture how robustness declines with the increasing number of cut vertices or bridges in a compound strategy.
- If we attribute some probability of failure to each of *N* cut vertices or bridges, then for equal probabilities, the probability of the compound strategy can be expressed as:

$$P_c[success] \quad = \quad (1 - P_i[\,failure])^N$$

- Where N is the number of cut vertices (or bridges) in the compound strategy. This is Lusser's product law.

Generalising the Robustness Metric

- In a complex compound strategy, the probabilities of failure associated with specific cut vertices or bridges may differ. Therefore the more generalised form applies:

$$P_c[success] = \prod_{i=1}^{N} (1 - P_i[\,failure])$$

- This model assumes no parallel redundancy in the graph, ie the loss of any cut vertex or bridge causes the whole strategy to fail.
- Where the compound strategy contains redundant paths, or dependencies exist between paths, then more general modelling techniques used in reliability engineering would be required.

Key Points

- Systematic analytical technique for modelling and analysing compound information conflict strategies exist.
- Compound strategies are modelled as directed graphs, with precedence relationships where applicable.
- Discrete state transitions in the victim can be used as a measure of success.
- The concept of robustness in a compound strategy is introduced, this being defined as a measure of how few component strategies in the compound strategy possess the cut vertex property.
- Future research is required to further explore techniques for the analysis of attacks *in progress*, techniques for modelling partial effects upon victims, and the effects of belief (false or true) in attackers and victims.

Tutorial

- Q&A
- Discuss examples