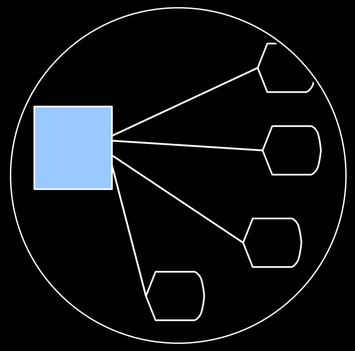
Enterprise Architecture

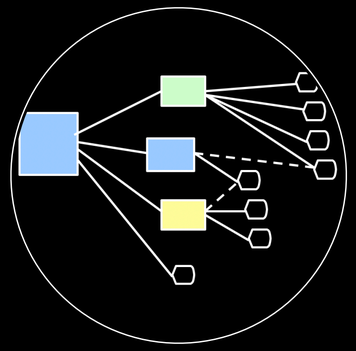
Enterprise architecture

Overview

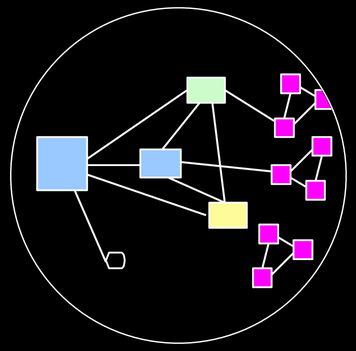
- Enterprises have made significant investment in system architectures, some over a number of decades.
- Many enterprises will still rely on prior enterprise architectures and/or system in their present systems and processes.
- Important to appreciate the **primary security concerns of each era** and the **legacy concerns** from these eras.



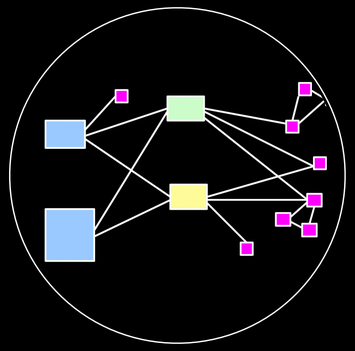
Mainframe Era



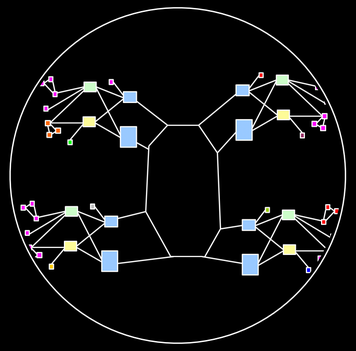
Minicomputer Era



Distributed/PC Era



Client-server Era



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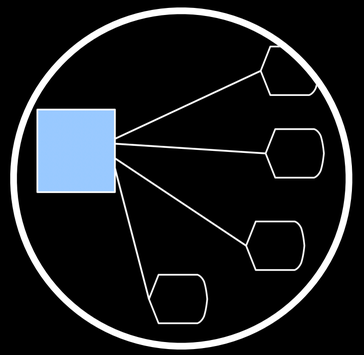

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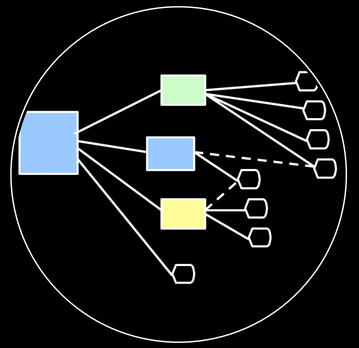

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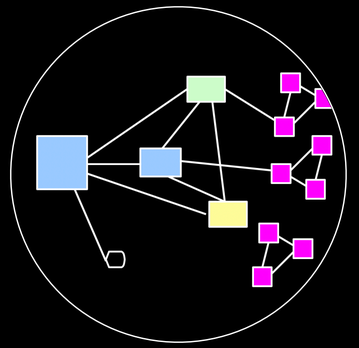

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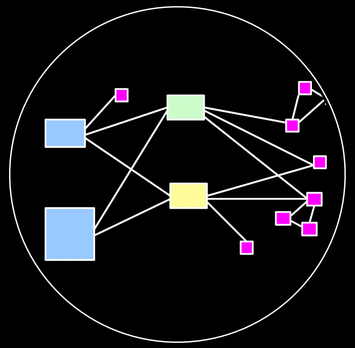

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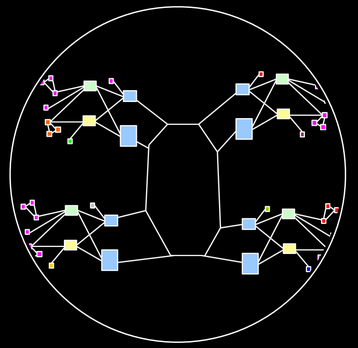

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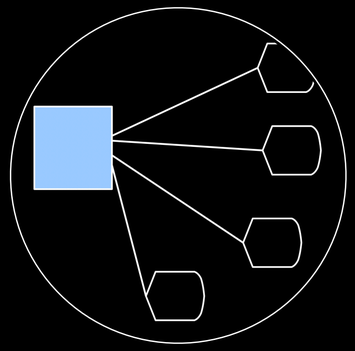

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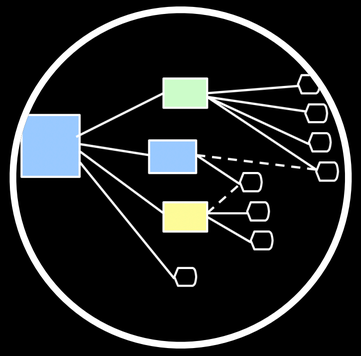

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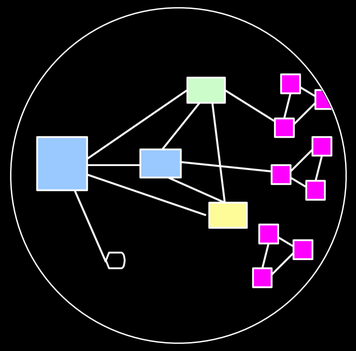

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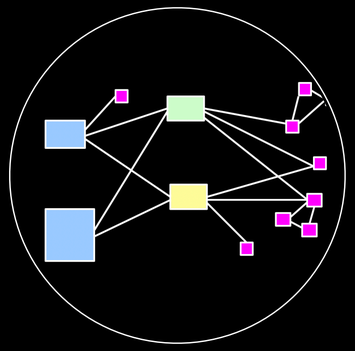

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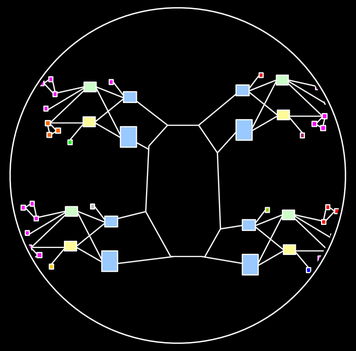

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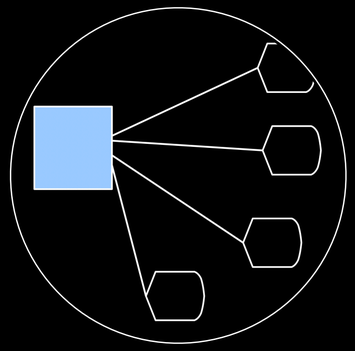

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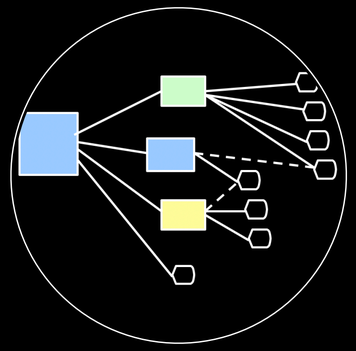

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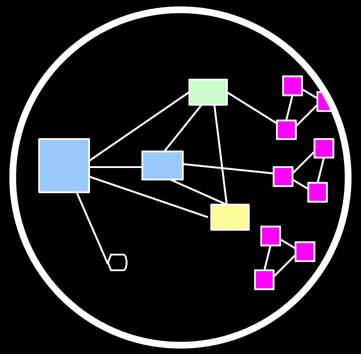

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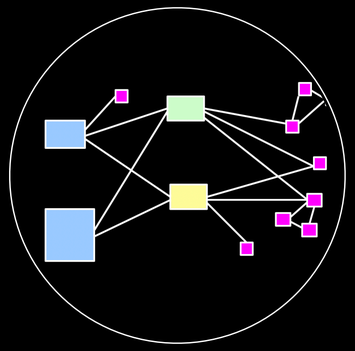

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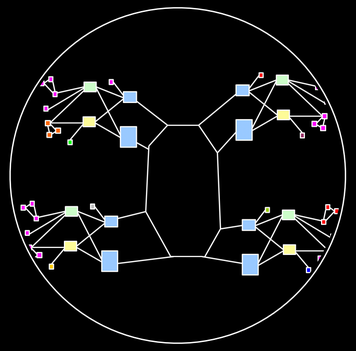

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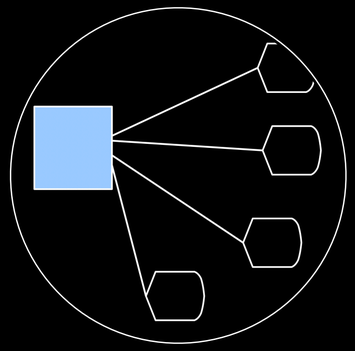

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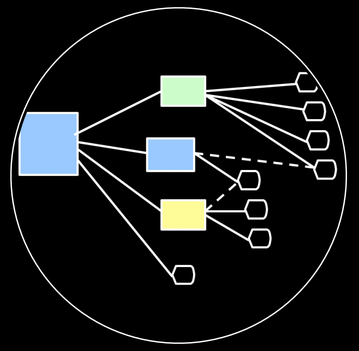

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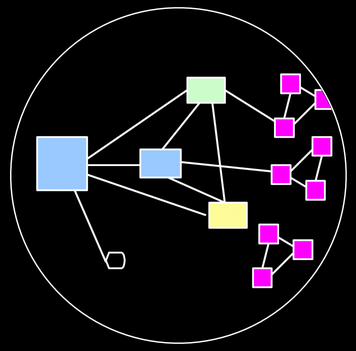

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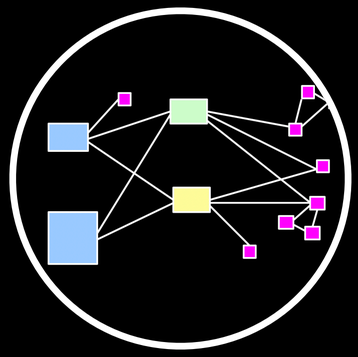

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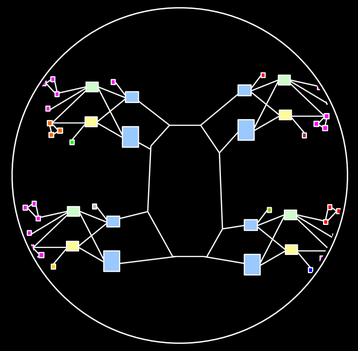

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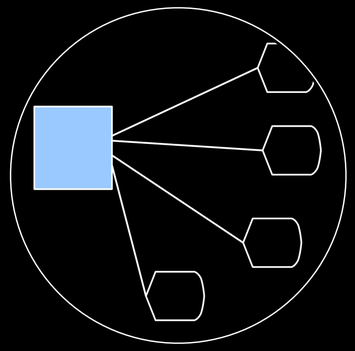

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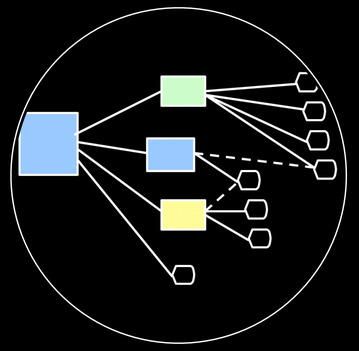

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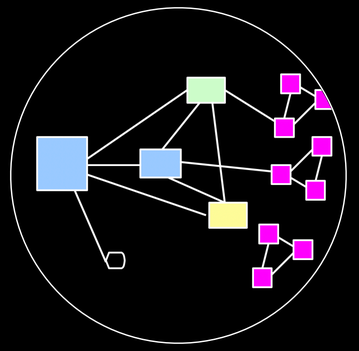

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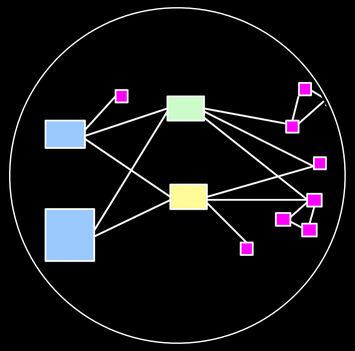

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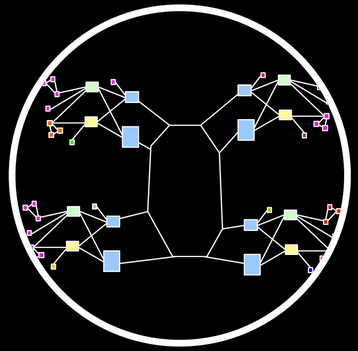

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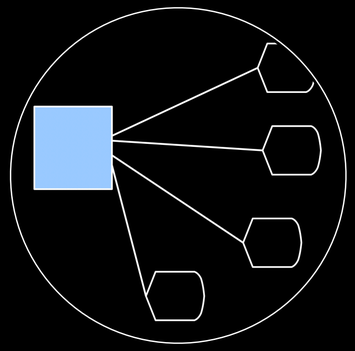

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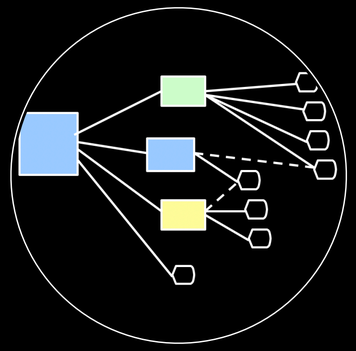

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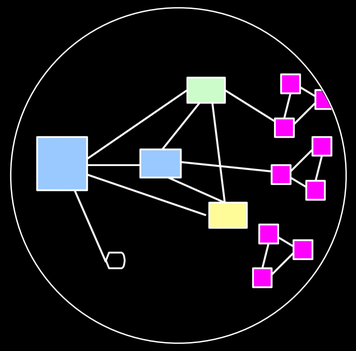

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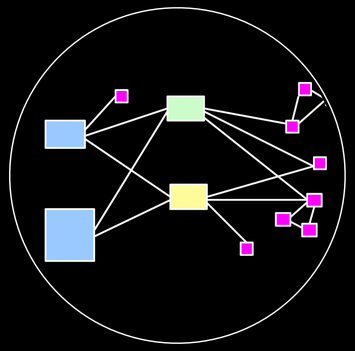

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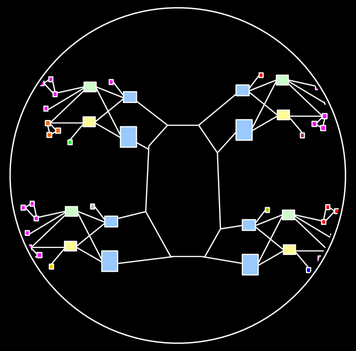

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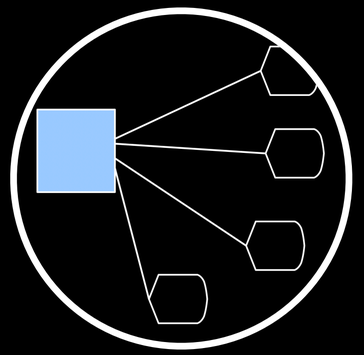

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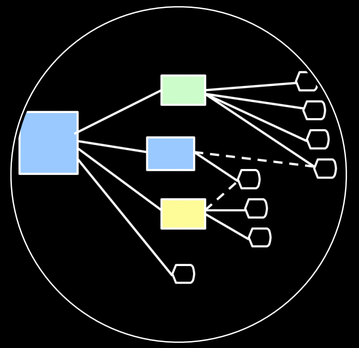

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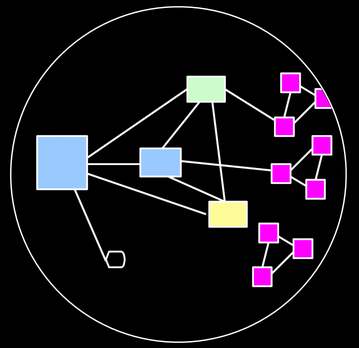

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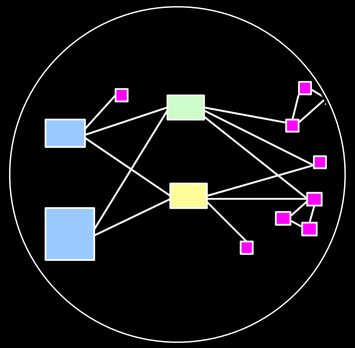

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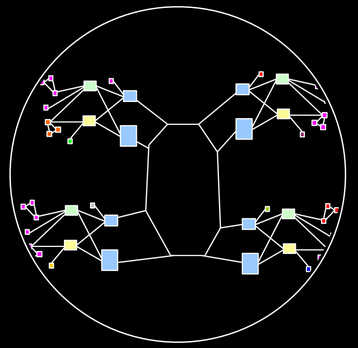

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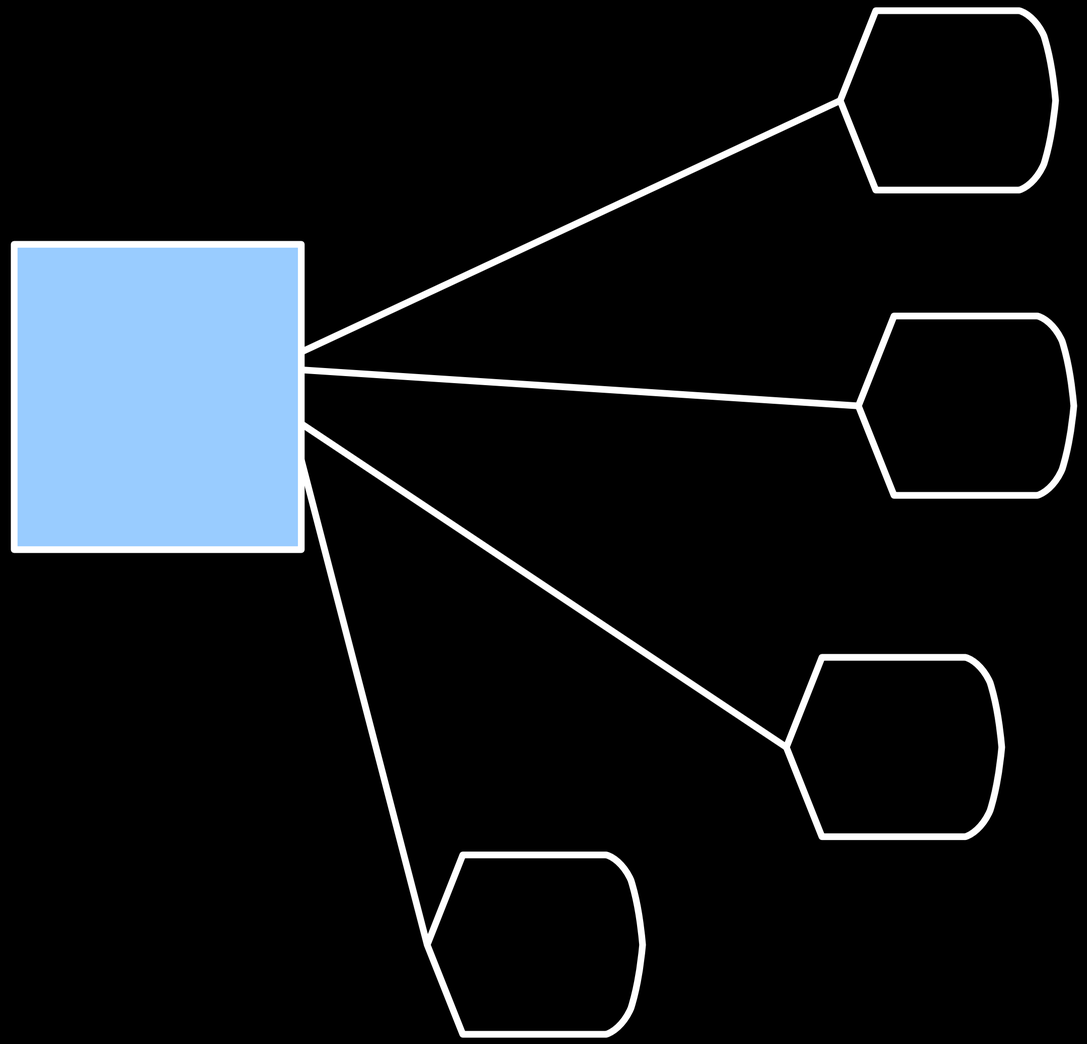
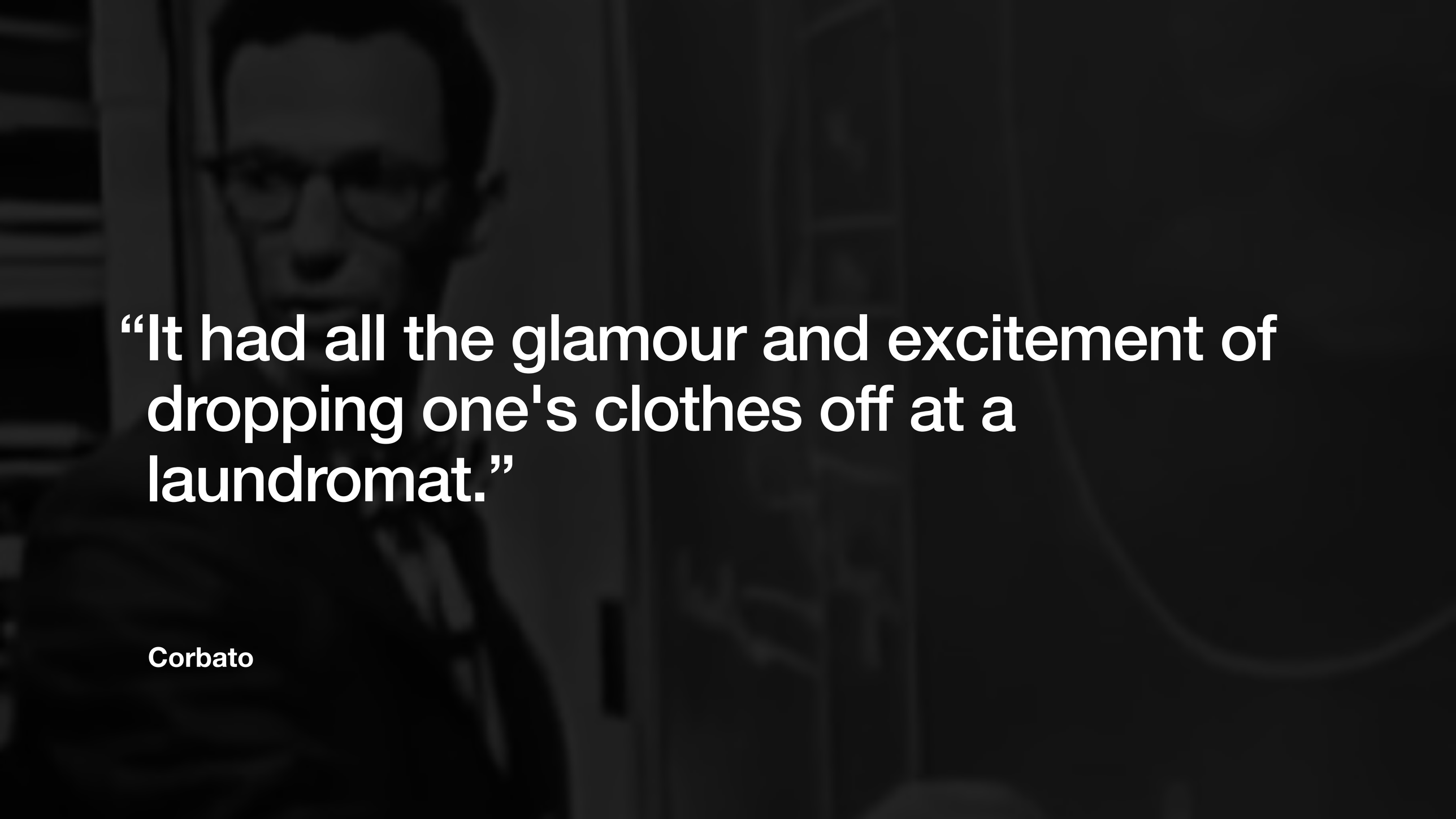


Mainframes

- Enterprises started to invest in mainframes, large computers that could be physically secured in a room.
- Such systems could be managed and maintained by professionals with others queuing to gain access to them.
- Not physical access, but resource access - many individuals in the 1960s would queue up with punched cards.
- As the decade progressed individuals could have these cards read remotely by machines connected by cable to the mainframe.



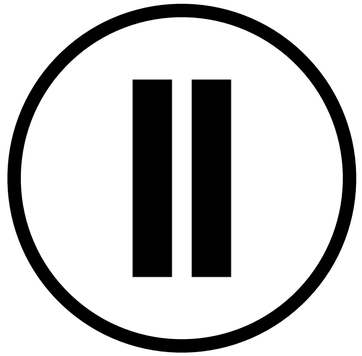
“It had all the glamour and excitement of dropping one's clothes off at a laundromat.”

Corbato

Mainframe era (1950s-70s)

- Few mainstream supplier choices (IBM, ICL, Amdahl, Burroughs, Univac, Honeywell, Fujitsu etc).
- Simple architecture with centralised tight control with low autonomy.
- Back office automation and transaction processing, relying on dumb terminals.
- The approach had very high costs and the emergence of siloed applications.

What do you think are the primary security concerns in this era?



Mainframes

Security concerns

- Physical more than virtual concerns.
- Integrity of data gained prominence.
- Systems not dependable with poor software and system quality.
- Computer crime started to emerge.

Mainframes

Physical

- **Physical concerns were of focus,** security at this stage would be to make sure the lock on the door is working and staff would physically trace cables.
- Electronic input slowly started to replace punched cards as form of interaction.
- Individuals started to get computers in their system, connected to the larger system.
- Security professionals would again physically trace all connections to make sure only authorised systems connected.

Mainframes

Data

- **Integrity of data gains importance, confidentiality and availability less so,** managers were less concerned about the security of information, in terms of confidentiality, butt integrity was concerning.
- Cryptography became of interest as elements of government came online, such as the Internal Revenue Service (IRS).
- Confidentiality became more an issue and National Institute for Standards and Technology (NIST) launched 1974 Privacy and Security act.
- Reason for this is that machines started to be connected intimately to an individual. The act concerned itself with government machines and use of personally identifiable information (PII).

Mainframes

Systems not dependable

- **Systems not dependable,** Computer systems were constantly failing and collapsing, modern software engineering practices were not in effect.
- Poor design decisions in terms of how individuals interacted with the system.
- Limitation in automation created issues, for example customer service agents could create reservations but purchasing would happen at another system.

Mainframes

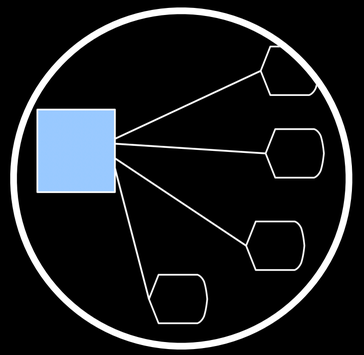
Computer crime

- **Computer crime was starting to emerge**, even being discussed in the media (mainly financial crimes).

Mainframes

Enterprise problems

- **Significant investment**, poor automation of many processes and not particularly dependent systems.



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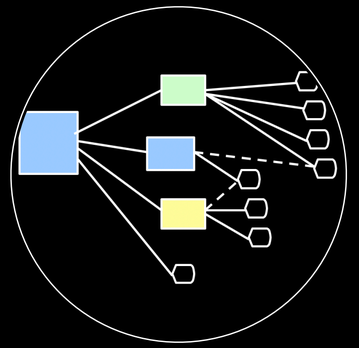

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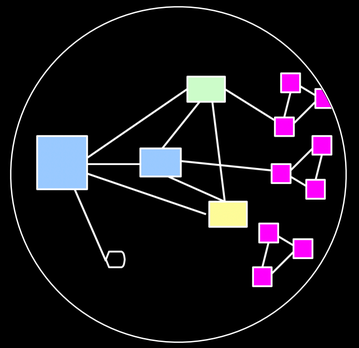

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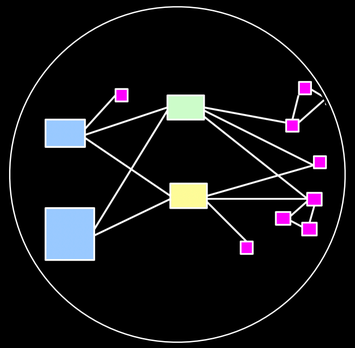

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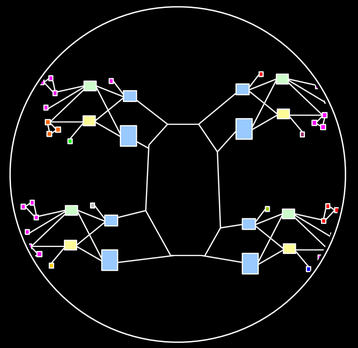

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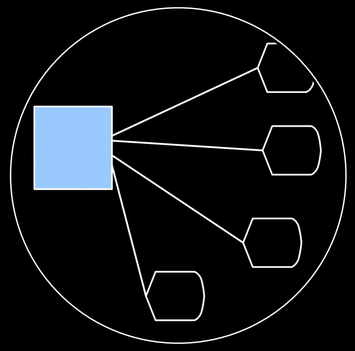

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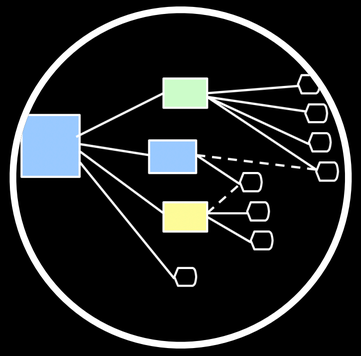
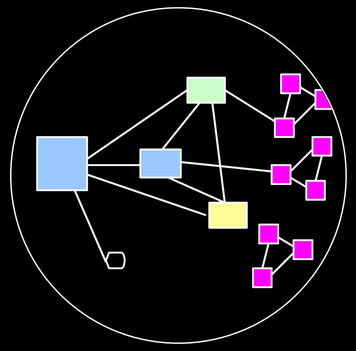
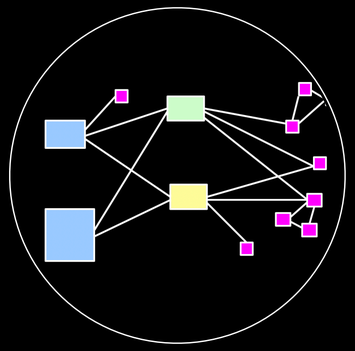


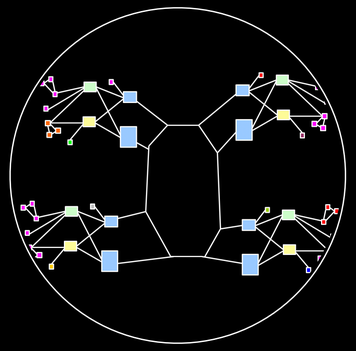
Minicomputer Era



Distributed/PC Era

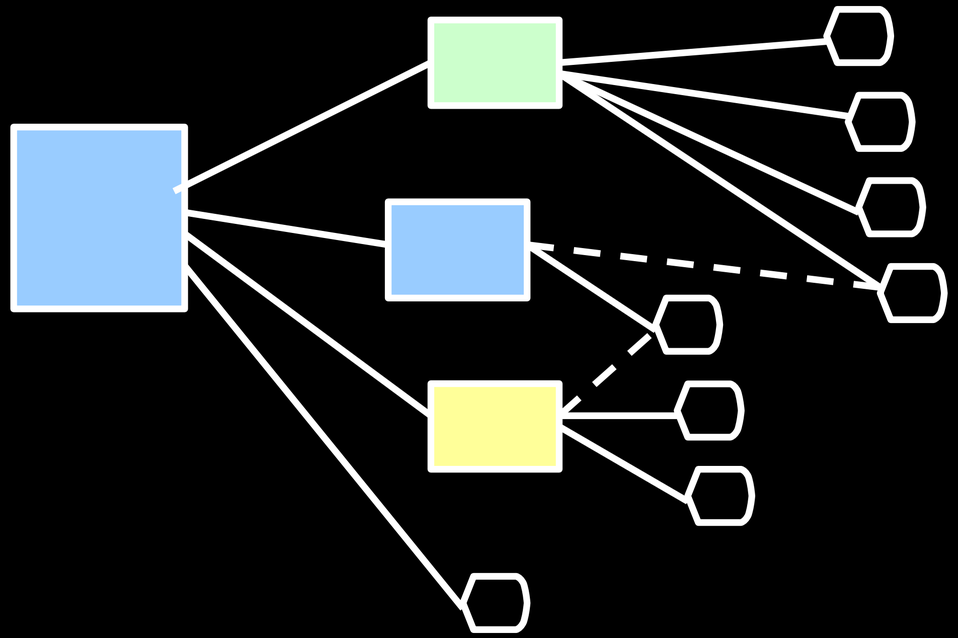


Client-server Era



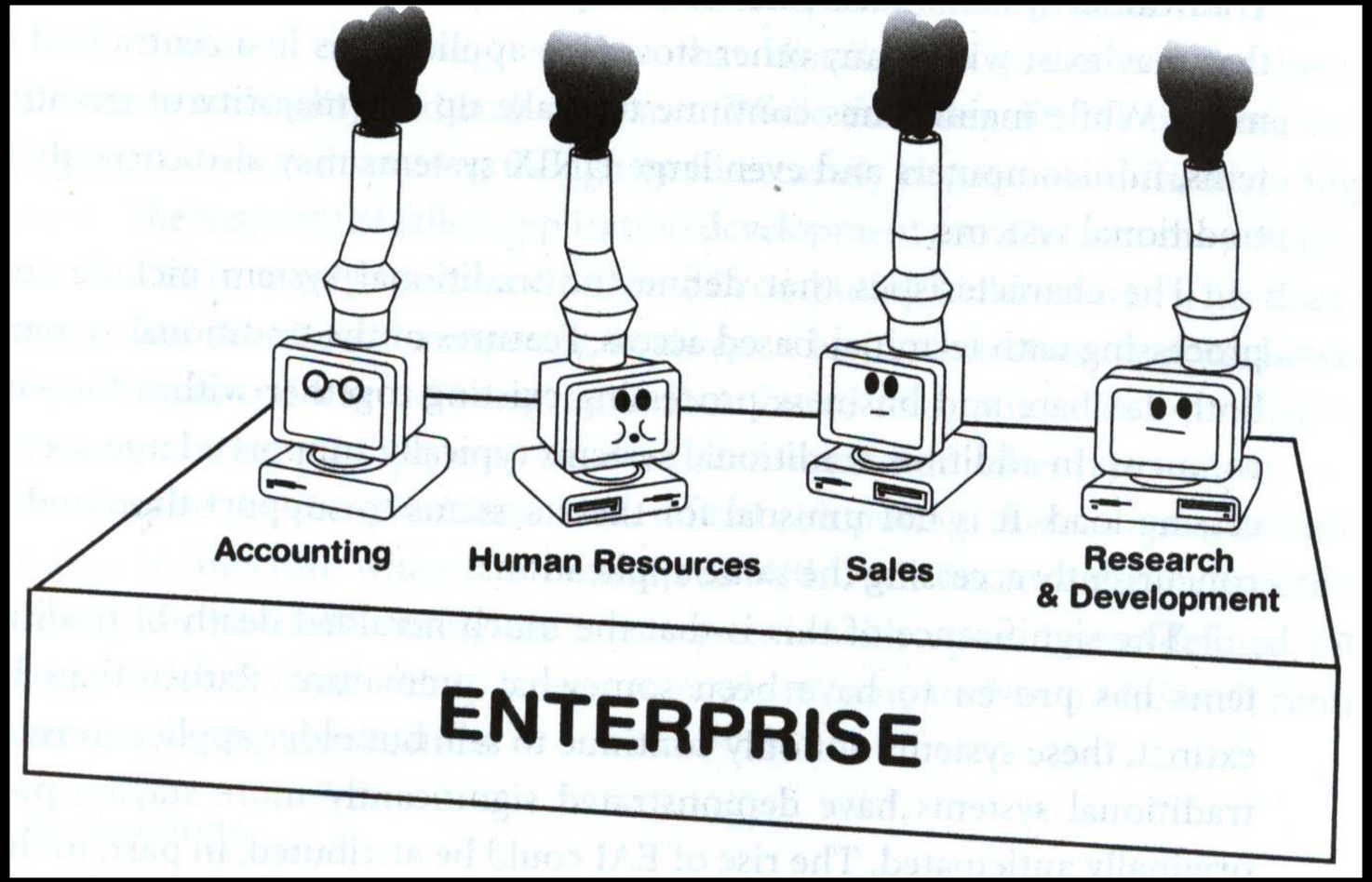
Networked Era

Minicomputer Era



Minicomputer Era (1970S, 80S)

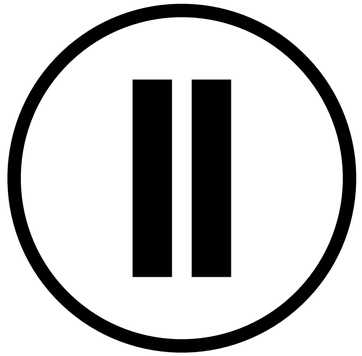
- Several mainstream supplier choices from 1960s (IBM, ICL, DEC, NCR etc.)
- Architecture remains simple with dumb terminals, but the focus is still transaction processing.
- Silo applications, ‘islands of automation’, mismatching data as well as strategy.
- Distributed autonomy starts to emerge with the approach still representing significant costs and concerns.


Accounting
Human Resources
Sales
Research
& Development
ENTERPRISE

Stovepipes

- Stovepipe systems are typically designed to fulfil a specific purpose and specific set of users.
- Stovepipe systems were typically implemented with in-fashion approaches and technologies.
- No real consideration of integration of different users or different systems.
- Business units, such as logistics or human resources, may have their own systems and applications that do not integrate.

What do you think are the primary security concerns in this era?



Problems with stovepipes

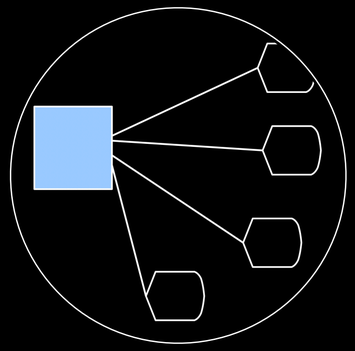
Security

- **Different stovepipes generated different design decisions,** poor integration and inconsistent approaches across enterprise.
- **Easier to secure from some perspectives,** as they do not share data, with data exchange, difficult to determine a coherent understanding of enterprise.
- Stovepipes can represent many processes and unseen challenges with integration.

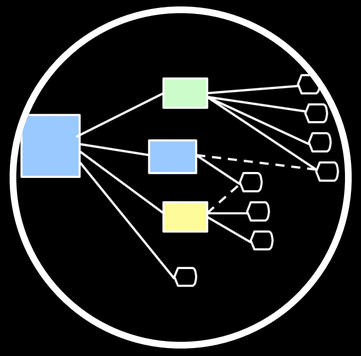
Problems with stovepipes

Enterprise

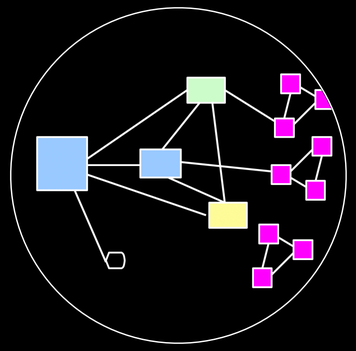
- Stovepipes can represent many processes and unseen challenges with integration.



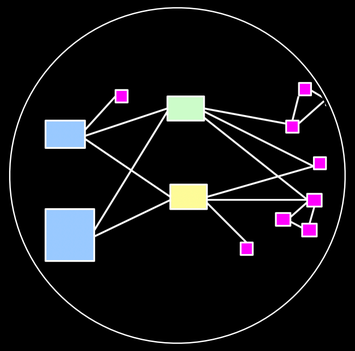
Mainframe Era



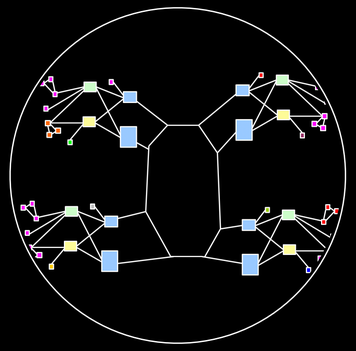
Minicomputer Era



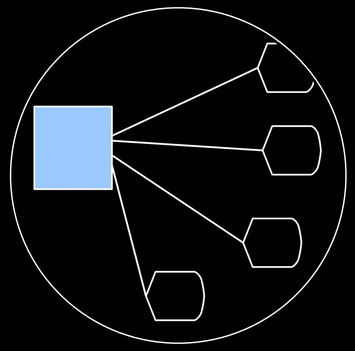
Distributed/PC Era



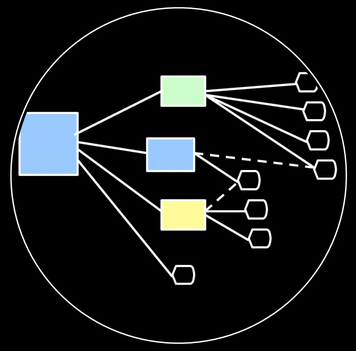
Client-server Era



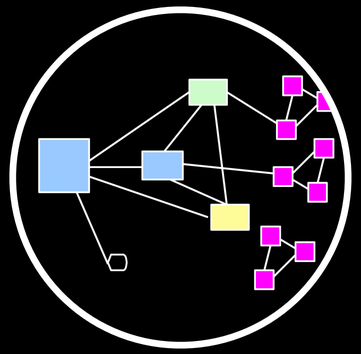
Networked Era



Mainframe Era



Minicomputer Era



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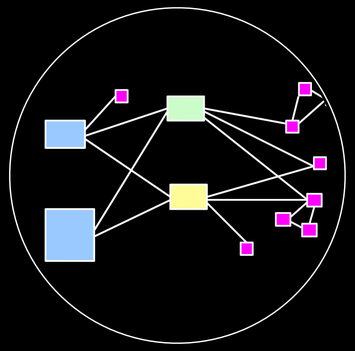

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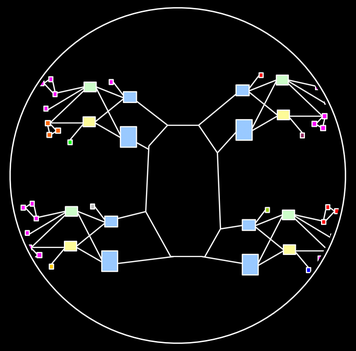
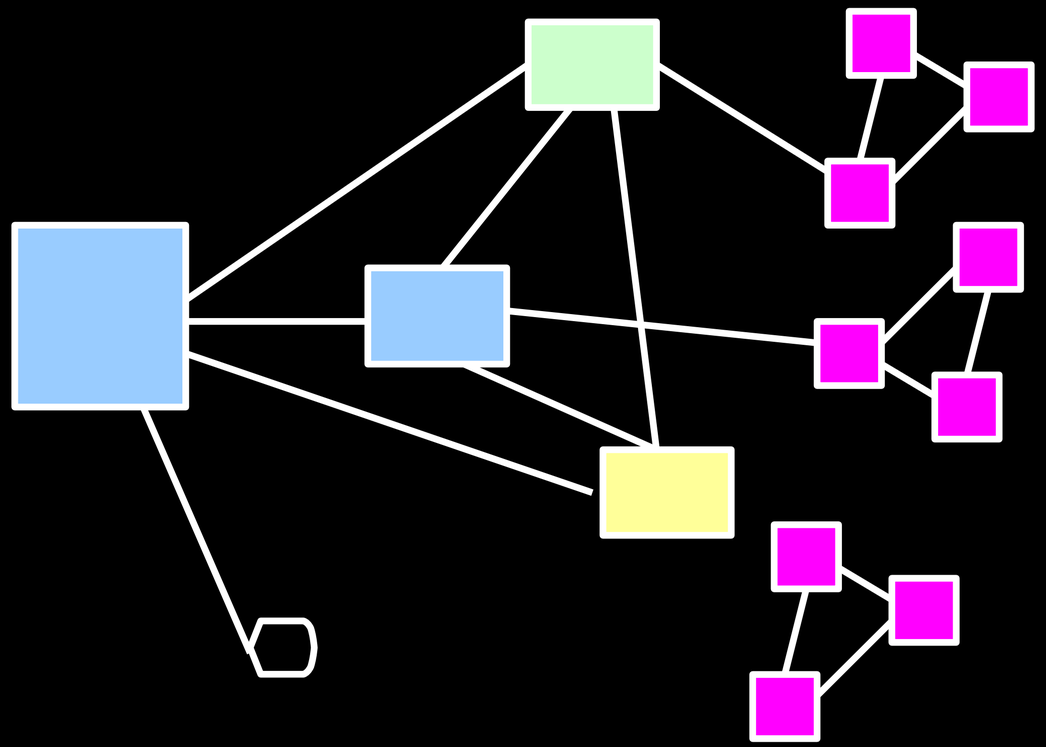


Networked Era

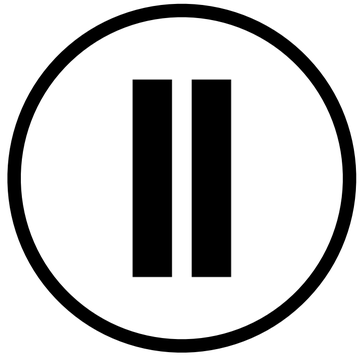
Distributed/PC Era



Distributed/PC era (1980s, 90s)

- Burgeoning market for personal computers with many different suppliers and varied capabilities.
- Complex architectures evolves with far more autonomy for units, down to departmental level.
- Integration still remains poor, becoming greater challenge with emerging technologies (voice, data etc).
- Associated cost is still and need to evolve to support ever more complex organisational structures.

What do you think are the primary security concerns in this era?



Distributed/PC problems

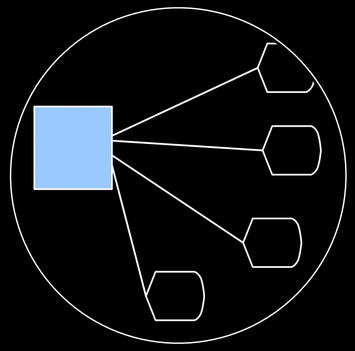
Security

- **Lack of control and coverage**, some individuals can now many decisions about settings and applications on individual systems introducing holes in the infrastructure.
- **Lack of security awareness and training**, enterprises relying more and more on individuals whose core competency is not security, never mind information technology.

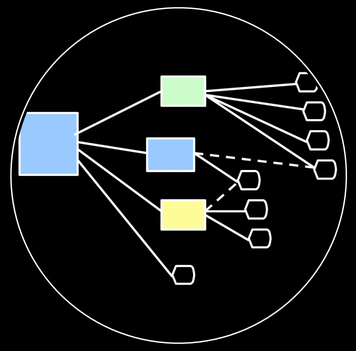
Distributed/PC problems

Enteprise

- **Still poor integration of data**, data still resides on individual systems or within separate units.



Mainframe Era



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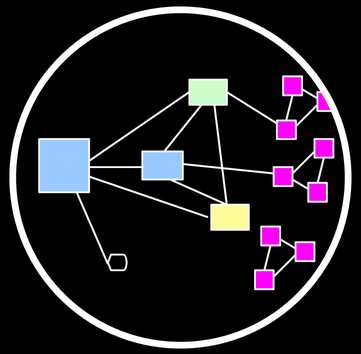
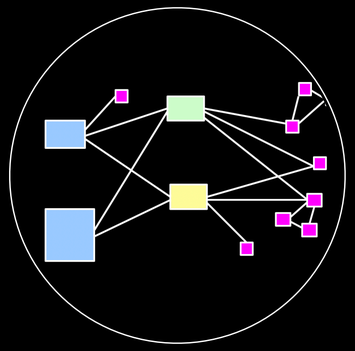
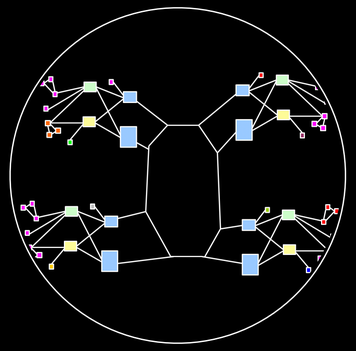


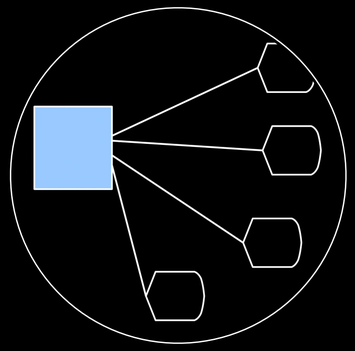
Distributed/PC Era



Client-server Era



Networked Era



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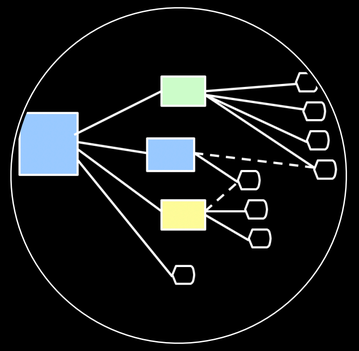

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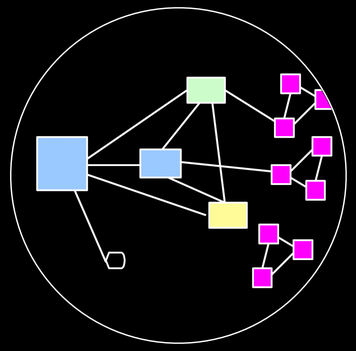

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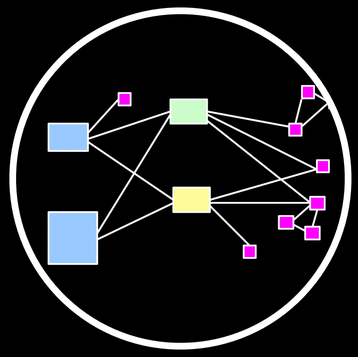
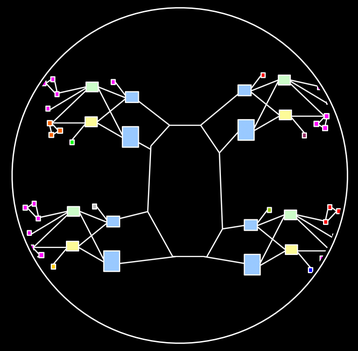
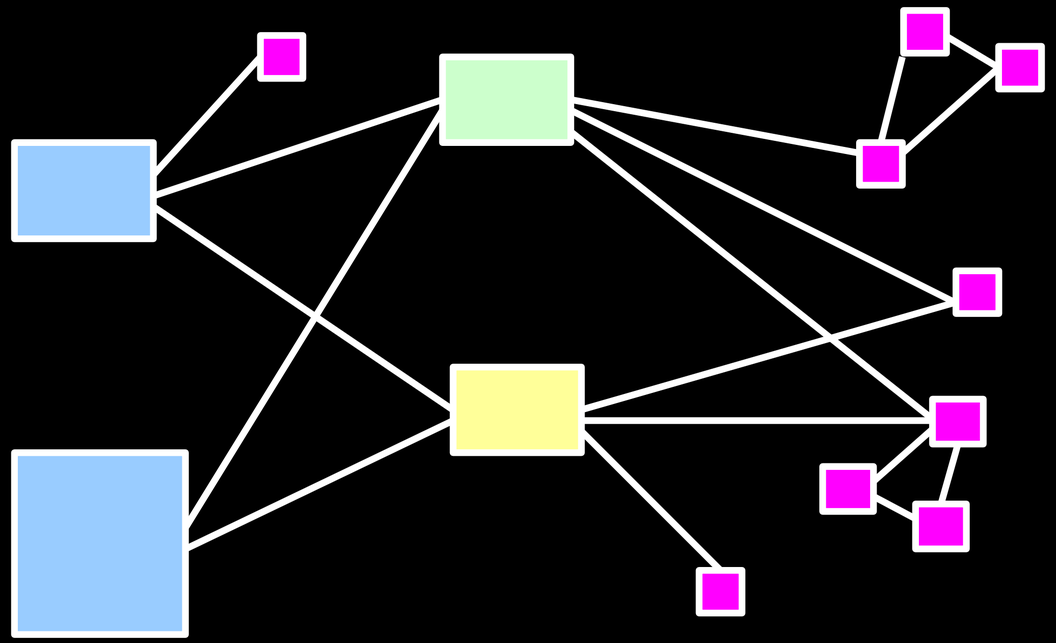


Client-server Era



Networked Era

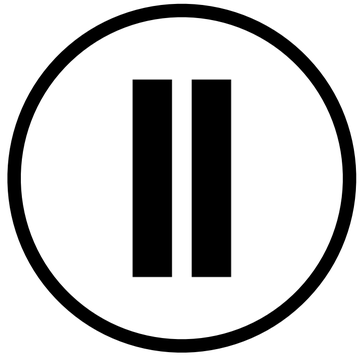
Client-server Era



Client-server era (1990s)

- Enterprises had a wealth of suppliers to choose from, but choice was restricted in terms of proprietary and open standards.
- The Internet became of greater interest and challenge to the enterprise, importantly it standardised communication.
- Business units had incredible autonomy, but this can be even more as concern as more and more data was captured.
- Enterprise investment still represented a significant consideration and cost.

What do you think are the primary security concerns in this era?



Client-server problems

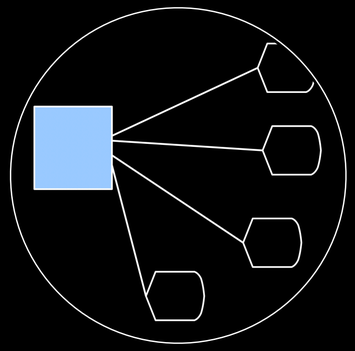
Security

- **Systems to improve coverage and control could be compromised**, systems use to update and improve systems could be compromised by attackers to take control of various elements of the wider system.
- **Concern over the confidentiality of data at rest and in transit,** in terms of technical controls.

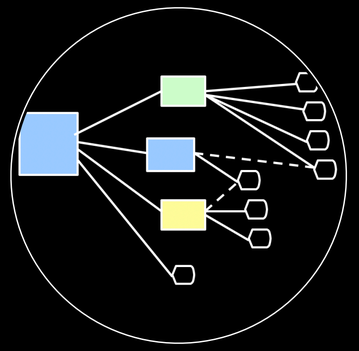
Client-server problems

Enterprise

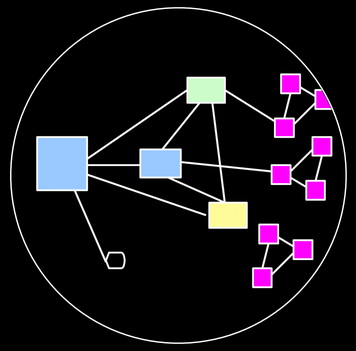
- **Still relatively poor oversight of data and integration of processes across business units**, vastly improved on by previous architectures but still not optimal and concerns with increased data capture.



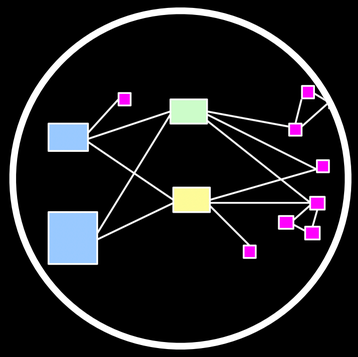
Mainframe Era



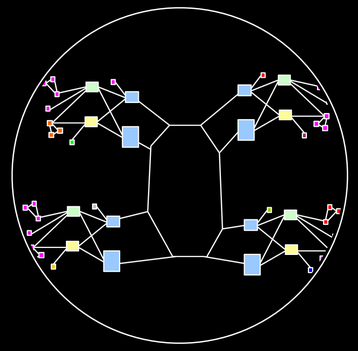
Minicomputer Era



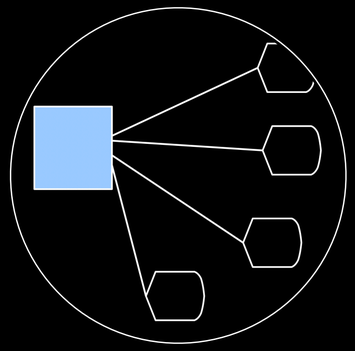
Distributed/PC Era



Client-server Era



Networked Era



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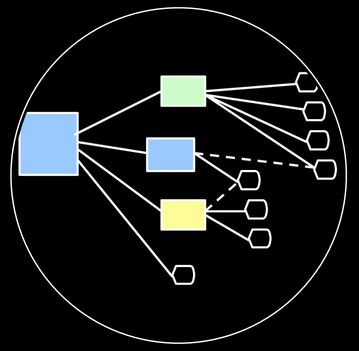

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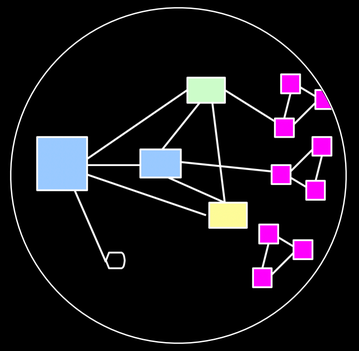

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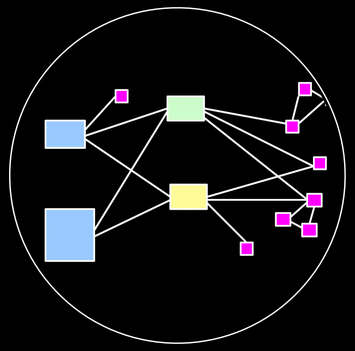

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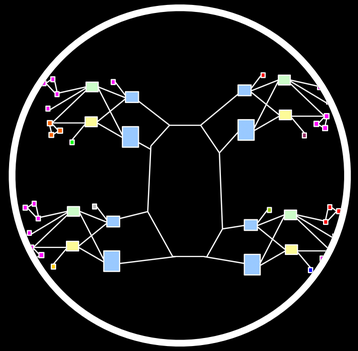
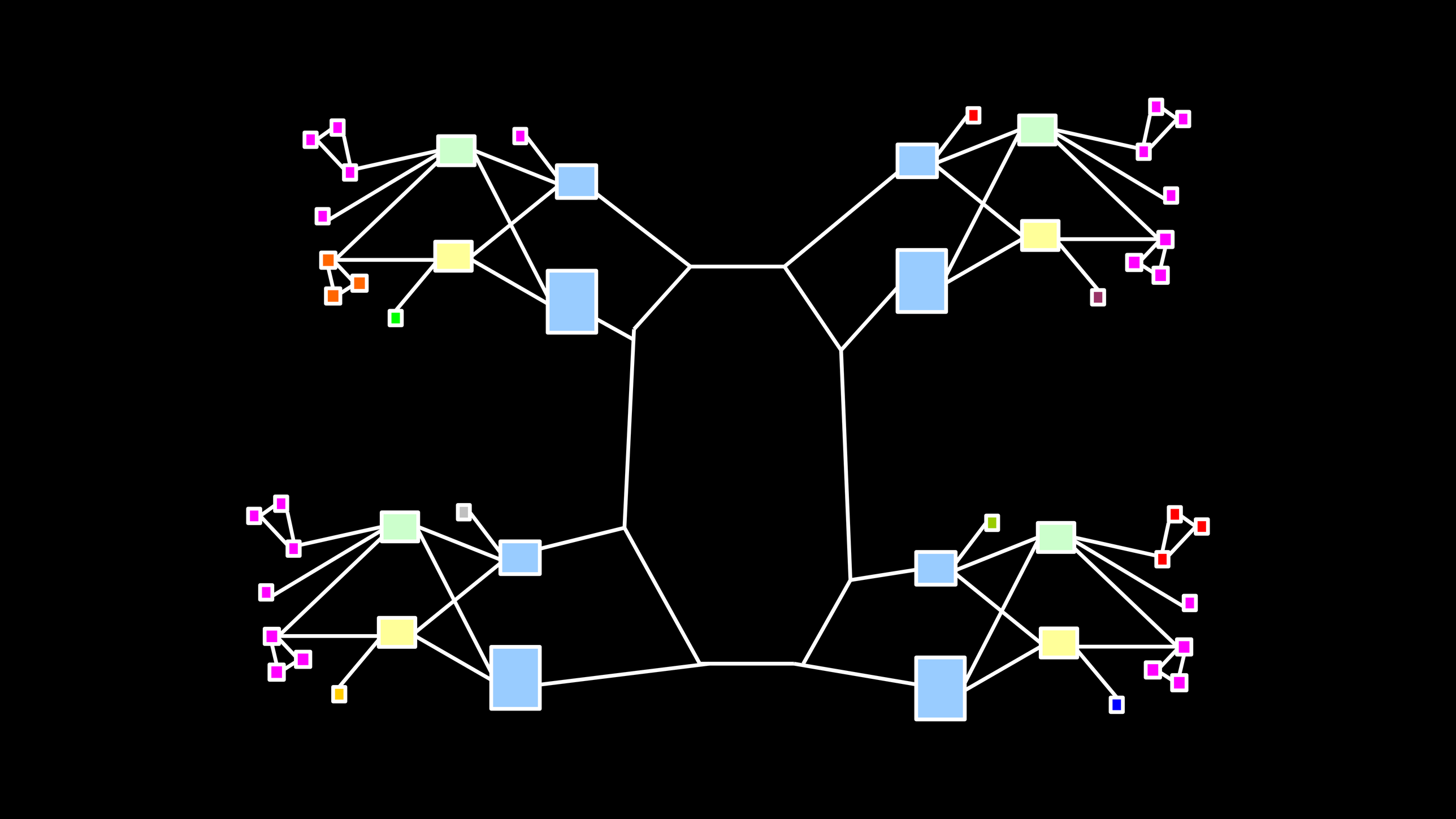


Networked Era

Network Era



Network era (2000s)

- Emergence of connecting various systems together to achieve business processes.
- Supplies offered more outsourcing choices, potentially to meet legal and compliance needs.
- Decreasing costs in technology ensure more capable hardware is available to more business units.
- Capable hardware to capture data within business units as well as harness resources from other areas of the enterprise.

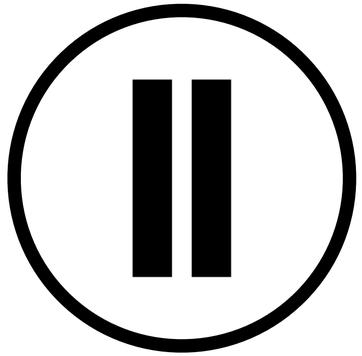
Cloud Era

- Enterprises can consider renting resources from various providers, effectively executing applications ‘in the cloud’.
- Legal and location issues with making use of such service providers and infrastructure.
- Relatively simple Application Programming Interface (APIs), compared to the needs of some enterprises.
- Can form Service Level Agreements (SLAs) and afford enterprise flexibility in scale.

Cloud Era

- Enterprises can take advantage of technology, potentially, without significant up-front investment, but this is not always the case.
- Affords efficient resource utilisation with the ability to scale up and down in line with the demands of the enterprise.
- Enterprises can potentially outsource challenging competencies to external organisations (e.g. time and resource management).

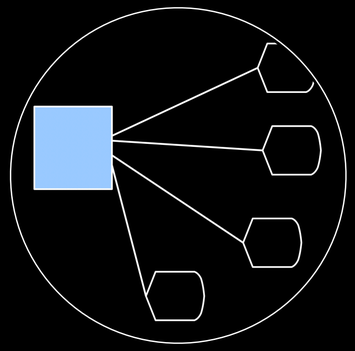
What do you think are the primary security concerns in this era?



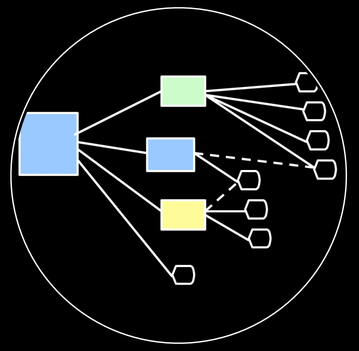
Network era onwards

Security

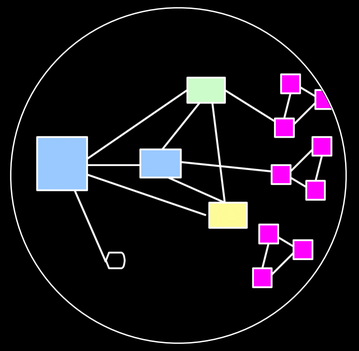
- **Many beyond the perimeter concerns!**
- **Location**, of subsystems, elements and data across the world includes increasingly complicated legislation and challenges.
- **Control and oversight**, both in terms of data and infrastructure becomes increasingly problematic as it is difficult to have full overview.
- **Infrastructure dependency,** in terms of outsourcing potentially core competencies to other entities.



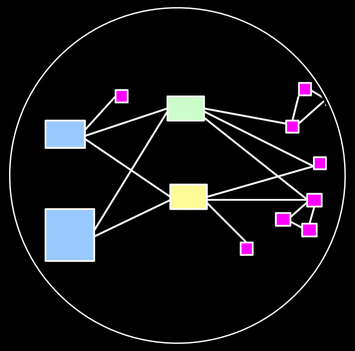
Mainframe Era



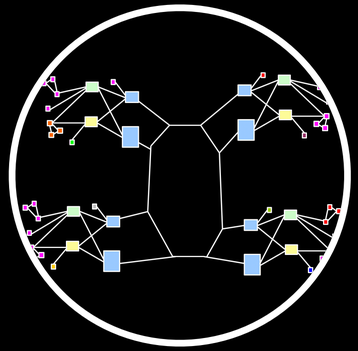
Minicomputer Era



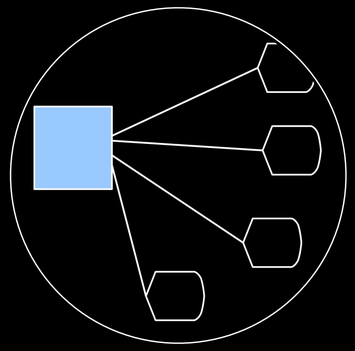
Distributed/PC Era



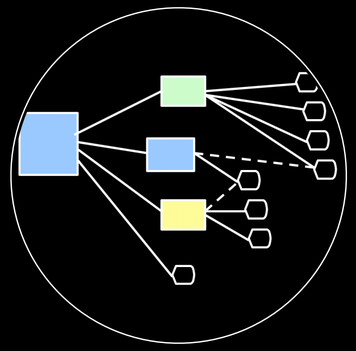
Client-server Era



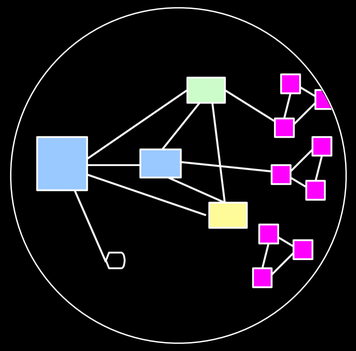
Networked Era



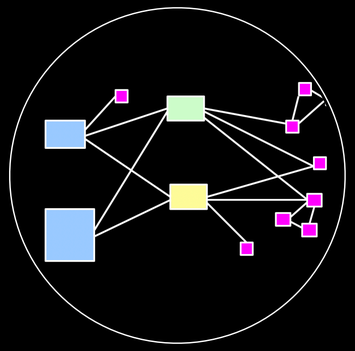
Mainframe Era



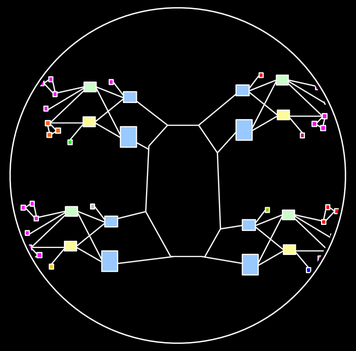
Minicomputer Era



Distributed/PC Era



Client-server Era



Networked Era