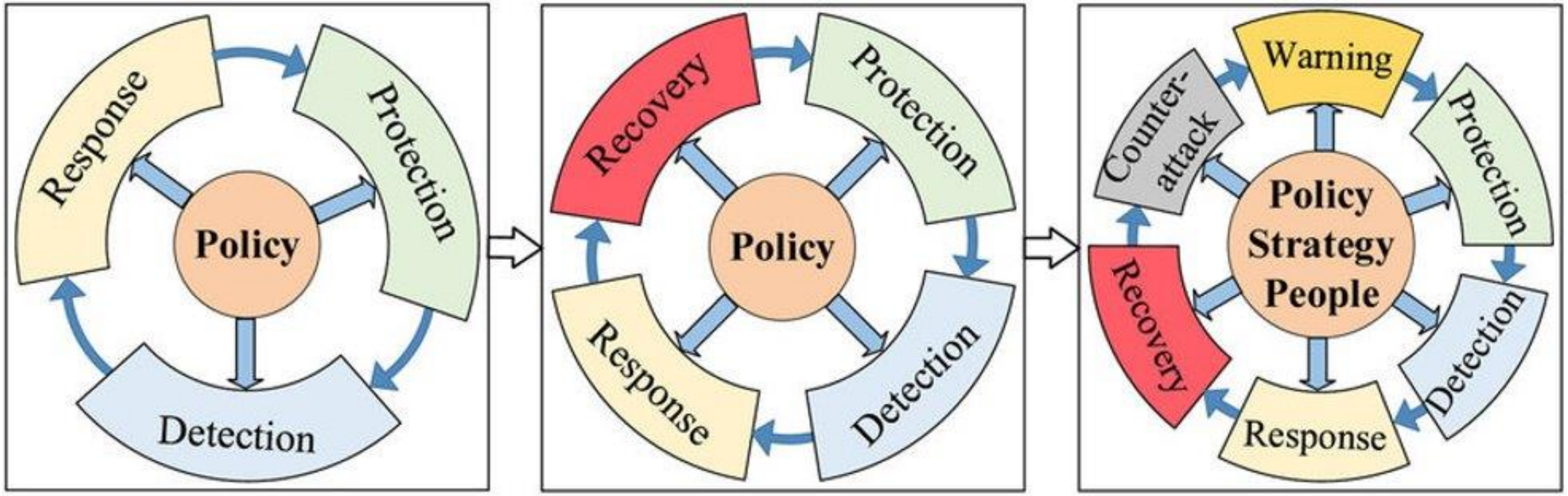
Security Models

- **Security means a complete system**
  - Policies
  - Procedures - detail how the policies are implemented
  - Models



Security Policies

- **Policies – the rules about what must be done.**

- **Policies include definitions of**
  - Subjects – the actors
  - Objects – the information and equipment
  - Actions – what can and cannot be done
  - Permissions – map subjects, objects and actions together.
  - Protections – rules which prevent subversion of the policy

Security Models

- **A classification scheme for people, secrets, activities.**
- **A common language used by policy makers and security administrators.**
- **Types of models:**
  - Discretionary Access Control
  - Mandatory Access Control

Discretionary access control

- Discretionary Access Control (DAC)
- Users have the authority to set permissions on their own files.
- Users can grant permission to other users.
- Examples – ACLs in Windows, Linux
- Assumes everyone who has permission exercises it responsibly.

Discretionary access control - example

- Let's consider a shared folder in a company's file server:

- Folder Owner: The owner of the shared folder is the Human Resources (HR) manager, who has created this folder to store confidential employee documents.

- HR Assistant: The HR assistant needs access to the shared folder to update and manage employee records.

- Finance Manager: The finance manager, from a different department, needs limited access to view specific financial documents of employees for payroll processing.

Discretionary access control - example

In a DAC system:

- The HR manager (folder owner) can grant "Read and Write" access to the HR assistant so they can add, modify, and delete employee records in the folder.
- The HR manager can also grant "Read-only" access to the finance manager, allowing them to view financial documents but not make any changes.
- Other employees who are not directly involved with HR or finance will not have access to this shared folder, unless the HR manager decides to give them access.

Mandatory access control

- MAC
- Users have no authority to set permissions.
- Centralised policy admins set permissions.
- Each rule maps a subject (actor) to an object (resource) with a specific set of permissions
- Example – SE Linux
- Assumes no-one who has access can be trusted to exercise it responsibly.
- Even root can have no authority.

Mandatory access control - example

Let's consider a highly secure government system with classified information:

- System Administrator: The system administrator is responsible for managing the system's security and configuring access control policies.
- User A: A government official with Top Secret clearance who needs access to highly classified documents.
- User B: A government contractor with Secret clearance who should not have access to Top Secret documents.

Mandatory access control - example

In a MAC system:

- The system administrator defines strict access control policies based on the security classification levels of the documents. They categorize documents as "Top Secret," "Secret," and "Unclassified."
- User A, with Top Secret clearance, is assigned a label as "Top Secret." This label is used to determine access to any object classified as "Top Secret."
- User B, with Secret clearance, is assigned a label as "Secret." This label allows access to "Secret" classified objects but not "Top Secret" ones.
- The system administrator configures the MAC rules so that User A can access "Top Secret" documents, but User B is restricted from accessing them.

Trust management

A form of security policy:

- Actions – sensitive operations
- Principals – actors
- Policies – rules which map principals to actions.
- Credentials – digitally signed documents which map allowable actions to principals.
- Example – XACML – xml-based language for defining trust management systems.

Bell-LaPadula (BLP) Model

- **Ensures confidentiality**
- **Based on multi-levels of classification**
- **Levels of secrecy for documents**
  - Unclassified, Confidential, Secret, Top Secret

- **Levels of clearance for users**
  - Public, Agent, Commander, President
  - Document at a certain level can only be read by a person with equivalent or higher clearance.

Bell-LaPadula (BLP) Model

Progressively more strict classifications of data

- **Clearance levels assigned to individuals**
  1. User cannot read data at a higher level
  2. User cannot write data to a lower level

- **Aggregate data is more sensitive than raw data; (only the commanders get the big picture).**
- **False data can move upwards and mislead decision makers.**

Biba Model

- **Ensures integrity**
- **Based on multi-levels of integrity.**
- **Levels of accuracy for objects**
  - e.g. Document in data centre has more accuracy than document in laptop.
- **Levels of integrity for users**
  - Policy makers (highest), Public (lowest)
  - Document at a certain level is considered reliable by a person with equivalent or lower level.

Biba Model

Progressively less reliable classifications of data

- **Integrity levels assigned to information**
  1. User cannot write data to a higher level
  2. User cannot read data from a lower level

- **Reliable data is must come from a reliable source. Low reliability data cannot be made to be reliable.**
- **False policy data can move downwards and misdirect workers.**

More Models

- **Low Watermark Model**
  - Relaxed version of the Biba model.
  - Users at high levels can read low-reliability data.
- **Clark-Wilson Model**
  - Based on integrity of transactions.
  - Checks system state.
  - Separate auditing process which ensures that transactions are valid.

Chinese Wall Model

- Chinese Wall Model (Brewer & Nash Model)
- Prevents conflicts of interest (CoI)
- Puts resources, people into CoI Classes
- A user can only access resources from one CoI class at a time.
- CoI allocation can change with time.

Trusted Systems

- **Implemented using Access Control Lists (ACLs), Bell-La Padula (BLP), MAC**
  - Users are authenticated, restricted access.
  - Users must be trustworthy (but have no discretion).
- **Secured hardware:**
  - Not on the internet (Air-gap)
  - Locked up in secure rooms
  - Isolated from power grid.
  - Rings of security/Defense in depth

Trusted Systems

- **Air-Gap – what can go wrong?**
  - NO automatic updates – Microsoft, Adobe, Oracle assume everyone is on the Internet.
  - Patch management is difficult to coordinate. Mission-critical systems are never shut down / re-booted.
  - Therefore new vulnerabilities are not patched.
  - Air-gapped systems are easy to compromise once the perimeter is breached (M&M security)