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Secure by Design
security design principles for the rest of us

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BACKGROUND

- Eoin Woods
  - CTO at Endava (technology services, 3300 people)
- 10 years in product development - Bull, Sybase, InterTrust
- 10 years in capital markets applications - UBS and BGI
- Software engineer, then architect, now CTO
- Author, editor, speaker, community guy

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CONTENT

- **What is security** and why do we care?
- What are **design principles**, why are they **useful**?
- **Security design principles**
  - 10 important principles useful in practice

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REVISITING SECURITY

- We all know security is important - but **why**?
  - protection against **malice**, **mistakes** and **mischance**
  - theft, fraud, destruction, disruption
- Security is a **risk management** business
  - **loss** of time, money, privacy, reputation, advantage
  - **insurance model** - balance costs against risk of loss

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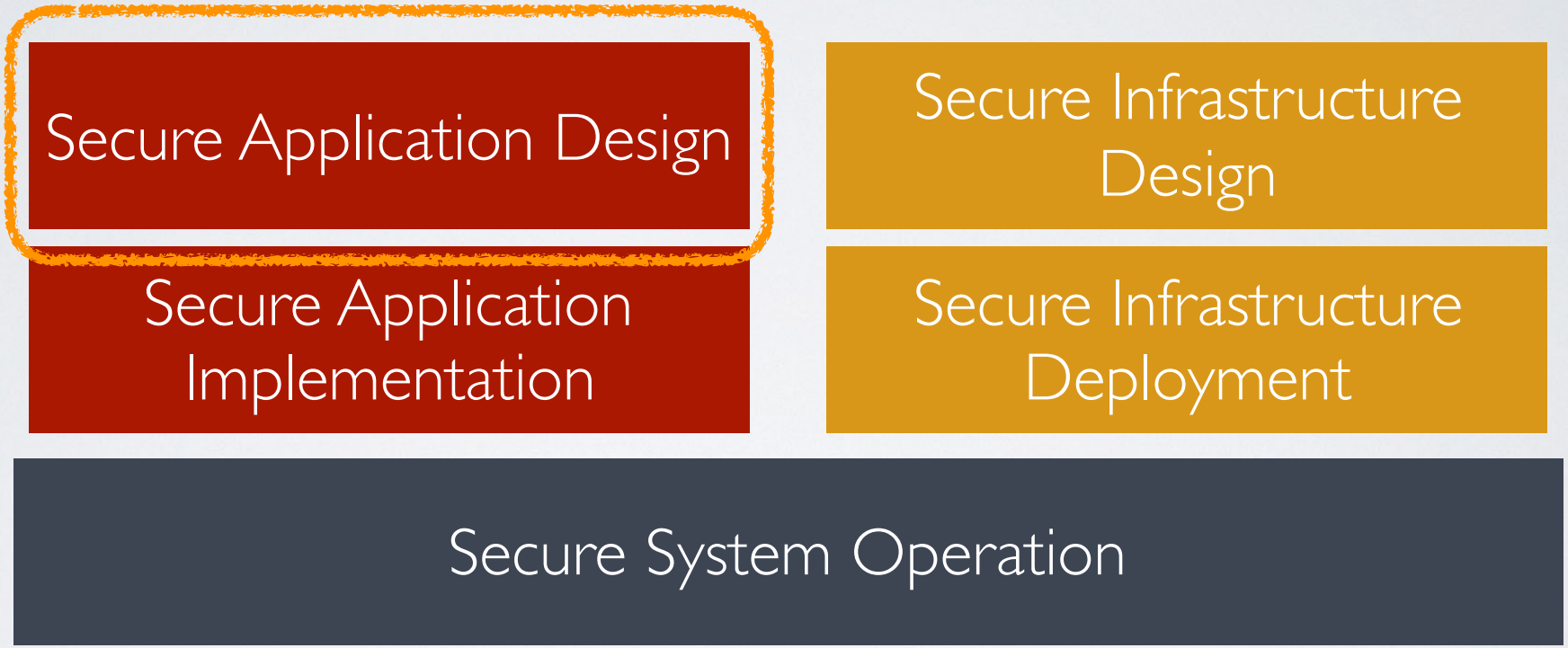
ASPECTS OF SECURITY PRACTICE



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SECURITY DESIGN PRINCIPLES

What is a "**principle**" ?

*a fundamental **truth or proposition** serving as the foundation for **belief or action*** [OED]

We define a **security design principle** as ….

*a declarative **statement** made with the intention of **guiding security design decisions** in order to meet the goals of a system*

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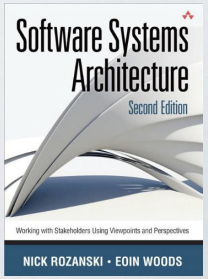
SECURITY DESIGN PRINCIPLES

- There are **many sets** of security design principles
  - Viega & McGraw (10), OWASP (10), NIST (33), NCSC (44), Cliff Berg's set (185) …
  - Many similarities between them at fundamental level
- I have distilled **10 key principles** as a basic set
  - these are brief summaries for slide presentation
  - www.viewpoints-and-perspectives.info



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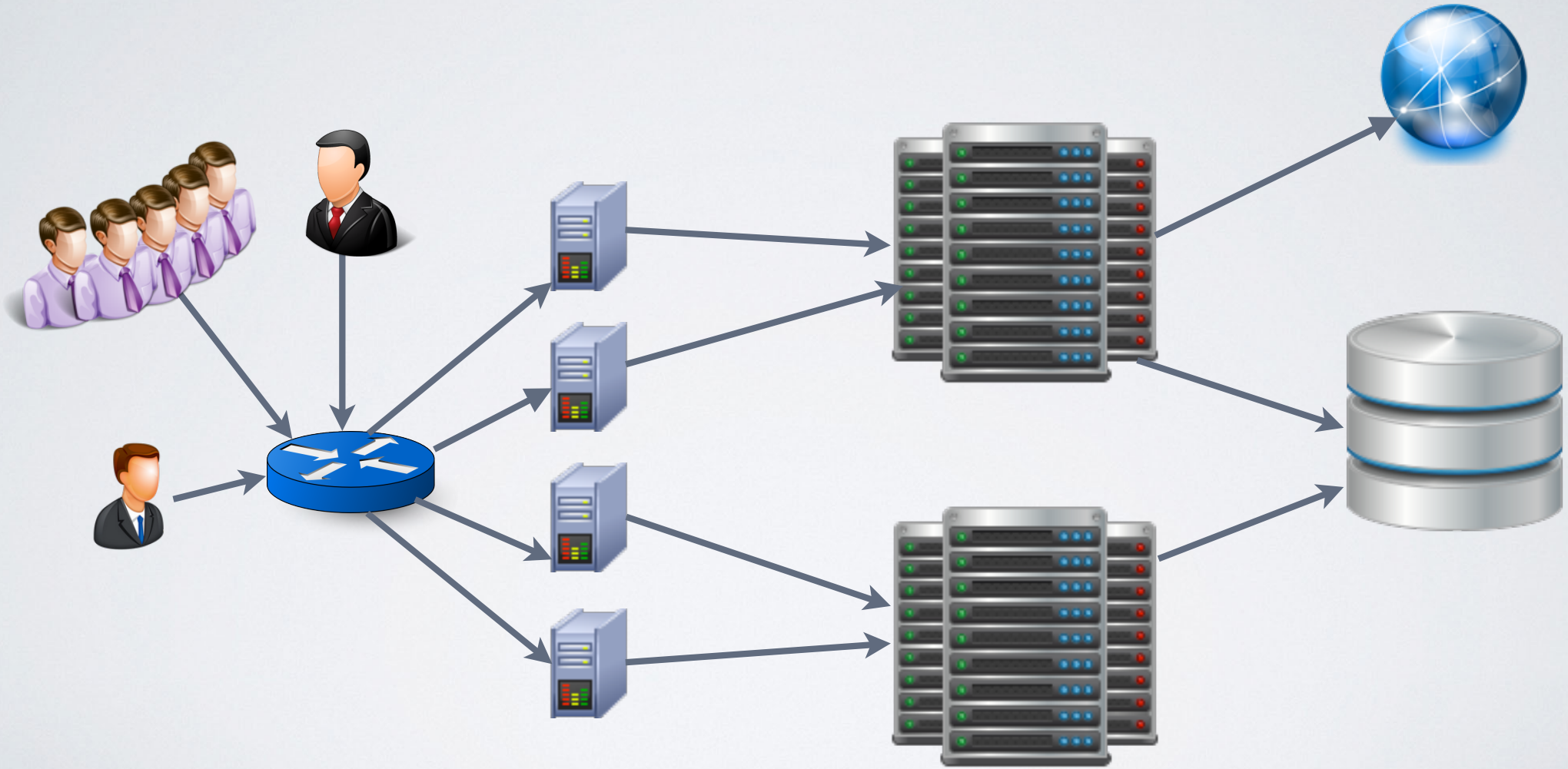
A SYSTEM TO BE SECURED



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TEN KEY SECURITY PRINCIPLES

- Assign the **least privilege** possible
- Separate **responsibilities**
- **Trust cautiously**
- **Simplest** solution possible
- **Audit** sensitive events
- **Fail securely** & use **secure defaults**
- Never rely upon **obscurity**
- Implement **defence in depth**
- **Never invent** security technology
- Find the **weakest link**

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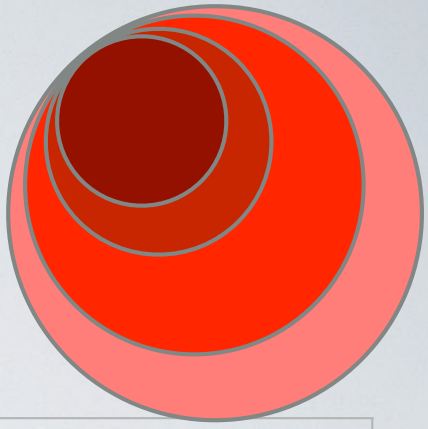
LEAST PRIVILEGE



Why?	Broad privileges allow malicious or accidental access to protected resources
Principle	Limit privileges to the minimum for the context
Tradeoff	Less convenient, less efficient, more complexity
Example	Run server processes as their own users with exactly the set of privileges they require

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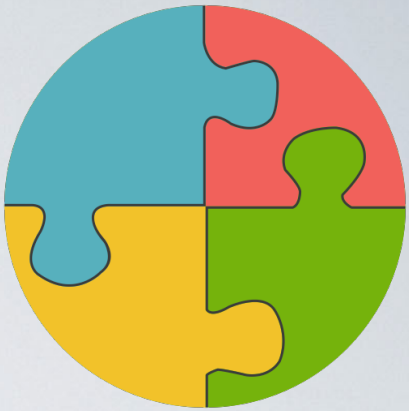
SEPARATE RESPONSIBILITIES



Why?	Achieve control and accountability, limit the impact of successful attacks, make attacks less attractive
Principle	Separate and compartmentalise responsibilities and privileges
Tradeoff	Development and testing costs, operational complexity, troubleshooting more difficult
Example	"Payments" module administrators have no access to or control over "Orders" module features

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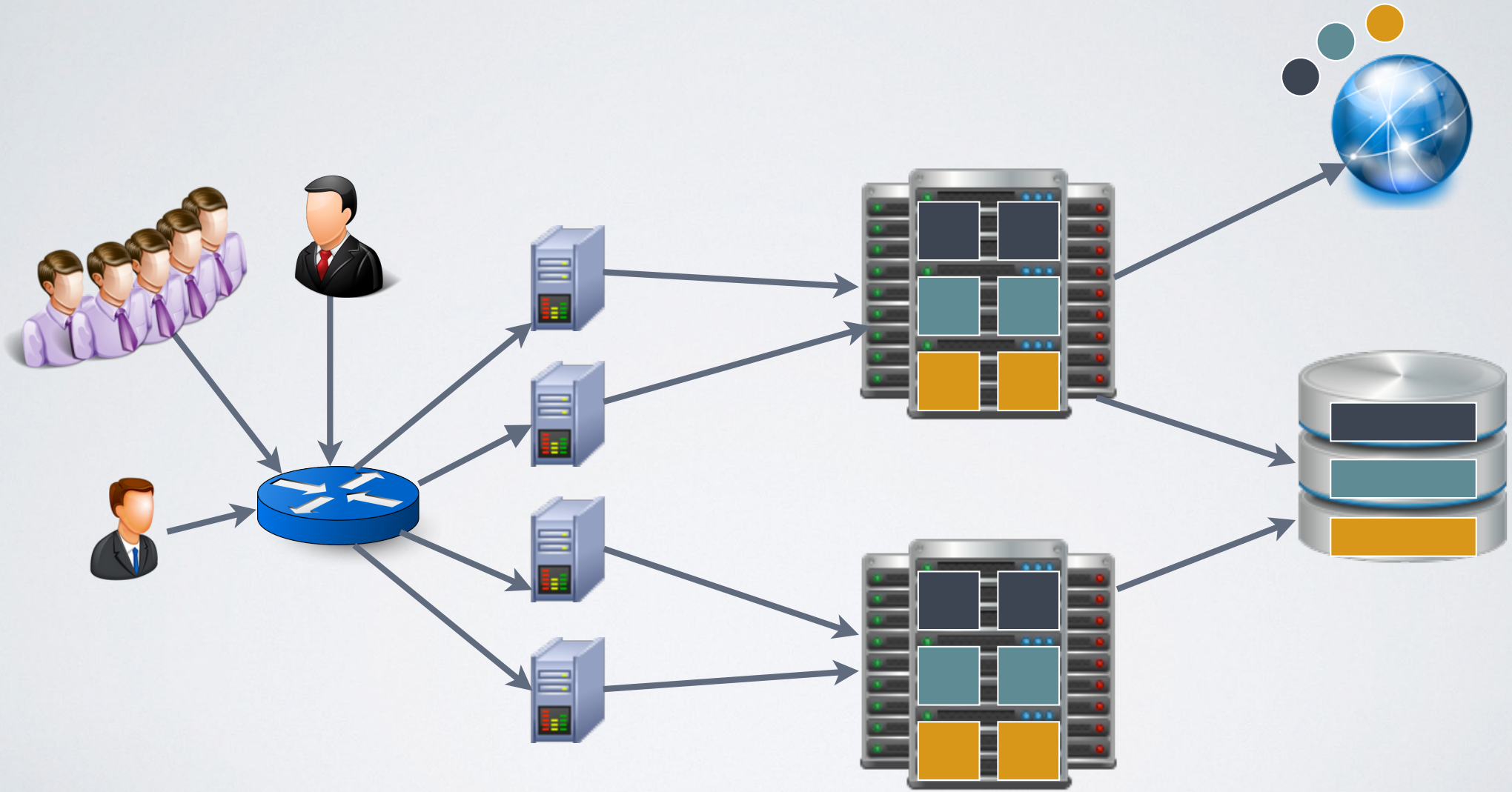
SEPARATE RESPONSIBILITIES



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TRUST CAUTIOUSLY

Why?	Many security problems caused by inserting malicious intermediaries in communication paths
Principle	Assume unknown entities are untrusted, have a clear process to establish trust, validate who is connecting
Tradeoff	Operational complexity (particularly failure recovery), reliability, some development overhead
Example	Don't accept untrusted RMI connections, use client certificates, credentials or network controls

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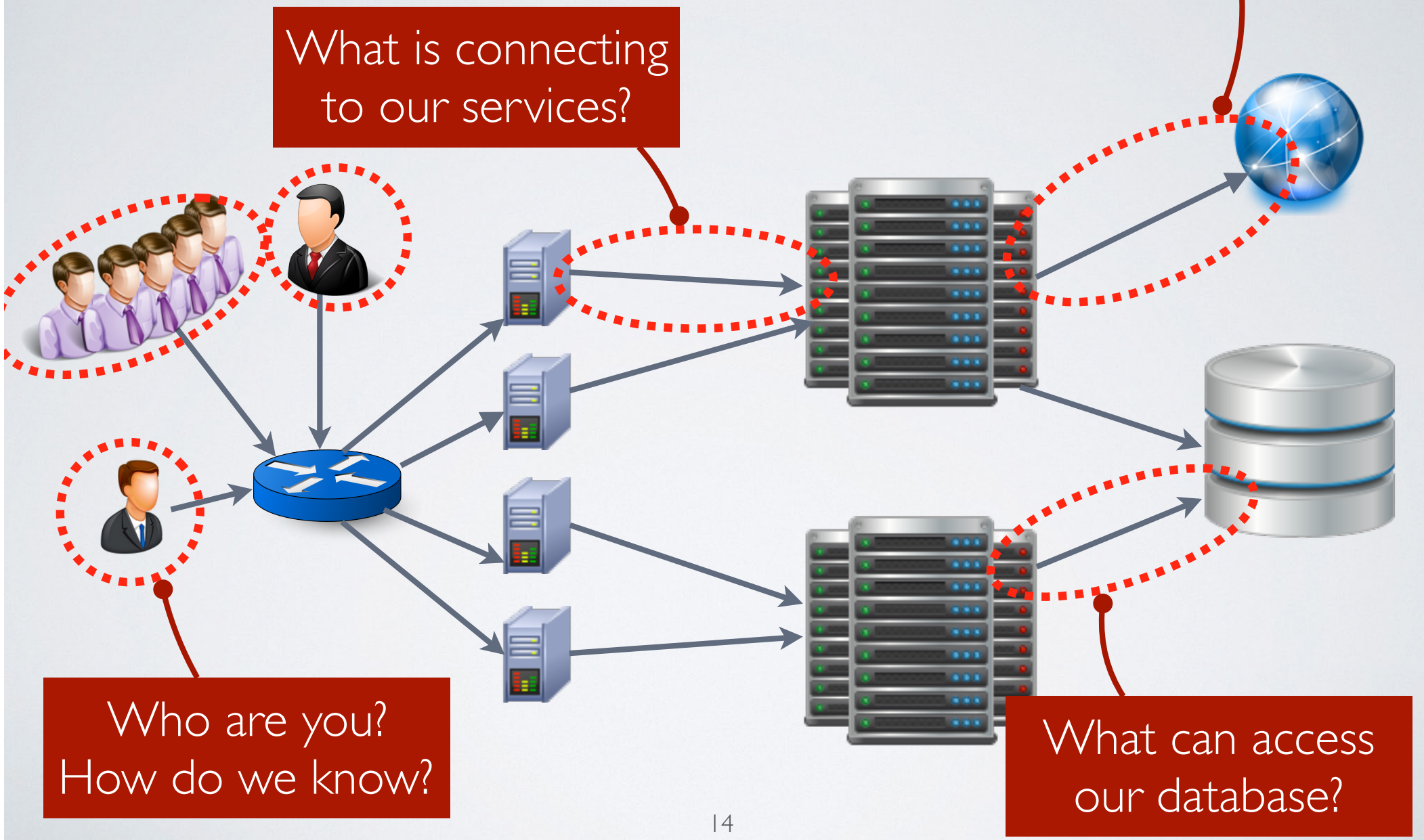
TRUST CAUTIOUSLY



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SIMPLEST SOLUTION POSSIBLE

*The **price** of **reliability** is the pursuit of the utmost **simplicity** - **C.A.R. Hoare***

Why?	Security requires understanding of the design - complex design is rarely understood - simplicity allows analysis
Principle	Actively design for simplicity - avoid complex failure modes, implicit behaviour, unnecessary features, …
Tradeoff	Hard decisions on features and sophistication Needs serious design effort to be simple
Example	Does the system really need dynamic runtime configuration via a custom DSL?

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AUDIT SENSITIVE EVENTS

Why?	Provide record of activity, deter wrong doing, provide a log to reconstruct the past, provide a monitoring point
Principle	Record all security significant events in a tamper-resistant store
Tradeoff	Performance, operational complexity, development cost
Example	Record all changes to "core" business entities in an append-only store with (user, ip, timestamp, entity, event)

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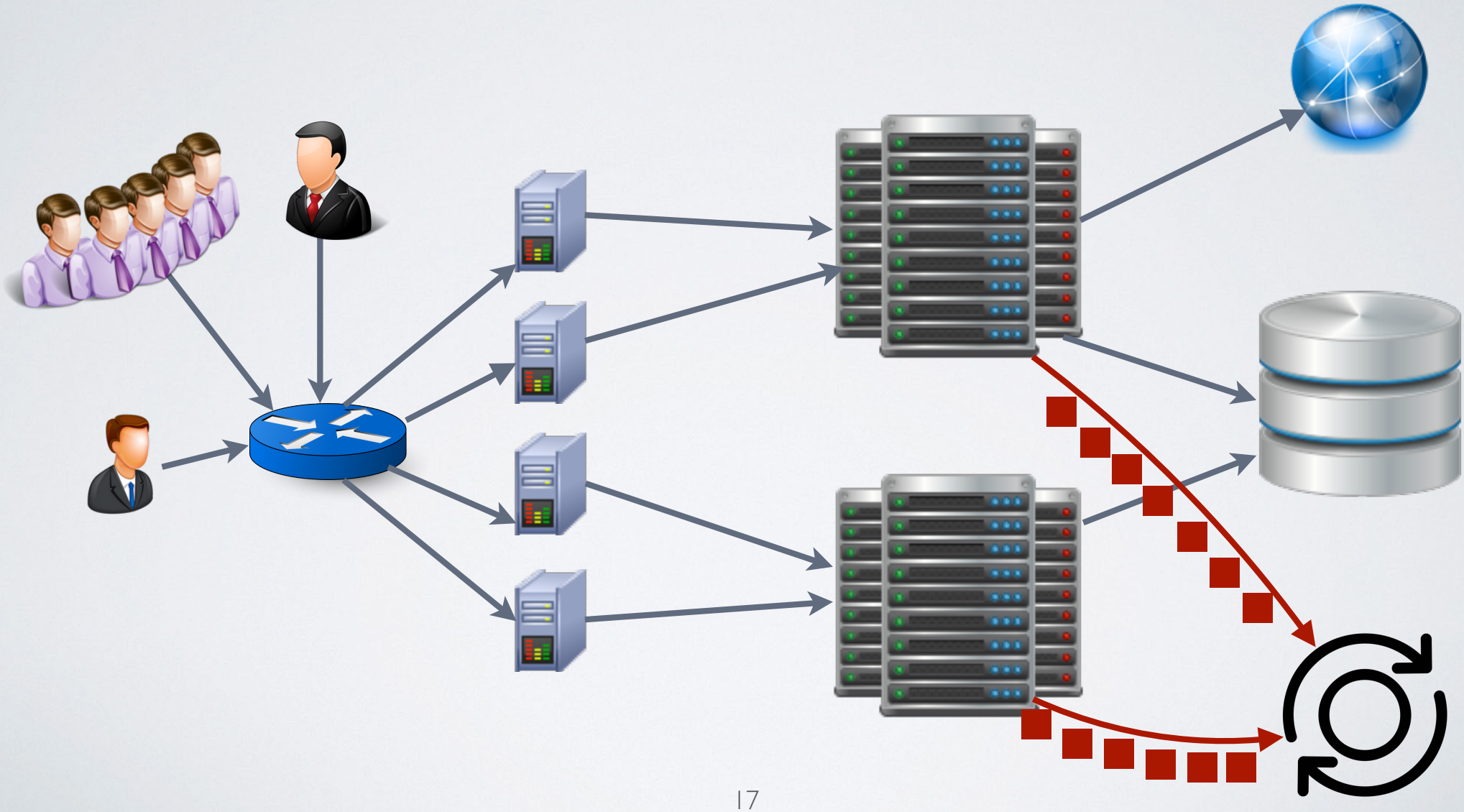
AUDITING



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SECURE DEFAULTS & FAIL SECURELY

Why?	Default passwords, ports & rules are "open doors" Failure and restart states often default to "insecure"
Principle	Force changes to security sensitive parameters Think through failures - must be secure but recoverable
Tradeoff	Convenience
Example	Don't allow "`SYSTEM/MANAGER`" after installation On failure don't disable or reset security controls

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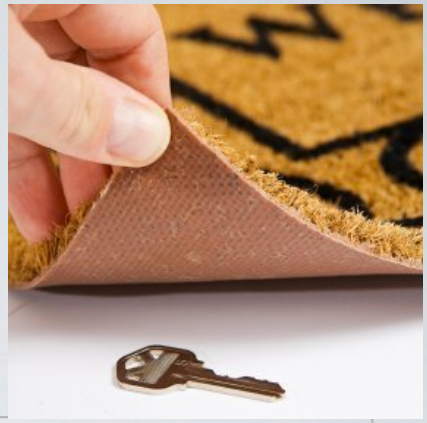
NEVER RELY ON OBSCURITY



Why?	Hiding things is difficult - someone is going to find them, accidentally if not on purpose
Principle	Assume attacker with perfect knowledge, this forces secure system design
Tradeoff	Designing a truly secure system takes time and effort
Example	Assume that an attacker will guess a "port knock" network request sequence or a password encoding

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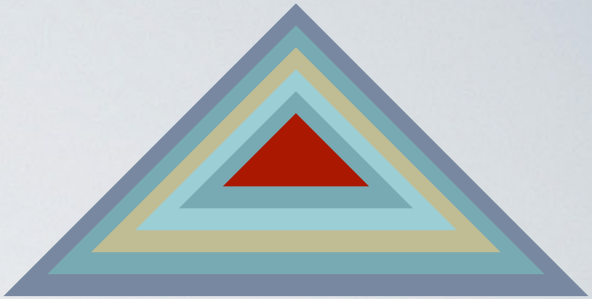
DEFENCE IN DEPTH



Why?	Systems do get attacked, breaches do happen, mistakes are made - need to minimise impact
Principle	Don't rely on single point of security, secure every level, stop failures at one level propagating
Tradeoff	Redundancy of policy, complex permissioning and troubleshooting, can make recovery harder
Example	Access control in UI, services, database, OS

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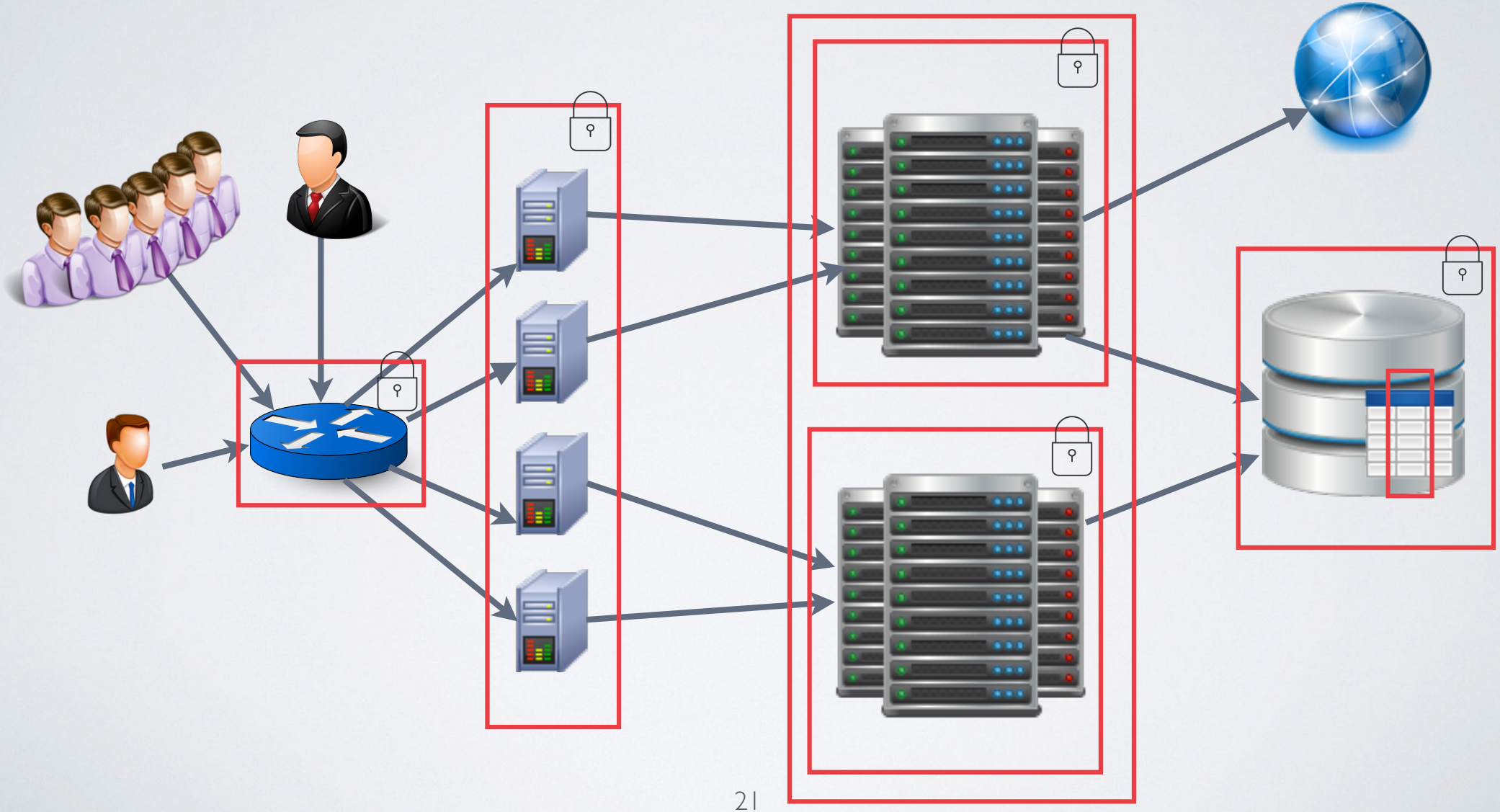
DEFENCE IN DEPTH



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NEVER INVENT SECURITY TECH

Why?	Security technology is difficult to create - specialist job, avoiding vulnerabilities is difficult
Principle	Don't create your own security technology always use a proven component
Tradeoff	Time to assess security technology, effort to learning it, complexity
Example	Don't invent your own SSO mechanism, secret storage or crypto libraries … choose industry standards

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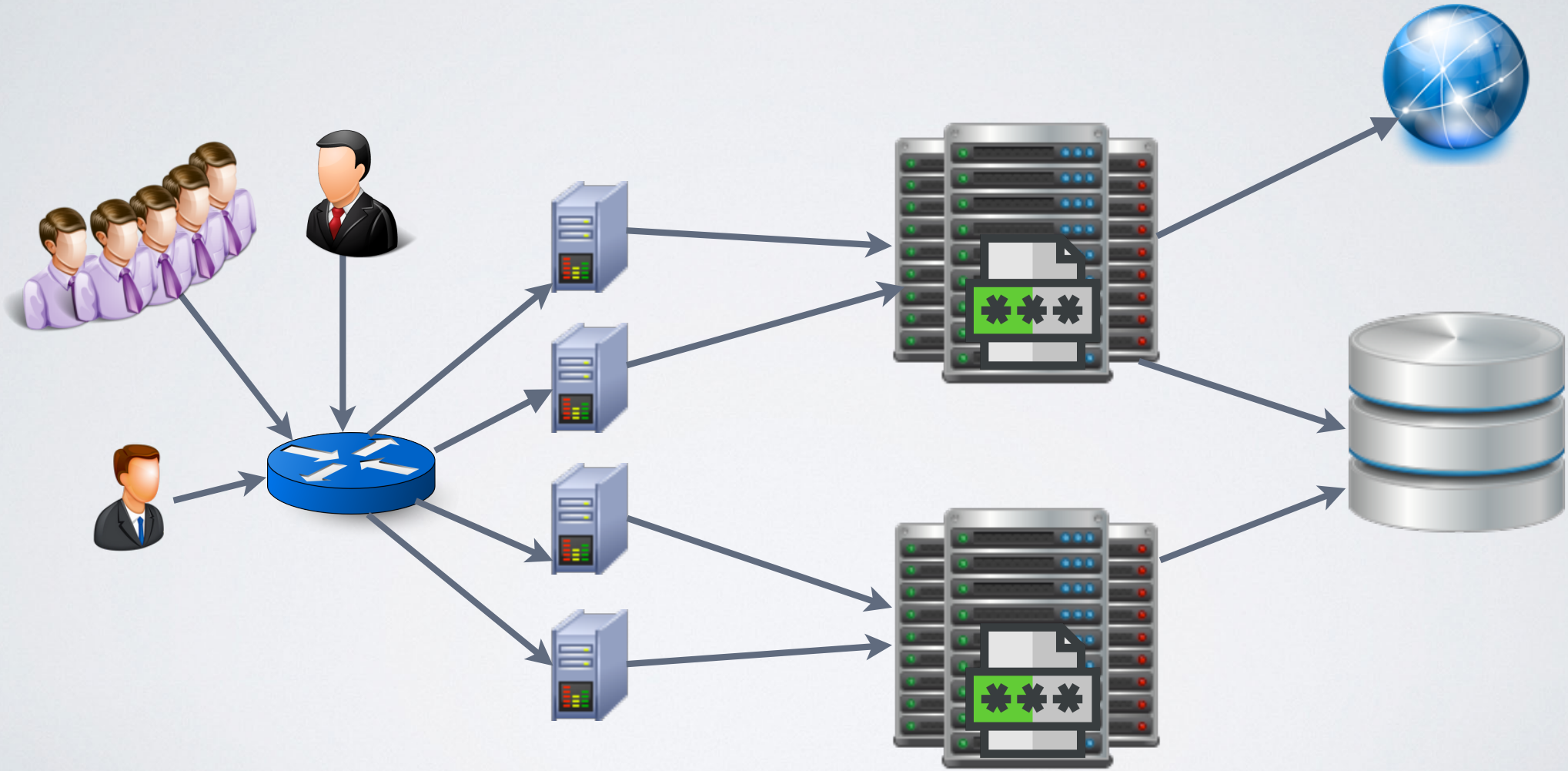
NEVER INVENT SECURITY TECHNOLOGY



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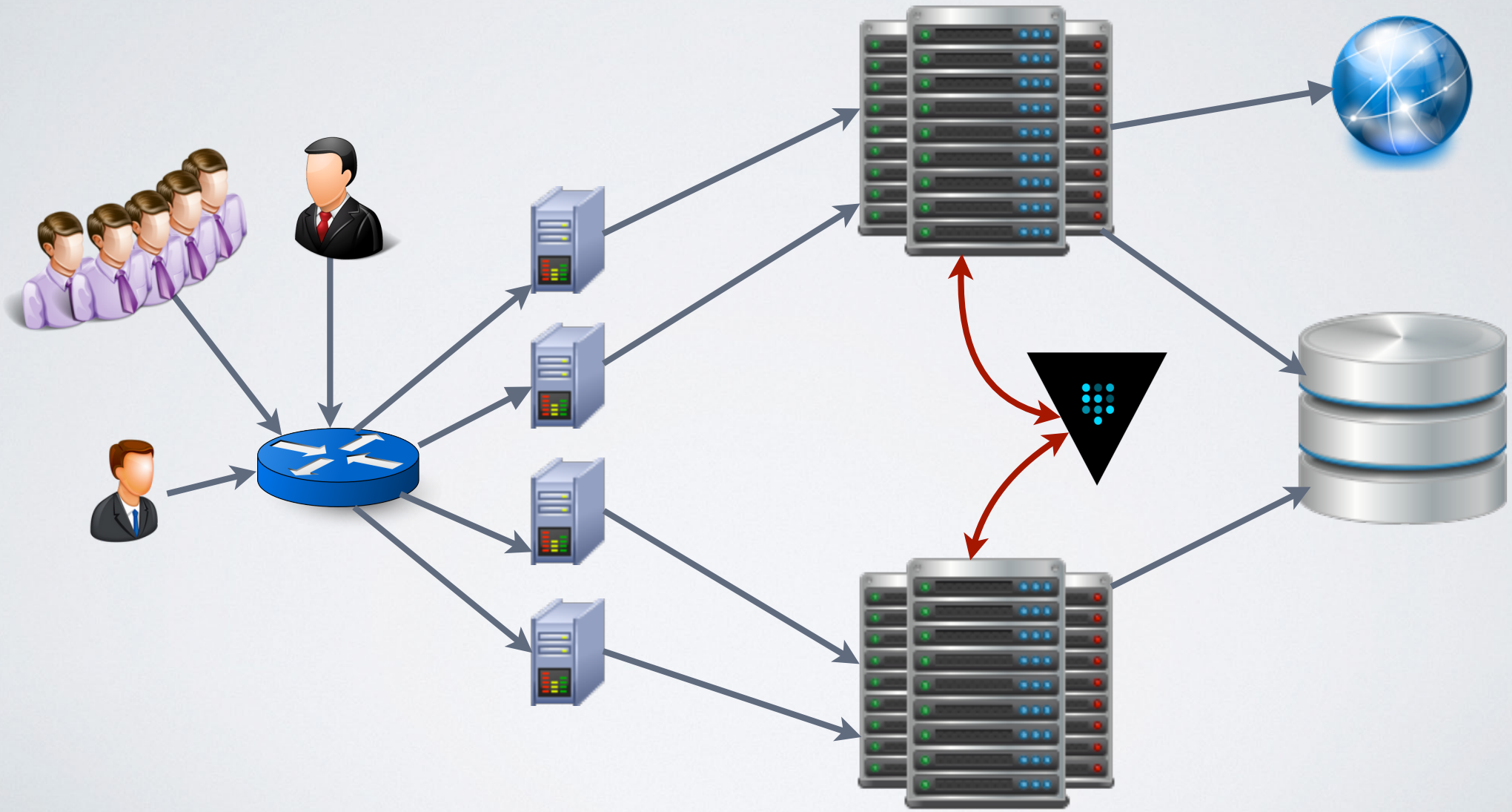

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SECURE THE WEAKEST LINK

Why?	"Paper Wall" problem - common when focus is on technologies not threats
Principle	Find the weakest link in the security chain and strengthen it - repeat! (Threat modelling)
Tradeoff	Significant effort required, often reveals problems at the least convenient moment!
Example	Data privacy threat met with encrypted communication but with unencrypted database storage and backups

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REFERENCES

- UK Government NCSC Security Principles: https://www.ncsc.gov.uk/guidance/security-design-principles-digital-services-main
- NIST Engineering Principles for IT Security: http://csrc.nist.gov/publications/nistpubs/800-27A/SP800-27-RevA.pdf
- Short intro to McGraw's set: http://www.zdnet.com/article/gary-mcgraw-10-steps-to-secure-software/
- OWASP Principles set: https://www.owasp.org/index.php/Category:Principle

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BOOKS

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THANK YOU … QUESTIONS?

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