Institute for Innovation and Public Purpose

UCL

David Eaves
Associate Professor of Digital Government
Institute for Innovation and Public Purpose
University College London

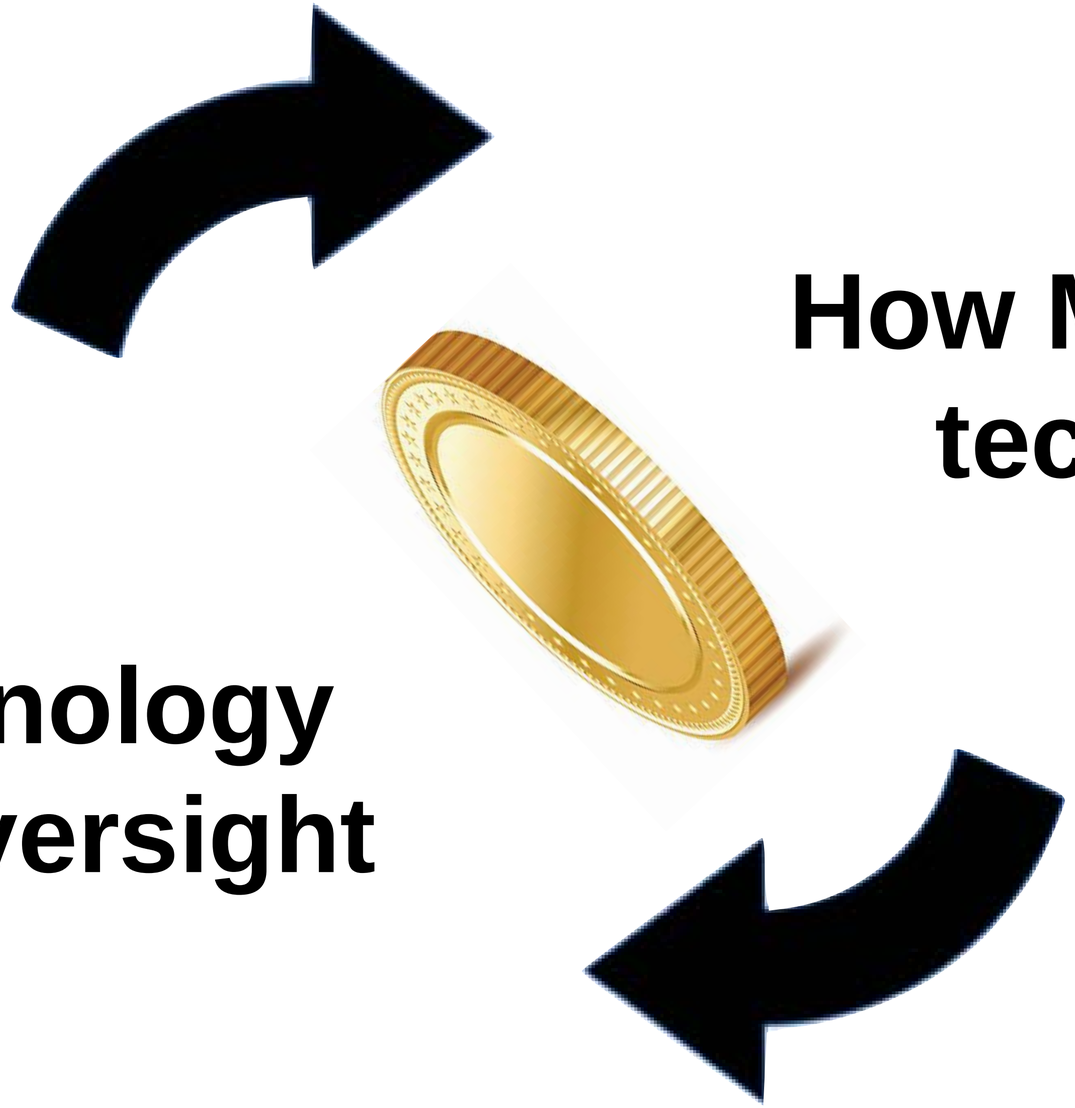
@daeaves

Slides by David Eaves

How technology enables oversight

Slides by David Eaves

How MoF assess technology



How technology enables oversight

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Current State

Department

Application

Database

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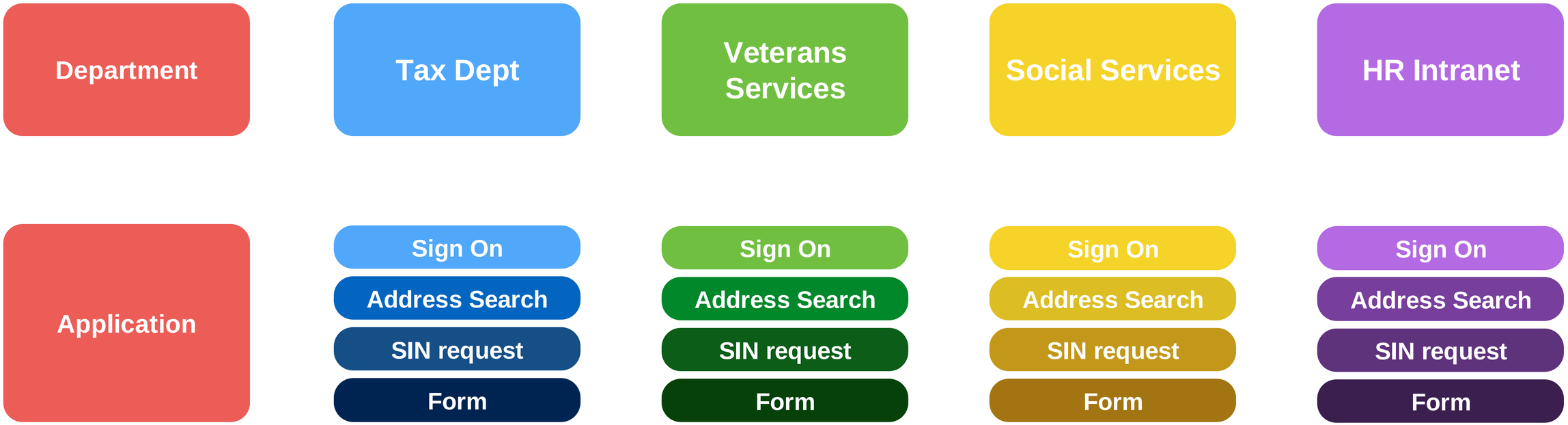

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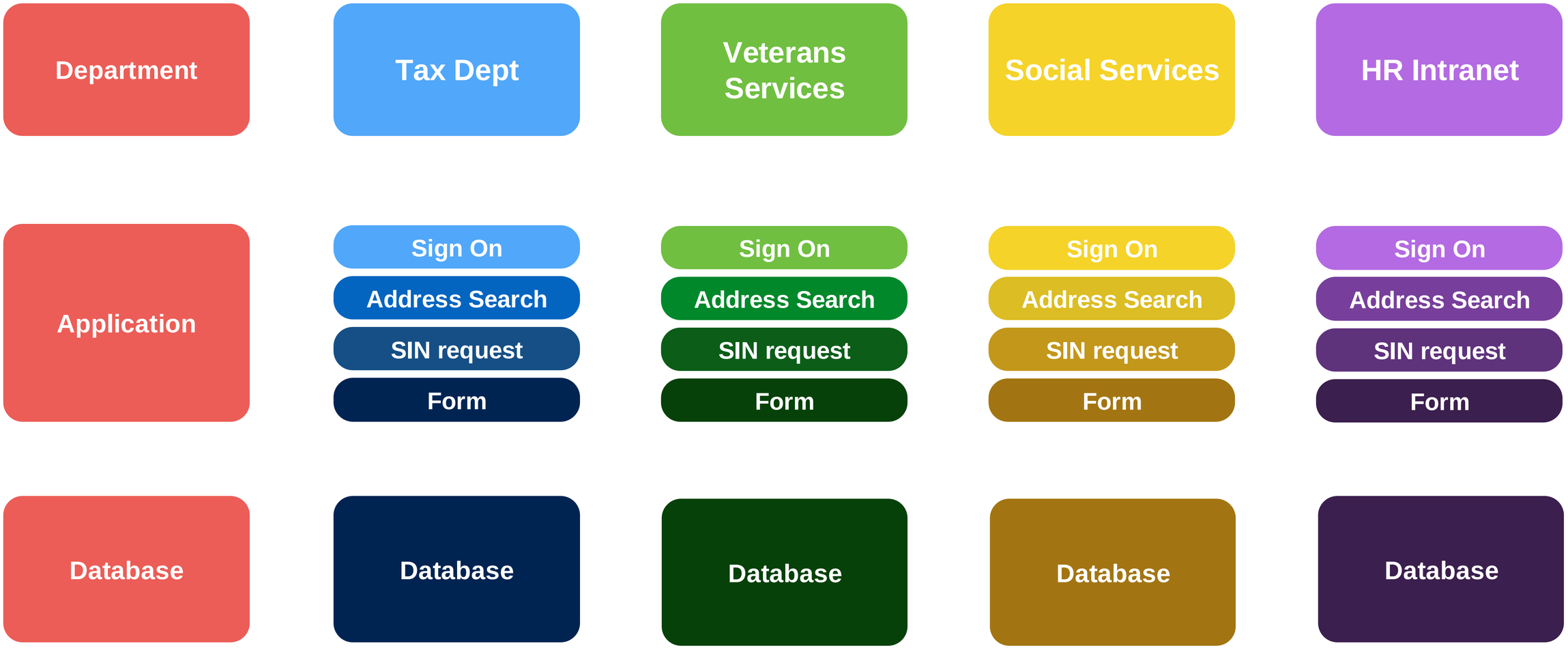

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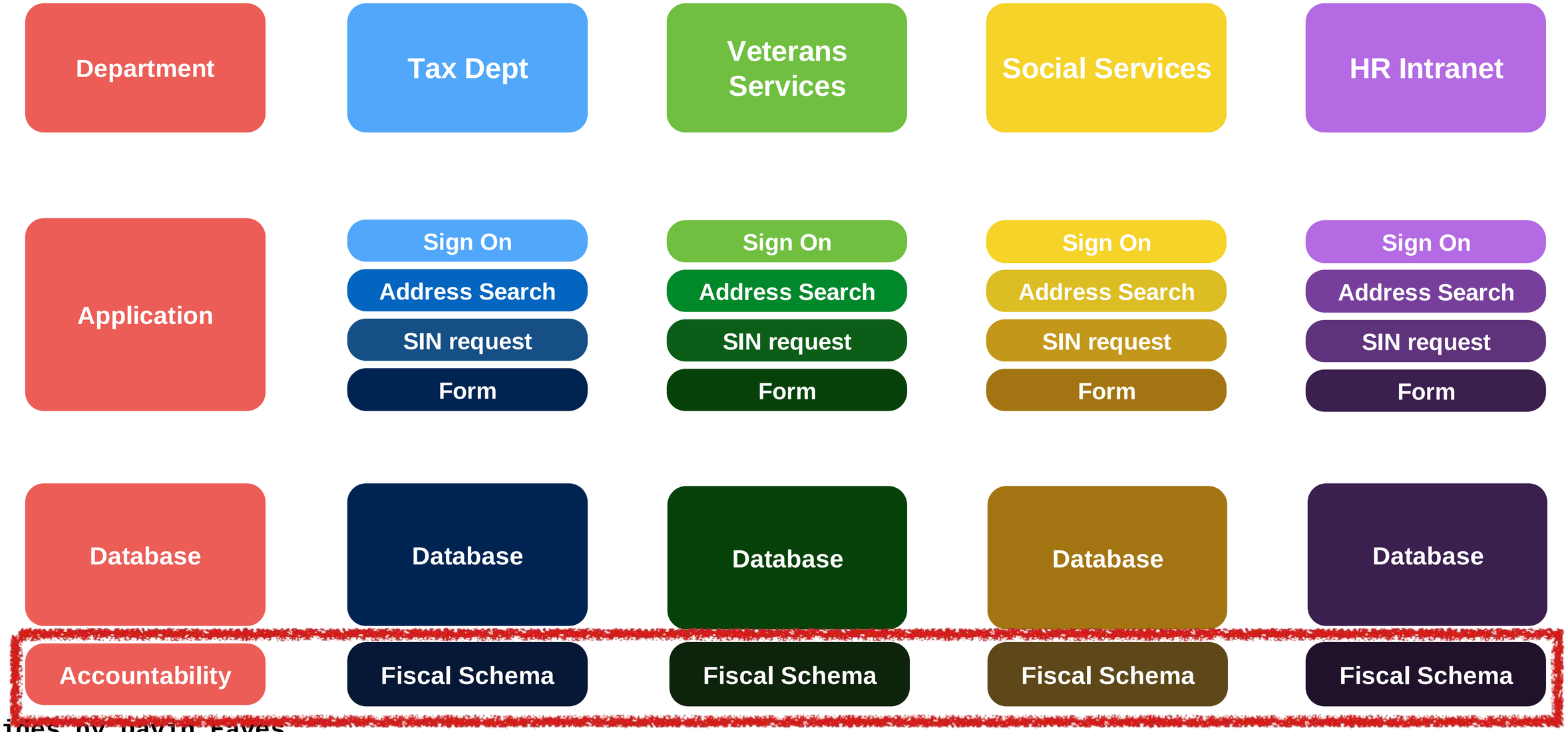

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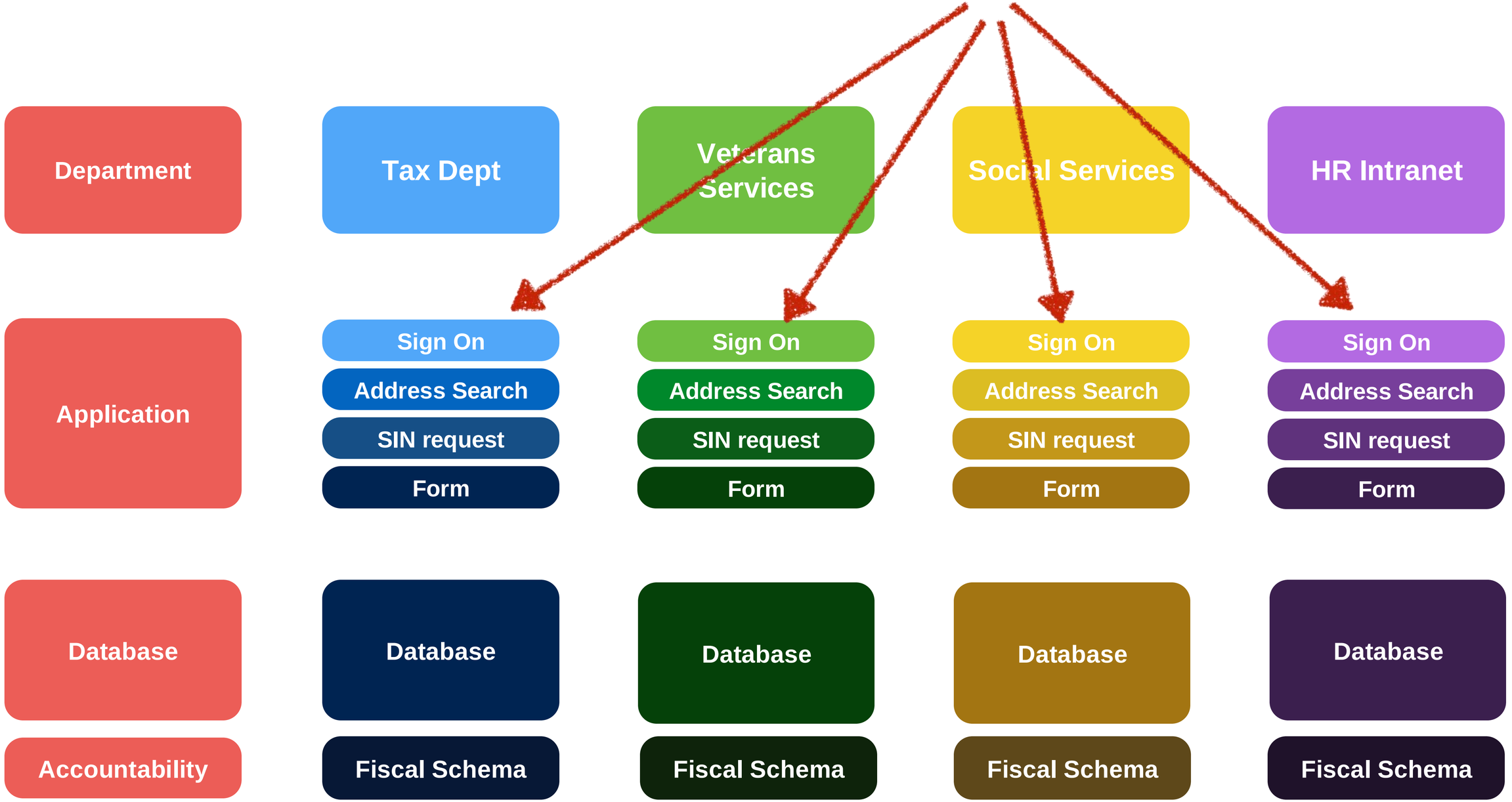
Duplication, Few standards, etc…



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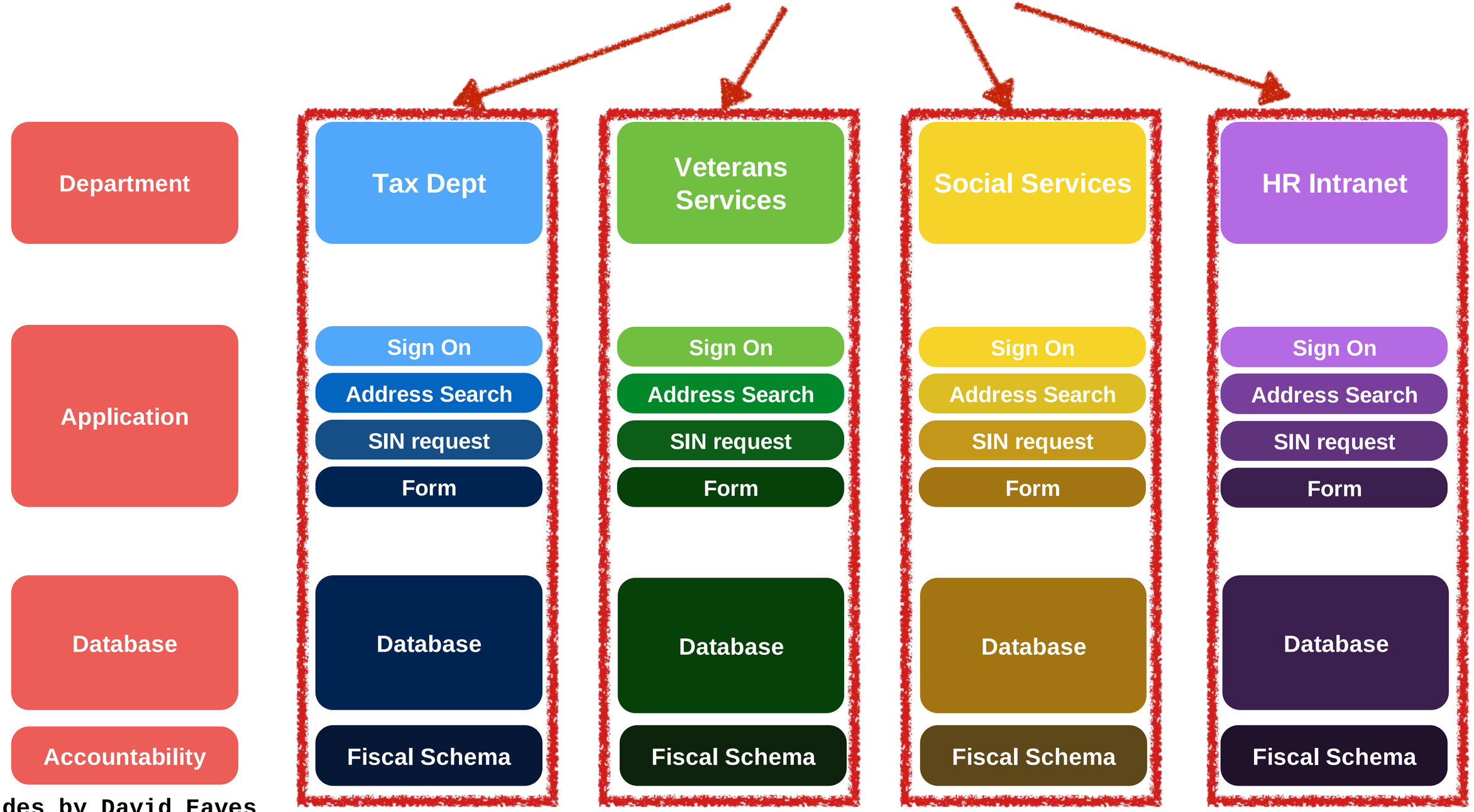
Vertical accountabilities



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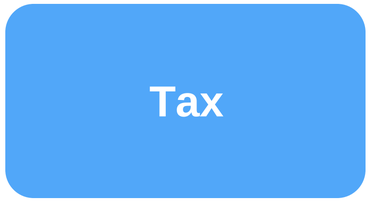
Actually…



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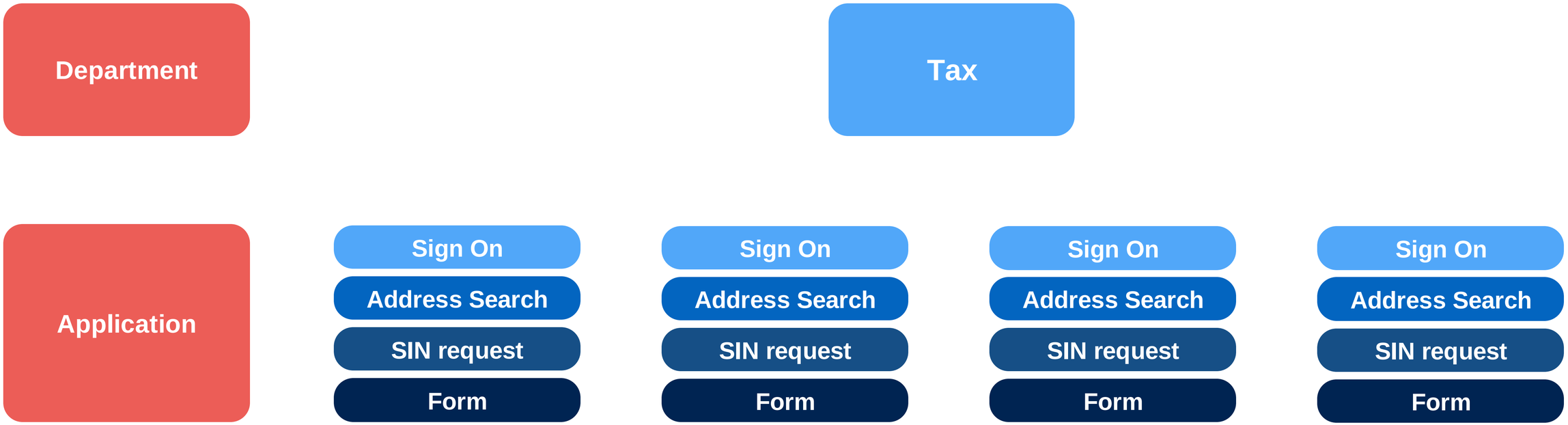

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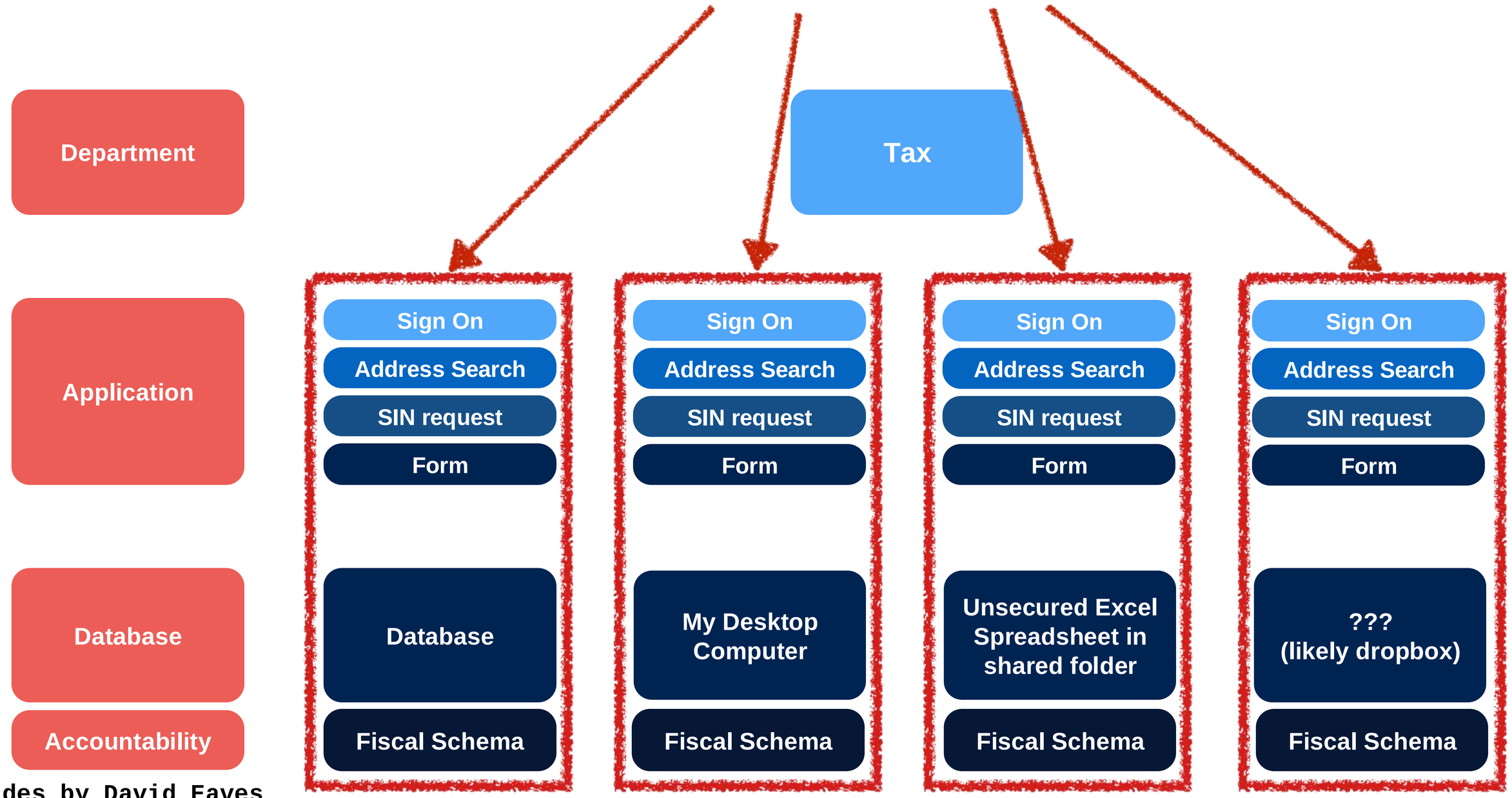
Duplication



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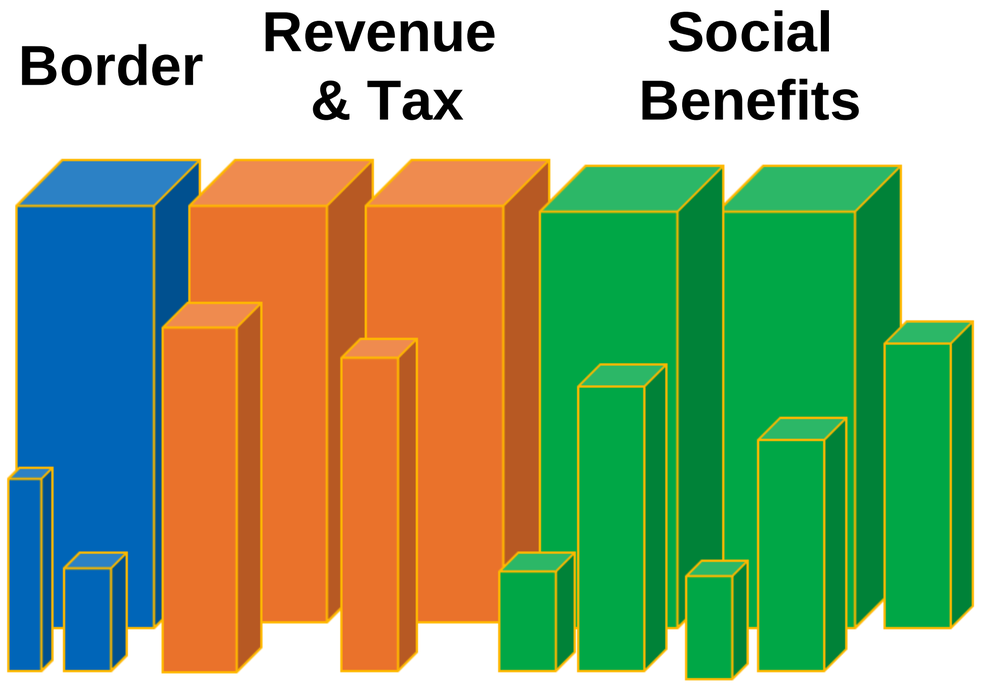
We are creating fragmented monoliths



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The Problem of Fragmented Digitalisation

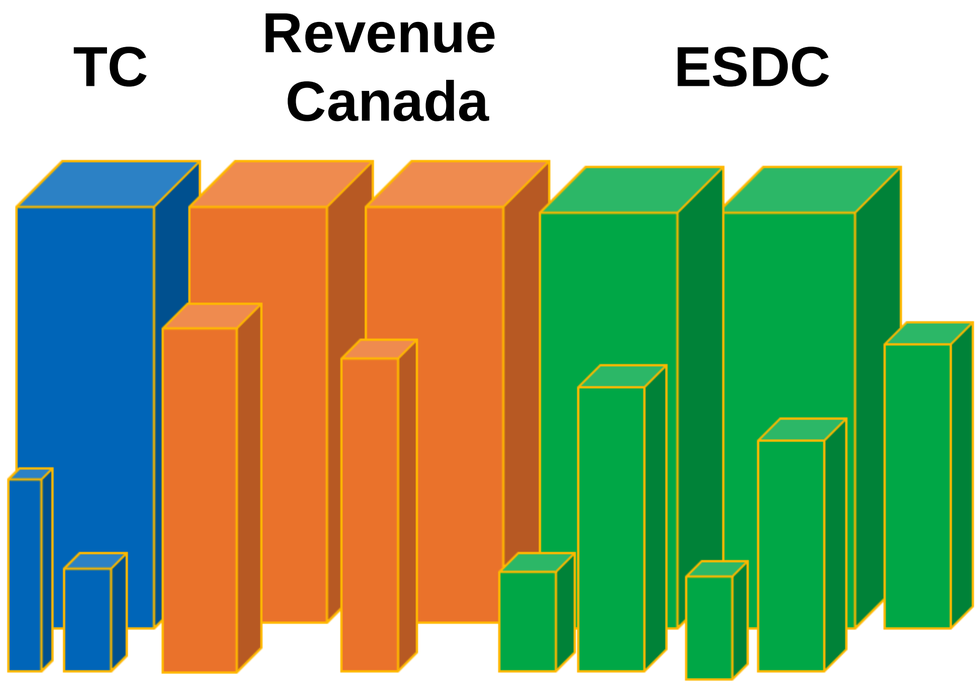
Digital technologies are now the backbone of modern societies..

...but despite decades of investment, many public digital systems remain fragmented and inefficient.

Traditional digitalisation challenges have included:

- **High duplication costs** → separate IT systems, increasing procurement, maintenance, and staffing expenses.
- **Vendor lock-in** → Non-interoperable software limits flexibility, making upgrades expensive and reducing competition.
- **Limited scalability** → System are built for a specific function, rather than reuse across government and society.
- **High transaction costs** → Inability to exchange data increases administrative burdens (e.g., repeated KYC checks, excessive paperwork).
- **Information asymmetry** → Poor data standards mean businesses, citizens, and governments have incomplete access to key information, leading to inefficiencies in decision-making.
- **Incomplete information** → Critical datasets (such as national ID, land registries, or business records) are often inaccurate, outdated, or inaccessible, increasing risks and reducing service quality.

This approach is inefficient, costly and limits government capacity



In Nigeria, maintaining **overlapping identification systems** was estimated to cost

US$4.3 billion

over eight years

Source: World Bank, 2015

In the US, a study estimates that, during COVID, only

23-34% of the $800B

Paycheck Protection Program to save jobs went to the target population

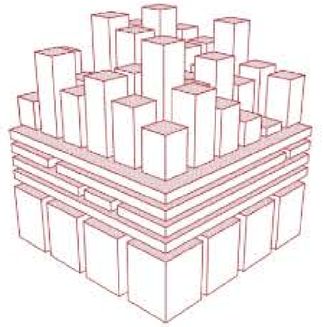
Source: NBER Working Paper, 2022

Successful countries are pursuing an emergent strategy… The Sovereign Stacks

Traditional digitization

- Vertical interoperability
- Modernization and efficiency in each department
- State as a problem solver
- Driver: operational efficiency and public services

Sovereign Stack



- Vertical and horizontal interoperability (DPI-enabled)
- Ecosystem of actors, spillover and market-shaping effects
- State as a problem solver and enabler of a wider ecosystem
- Driver: inclusive economic development, fiscal constraints, reducing rent extraction and sovereignty

What does an infrastructure view of government look like?

Services

Components

Data

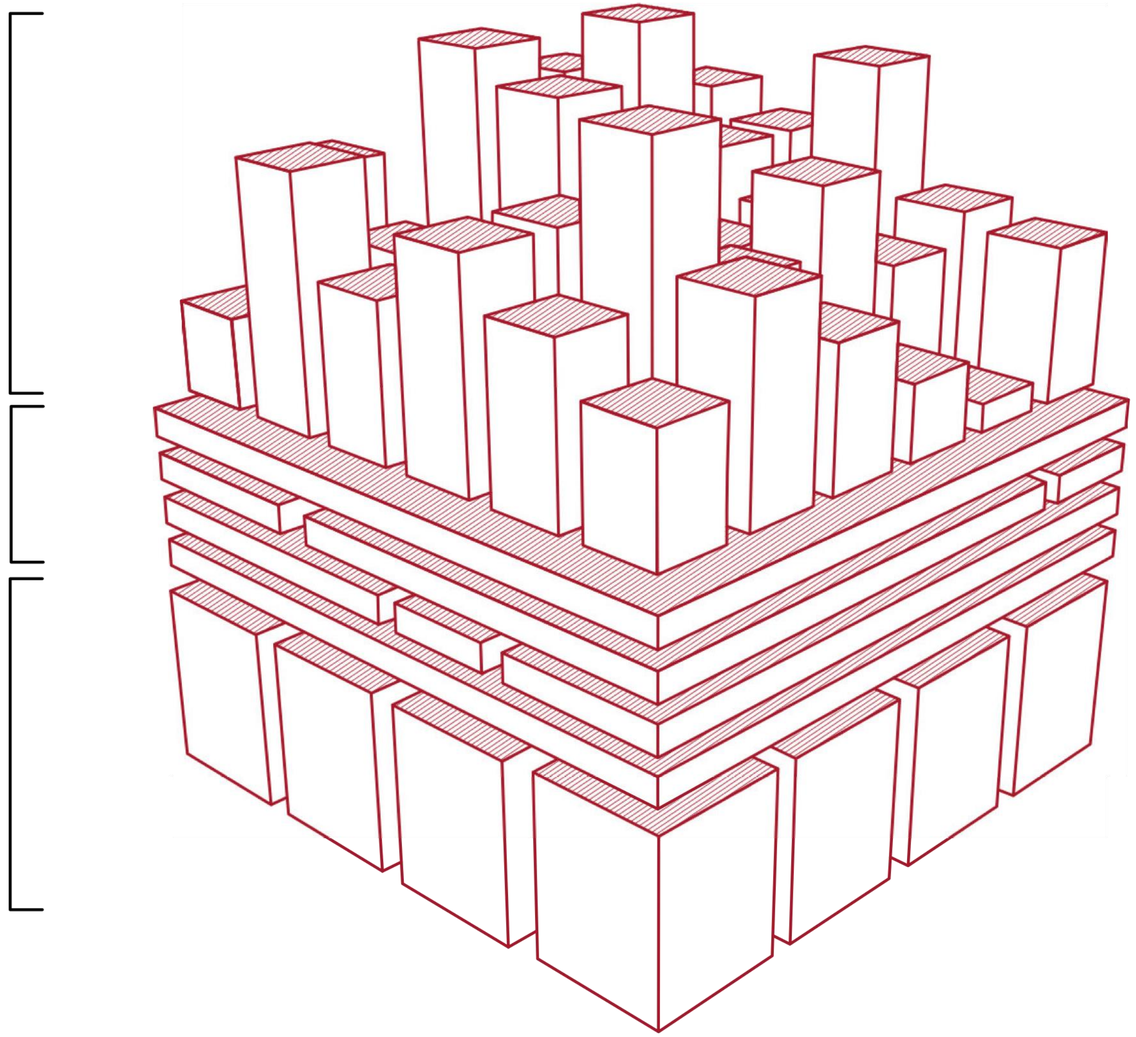


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Image my Richard Pope

Data (Registries)

Civic (birth, death, marriage)

Land (GIS)

Health Records

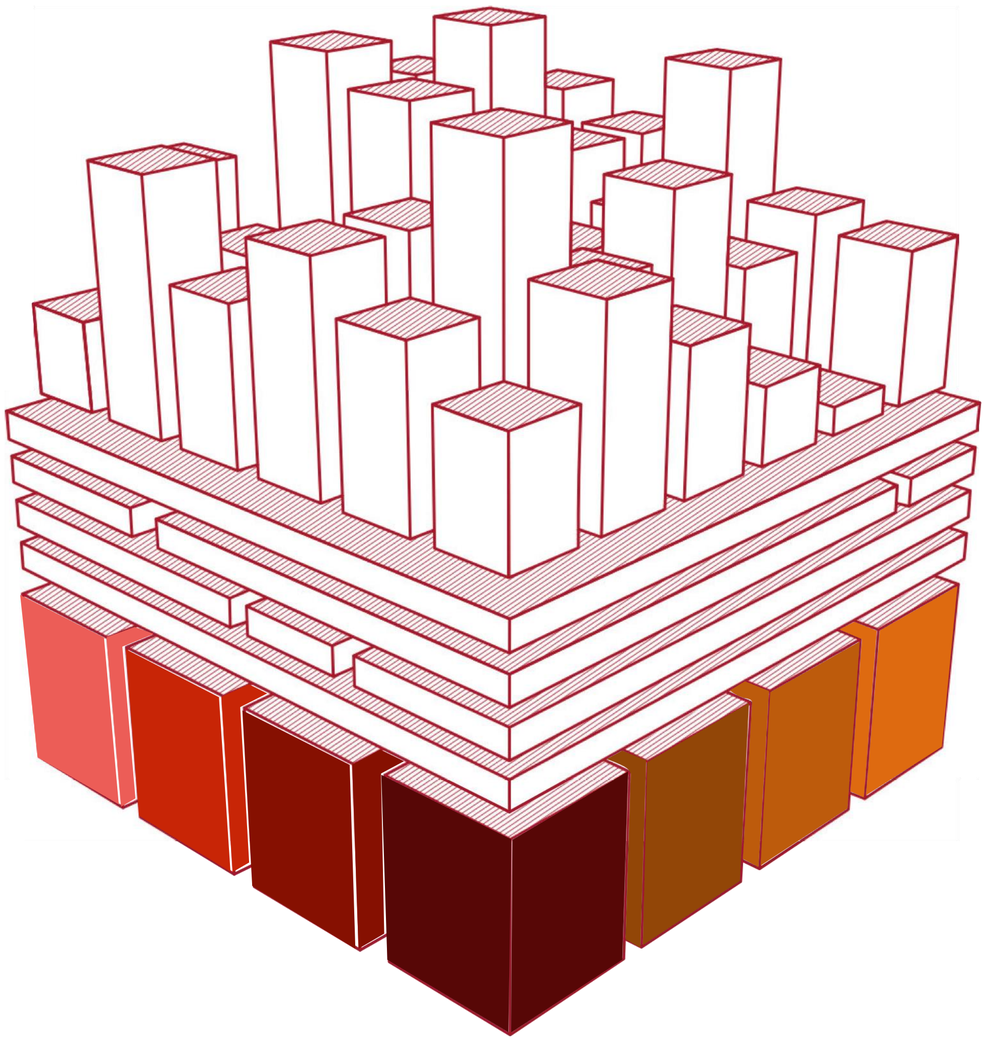
Education

Property

Business/Incorporated Entities

Registry of registries

Fiscal Definitions



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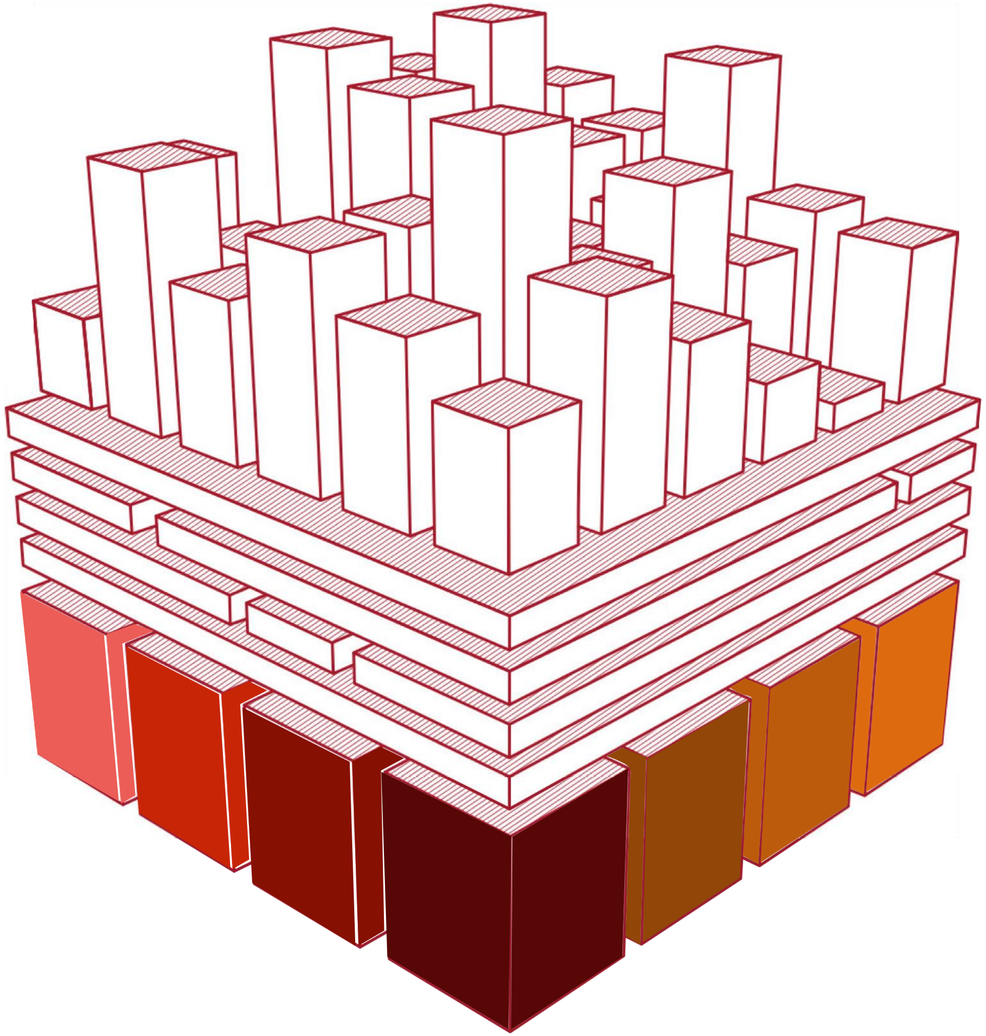


Components

Identity

- Authentication
- ID
- e-KYC/Proof

Payments

Data Exchange

- Permissoning Registry?
- Security/Time Stamping/Auditing

E-Signature

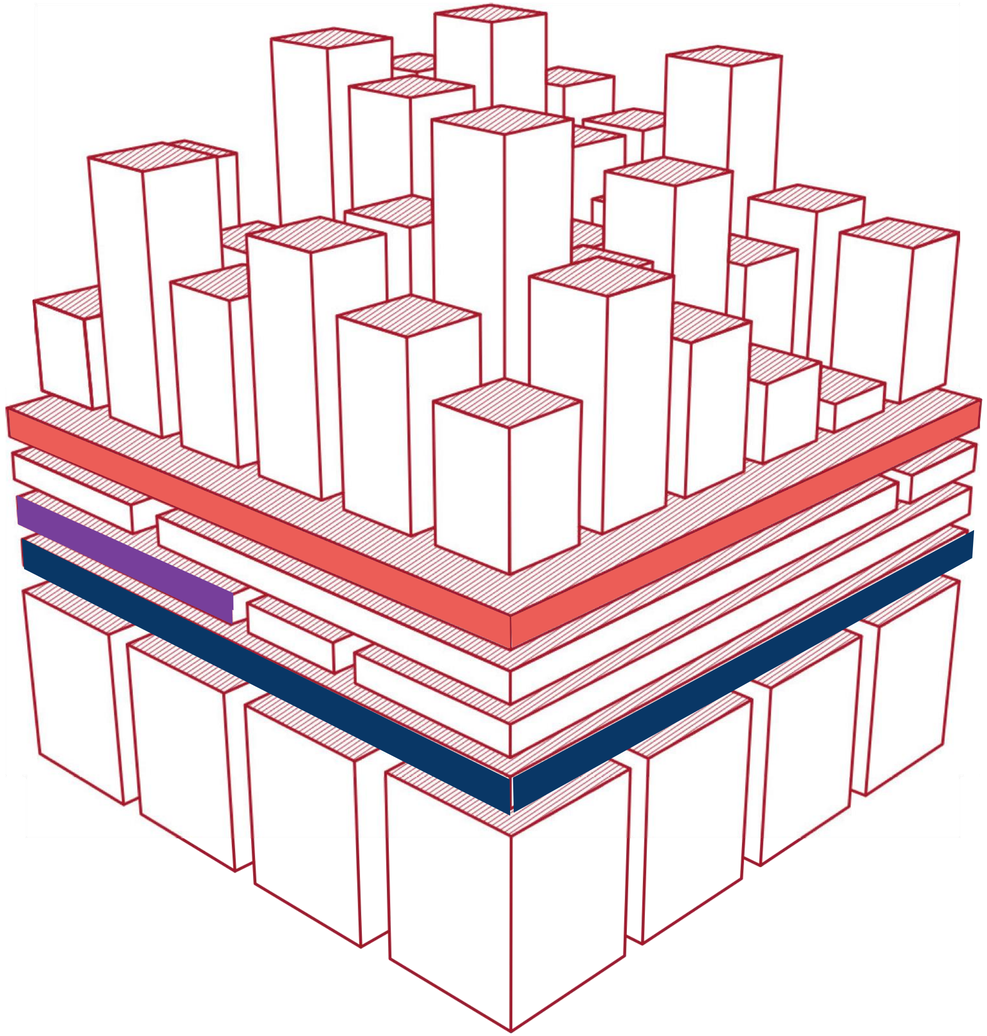
- Public Key Infrastructure

Notifications

Credentials

Forms

Scheduling



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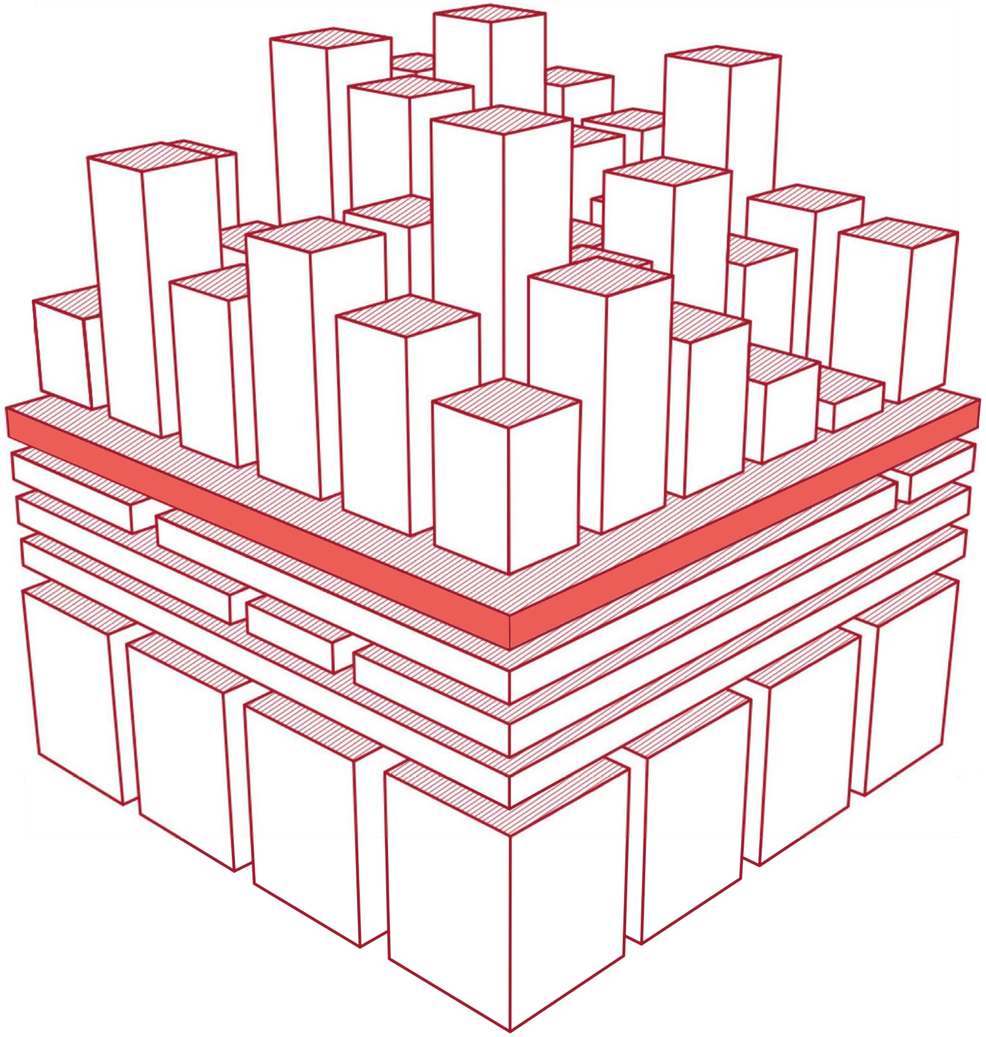
Authentication



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Authentication

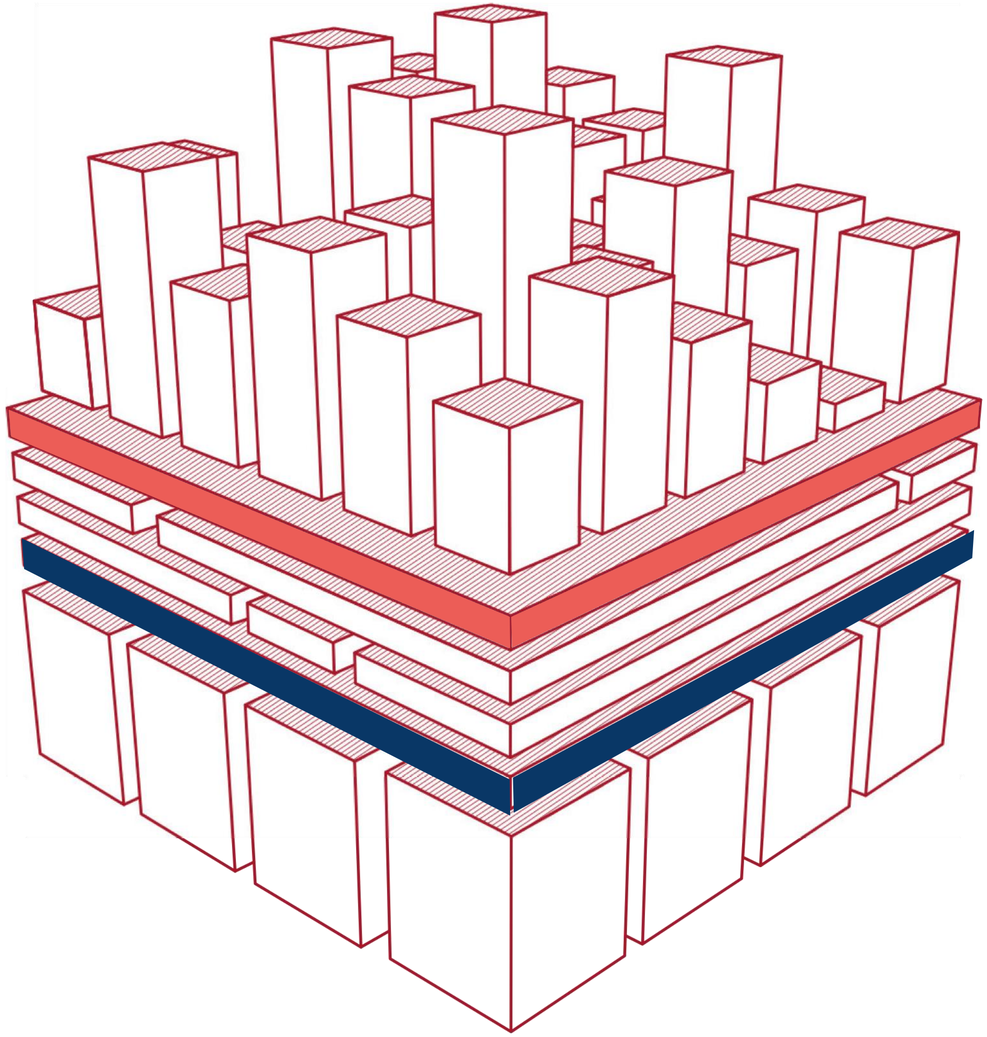
AADHAAR

SingPass

Payments

pix powered by Banco Central

UPI UNIFIED PAYMENTS INTERFACE



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Authentication

AADHAAR

SingPass

Payments

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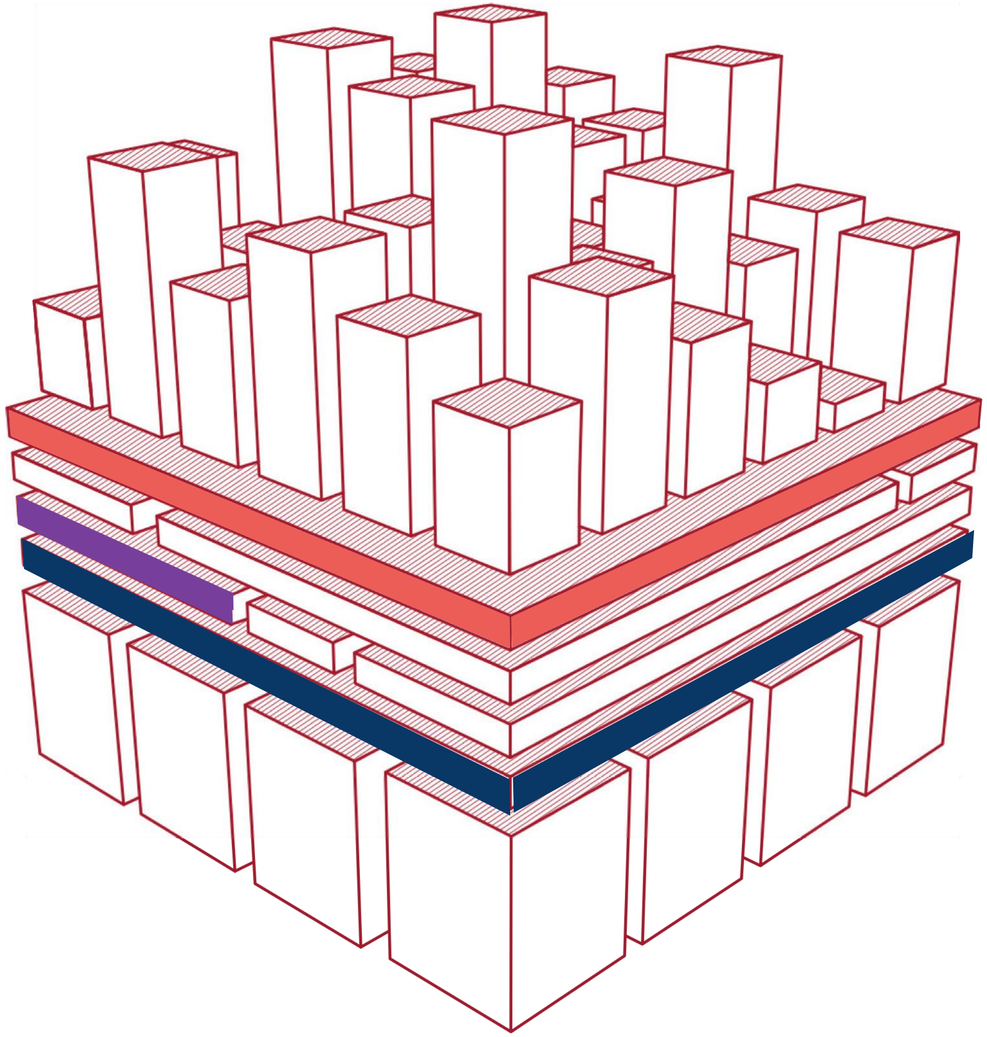
UPI UNIFIED PAYMENTS INTERFACE

Data Exchange

DigiLocker Your documents anytime, anywhere

X-ROAD®



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DPI Map

Click on a country on the map to explore its digital identity / digital payment / data exchange system that acts as DPI.

You can also use the **regional filter** on the left to find a country. Clicking on the country in the list, and then the map, will show you more information.

Find the raw data on the DPI Map here.

Explore the Map's methodology here.

DPI Dashboard

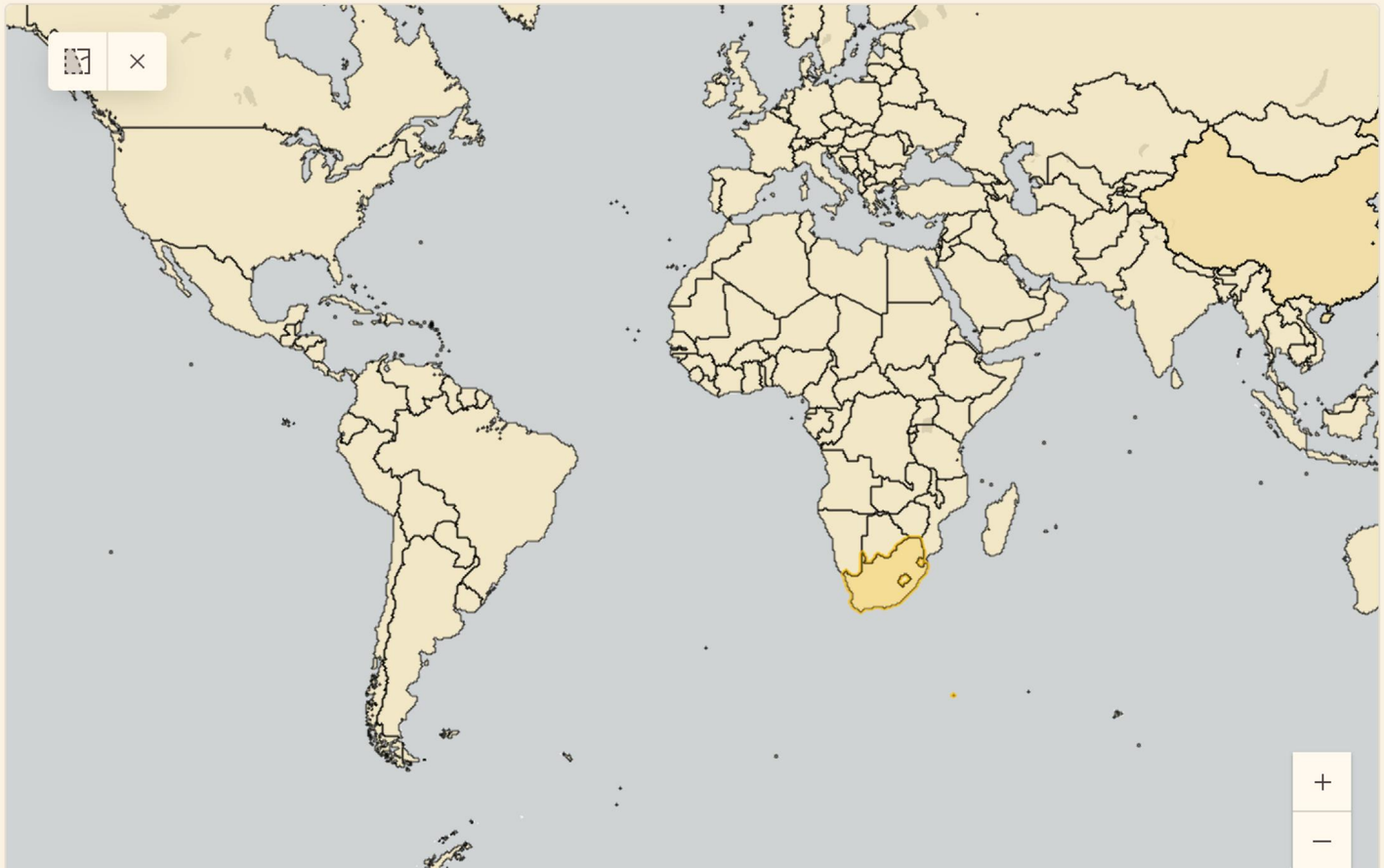
Region

- Africa
- Asia
- Caribbean
- Europe
- Latin America
- Middle East

Country

- Afghanistan
- Albania
- Algeria
- American Samoa
- Andorra
- Angola
- Anguilla
- Antarctica

DPI Database	Digital ID	Digital Payment	Data Exchange
210 countries	57	93	103



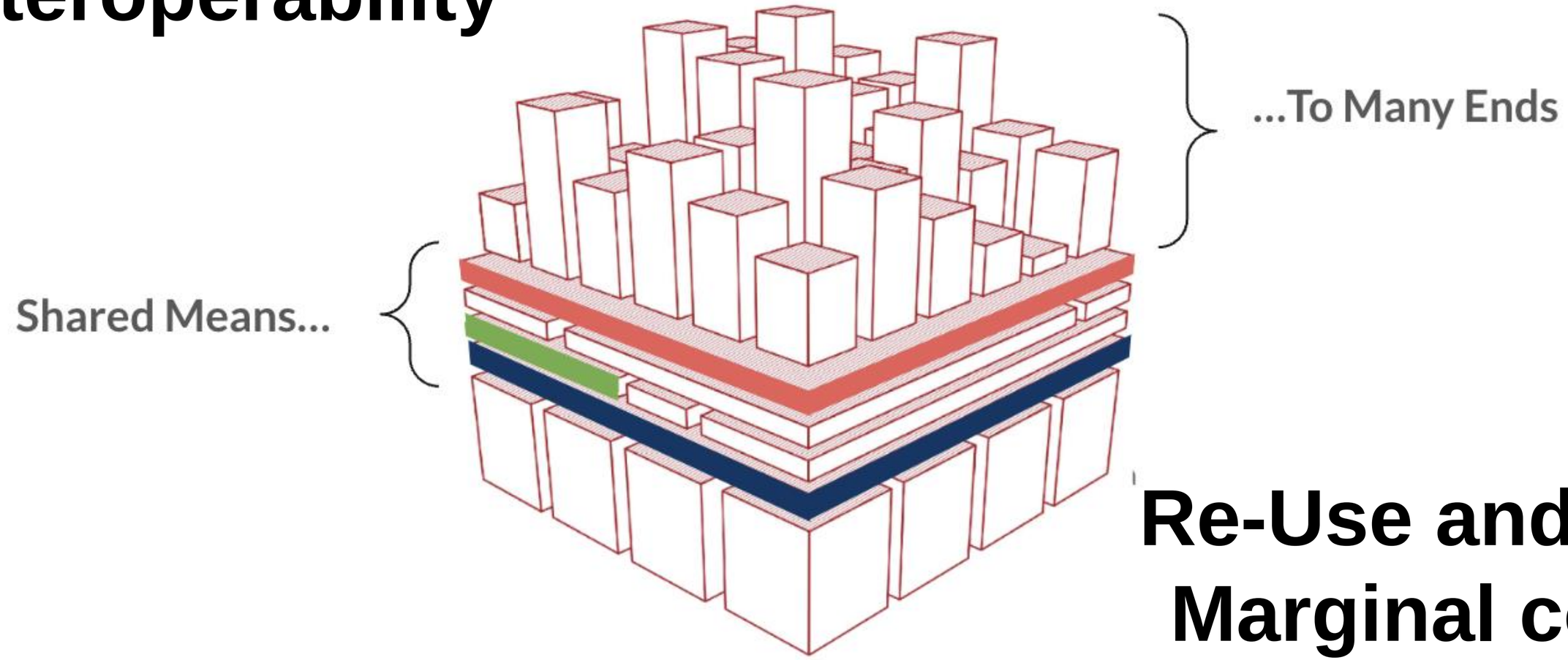
South Africa

Digital ID

Digital ID name	Smart Identity Card (Smart ID)
URL	Unknown
Status of implementation	Plan
Claim of digital (or electronic) ID	Yes
ID/ Civil Register Act	Yes
Digtial authenticatio n function	Yes
Governi entity	
Institutional	Security and

Provide feedback

Standards And Interoperability



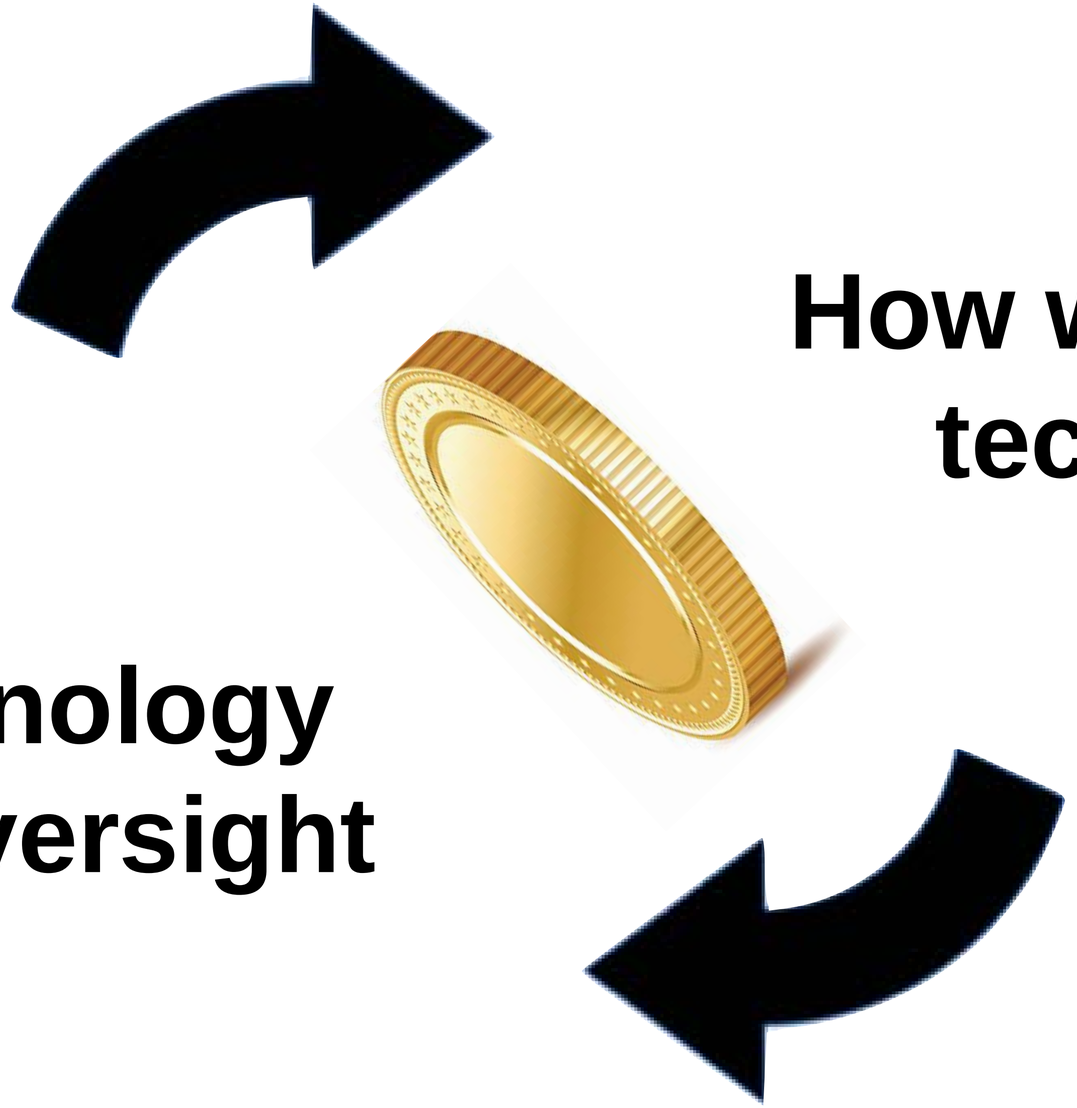
Re-Use and Low Marginal costs

Ministries of Finance shape the size and structure of government.

And thus efficiency and scale of government.

Why have ministries of finance been disinterested in digital infrastructure?

How we invest in technology



How technology enables oversight

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Therefore, our project attempts to capture the value of digital infrastructures & address shortcomings of traditional cost-benefit analysis

Access here

Our method:

1. We outlined the **characteristics of traditional infrastructure**
2. We explored which **digital design characteristics** were associated with infrastructural characteristics
3. We built a **framework for assessing the public value of digital infrastructures** by:
    a. Analyzing different conceptual models (e.g.: RQIV, public value framework)
    b. Interviewing policymakers to understand the value of DPI
    c. Analyzing over 60 policy reports and academic papers about the impact of DPI

1. We identified **additional factors** that impact value creation (4 enablers and 3 tradeoffs)

David Eaves

Diane Coyle

Sumedha Deshmukh

Beatriz Vasconcellos

Institute for Innovation and Public Purpose

UCL

Bennett Institute for Public Policy Cambridge

BILL & MELINDA GATES *foundation*

Three Economic Properties of DPI

1. **standardization** can reduce transaction costs, generating efficiencies and helping with information asymmetries.
2. **interoperability** beyond immediate applications can generate spillovers;
3. **high potential for reuse** due to a relatively low marginal cost can enable combinatorial innovation, shaping markets.

The DPI's economic properties are associated with potential for amplified economic value

Types of effects	*Examples of effects*
Direct **Static efficiency and consumption**	• Fiscal impacts (savings, tax collection, leakage, etc) • Human intermediaries • Administrative burden
Dynamic **Spillovers and externalities**	• Nonlinear fiscal impacts associated with interoperability • Nonlinear savings from building new solutions • Potential effects on formalization, corruption levels, etc
Market-Shaping **Ecosystem-wide transformative effects**	• Effects on competition • Effects on market creation/ dismantling • Changes in capacity to respond to crises

Interoperability vs centralization

Value vs compliance

Infrastructure vs project

How MoF assess technology

Interoperability vs autonomy

CBA vs Broader Assessment

Infrastructure vs project

How technology enables oversight

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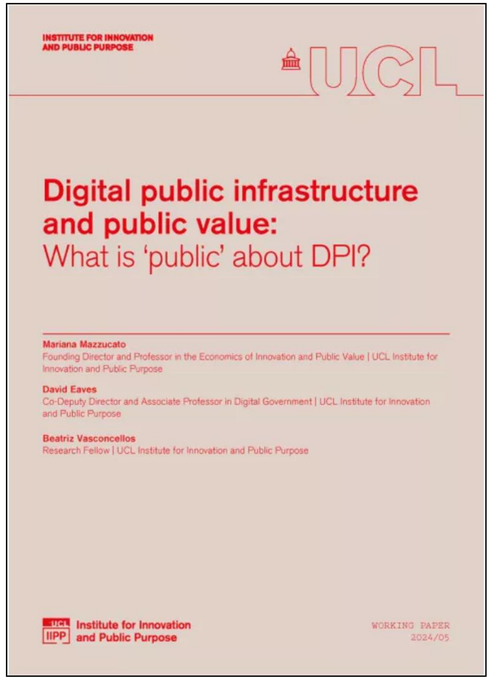
To benefit from AI

large scale interoperability is a priority

What is Public in Digital Public Infrastructure



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Economics of Shared Digital Infrastructure

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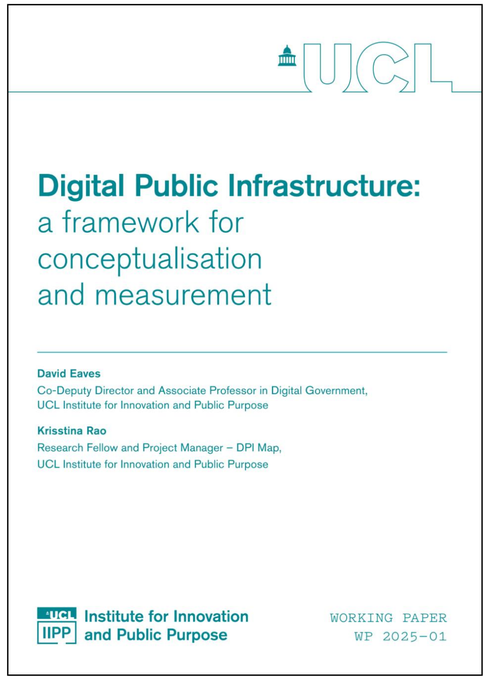

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David Eaves
Associate Professor of Digital Government
Institute for Innovation and Public Purpose
University College London

@daeaves

Slides by David Eaves

1. We outlined the **characteristics of traditional infrastructure**

Relevance	**1. Inputs essential to a range of activities** that either facilitate market participation (e.g. transportation or identity services) or provide services deemed essential to participation in society or life (e.g. water, or communication).
Financing Properties	**2. Long-lived collective assets**, often involving a higher upfront investment cost relative to the low marginal cost of supply; **3. Non-rival up to congestion limits**, so many can use it without diminishing availability. **4. Collective and Non-excludable,** with access that is either either universal or does not depend on personal relationships or identity. **5. Generic or standardised capital services** that can be used as inputs into a wide range of other activities;
Dynamic Nature	**6. Derived demand** (economic value created by downstream applications); **7.** Creates **spillovers and externalities**. **8.** Often **complements or substitutes** for other infrastructures.

a capacity deemed **essential to the functioning of society** and thus of deep interest to - and possibly a core responsibility of - the state

the long-lived character of returns on investment requires an investor with a sufficiently low discount or hurdle rate, **thus government funding or orchestration**

Infrastructure has a **dynamic nature**, make it challenging to identify and estimate the economic returns to infrastructure investment - **CBA falls short**

2. We explored which **digital design characteristics** were associated with infrastructural characteristics

Annex: From Infrastructural Characteristics to DPI Design Characteristics

Infrastructural Characteristic	DPI Design Characteristics				
	Standardisation	**Interoperability Beyond Immediate Applications**	**Minimal & Reusable Building Blocks**	**Data as a High-Value Input**	**Public Oversight & Governance**
Essential Inputs to Wide Range of Activities (activities either essential for market participation or basic societal needs)	Enables API and/or protocol consistency across multiple domains	Allows cross-sector data sharing and service integration and reduces duplication in public sector IT systems	Allows for cost-effective and adaptable digital solutions that support multiple services	*Weak or no relationship*	Makes DPI a core responsibility of the state and ensures essential functions are prioritised
Long-lived collective assets with high upfront costs relative to the low marginal cost of supply (requires long-term investment and governance)	Creates durable interoperability standards that remain useful over time	*Weak or no relationship*	Supports modular expansion without costly system overhauls and increases long-term sustainability by allowing targeted upgrades rather than full system overhauls	Maintaining long-term reliability and economic value requires sustained investment in data quality, verification, and governance	Requires an investor with a sufficiently low discount or hurdle rate, andand potential de-risking of private investment. Also needs governance to ensure data accuracy, prevent bias, and uphold responsible stewardship
Non-Rival Up to Congestion Limits (can be used by many without reducing availability)	*Weak or no relationship*	Expands the utility of DPI across sectors without overburdening individual services	Supports shared infrastructure across different industries	Data is non-rival but privacy, security, and governance concerns must be managed	Requires sustainable funding models to mitigate free rider issues and ensure long-term maintenance, security, and upgrades
Collective and Non-excludable (access is either universal or does not depend on personal relationships or identity)	Prevents proprietary barriers that limit usage	If open, allows open access across public and private sectors	Allows more players to build services on top of DPI with lower costs and supports rapid scaling of digital services across new sectors	Expands coverage and access to trusted data sources	Ensures public accessibility through cross-subsidies and regulatory oversight, even when privately operated
Provides generic/ standardized capital services (used as inputs to "many ends")	Creates uniform rules that reduce friction in government and market interactions	Ensures different systems can connect, making DPI more broadly useful	Allows shared digital infrastructure to be used in multiple applications	Structures data so it can serve as a reusable economic resource.	*Weak or no relationship*
Derived Demand (value is created by downstream activities that use them as inputs)	Encourages demand for interoperable systems and digital compliance	Supports broader DPI adoption by increasing its applicability across industries	Reduces costs for future DPI-based services	Improves downstream services through data-driven insights and automation	Requires oversight to ensure broad public benefit and prevent rent extraction
Creates Spillovers & Externalities (impacts beyond direct users)	May enable more market participation by lowering entry barriers and lowers compliance and operational costs for businesses and service providers	Reduces information assymetry and enables data-driven efficiencies and innovations in public and private services	Supports ecosystem-wide innovations through reusability	Enhances real-time and evidence-based decision-making capabilities and strengthens economic forecasting	Requires adaptive governance to manage evolving risks and ensures public accountability to prevent negative externalities
Interdependent & Layered (complementary or substitutes for other types of infrastructure)	May ensure DPI compatibility with legacy and future systems	Enables cross-border and cross-sector interoperability (e.g., trade, travel, finance)	Encourages innovation in complementary sectors	Allows data to serve as a bridge across multiple systems	Does not inherently influence interdependence but can establish policies to manage integration
Risks & Trade-offs	Over-standardisation can **limit flexibility and lock out smaller players**. If standards favour dominant players, they can can also **discourage new market entrants**	Interoperability without safeguards can lead to **data security risks** and unintended **market concentration**	Reusable building blocks risk **entrenching monopolies** if dominated by a few vendors	Low quality data or poor data governance can **reinforce bias and exclusion**	Weak oversight increases risks of **regulatory capture** by dominant firms

2. We explored which **digital design characteristics** were associated with infrastructural characteristics

Table 1. Potential Sources of Economic Value with DPI

DPI Design Characteristic	What it means	How it potentially changes the economy
Standardisation	Establishes common rules, formats, and protocols that create consistency across systems and processes.	- **Reduces transaction and compliance costs** by simplifying integration and regulatory requirements. - **Prevents vendor lock-in** by lowering the cost of switching suppliers (if the standard is not proprietary). - **Affects market participation**: may enable more participation by lowering entry barriers or discourage new market entrants if standards favour dominant players.
Interoperability Beyond Immediate Applications	Often enabled by standardisation, ensures that different systems and organizations can exchange and make use of data, even in sectors beyond their original design.	- **Breaks down information silos and reduces information asymmetries**, improving efficiency in both public and private service delivery. - **Minimizes redundant IT spending** by enabling compatibility across multiple agencies and sectors. - **Facilitates spillovers and combinatorial innovation** by allowing firms to build on common infrastructure layers without requiring direct coordination. - **Shapes market competition**—interoperability can encourage cross-sector business models and innovation, but if standards or data flows are controlled by dominant players, it may entrench monopolies.
Minimal & Reusable Building Blocks	Uses modular digital components that can be repurposed across different services, reducing the need to build from scratch.	**- Reduces redundant infrastructure costs** by allowing shared components to be reused across multiple services. **- Supports rapid scaling and cross-sector expansion** by enabling adaptable, modular digital services. - **Lowers the cost of innovation** by shortening development cycles and enabling customizability, allowing services to be adapted without full redesign. **- Enhances long-term sustainability and resilience** by enabling targeted upgrades instead of full system overhauls, reducing systemic risks associated with large, inflexible digital systems.
Data as a High-Value Input	Establishes trustworthy data systems that functions both as an enabler of more efficient services (input) and as an economic and governance asset (output).	*If the data is reliable and well-governed[2]:* **- Reduces information asymmetry and incomplete data gaps**, improving decision-making in public services, markets, and regulatory enforcement. - **Minimizes risks and uncertainty** across finance and public services by improving identity verification, eligibility assessments, cybersecurity, and fraud detection. **- Enhances efficiency and targeting** in government programmes and private sector services, reducing administrative burdens and leakages. **- Supports economic forecasting, AI-driven analytics, and crisis response** by improving access to structured, interoperable data across sectors. **- May strengthen public accountability** by enabling transparency in digital transactions, limiting data monopolization, and protecting individual rights—depending on governance and oversight mechanisms.
Public Oversight & Governance	Implements governance mechanisms (regulatory frameworks, open standards, public-private coordination) to ensure DPI operates in the public interest, balancing private sector participation with equitable access and accountability.	**- Creates fair market conditions** by preventing monopolization, excessive rent extraction, and anti-competitive practices. **- Ensures DPI remains a public good** by fostering universal adoption, inclusion, and trust while maintaining affordability for users and businesses. **- Protects rights and security** through regulations on data privacy, cybersecurity, and ethical data use. - **Reduces systemic risks** by establishing safeguards against market failures, concentration of power, and unintended consequences of digital infrastructure.

Source: Author's Elaboration

3. We built a **framework for assessing the public value of digital infrastructures**

Table 2: Explaining the three dimensions of the DPI Public Value Measurement Framework

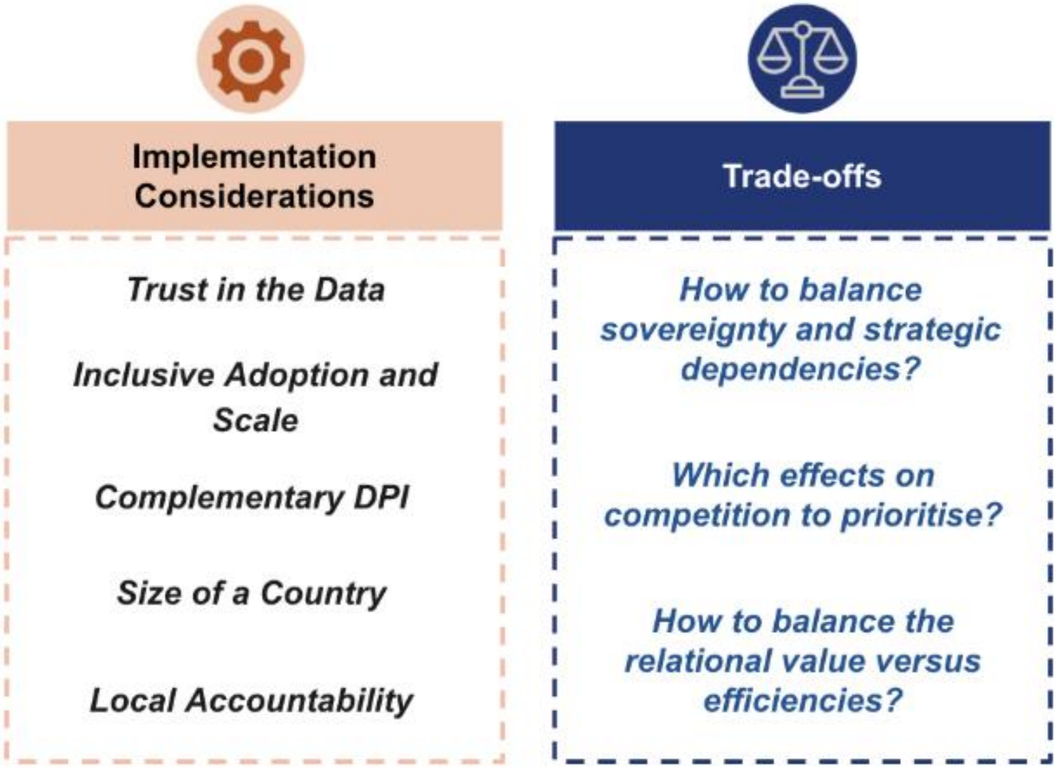
Effects	Direct	Dynamic	Market-Shaping
Defining Characteristic	**Operational and service efficiency gains within core DPI functions**	**Network effects, spillovers, and cross-sector externalities expanding DPI impact**	**Structural transformation in industries, societies and market dynamics**
Core Features	• Directly tied to DPI functionality (e.g., more secure/reliable authentication) • Efficiency & accessibility gains within primary users • Emerges even without large-scale adoption • Often measurable immediately	• New use cases beyond original intent • Interoperability and reusability expand effects across sectors • Typically medium-term effects but can emerge quickly	• Structural industry & state capacity shifts • Alters power dynamics between governments, firms, and individuals • Effects are often durable and harder to reverse
Examples in DPI	• Faster processing of government services • Increased authentication speed & accuracy • Public sector cost savings (e.g., IT consolidation, reduced paperwork)	• Financial services integrating e-ID for faster credit scoring • Private sector using DPI for secure authentication • Cross-agency data sharing for better service coordination	• Shift from cash to digital payments, increasing tax compliance • Growth of DPI-driven financial ecosystems • More competition, new monopolies or market dependencies forming around DPI services
Why It Matters for Policymakers	• Key for demonstrating DPI's short-term benefits • Helps justify early investments • Informs risk mitigation in early rollout	• Determines if DPI adoption will scale effectively • Requires safeguards for fair access & preventing exclusion • Anticipating spillover risks is key for regulation	• Governments must proactively manage market dependencies • Long-term policy strategy must align with economic shifts DPI creates • DPI ecosystems need governance to ensure fair competition & sovereignty

Key clarifications:

- Categories are not rigid and some effects span multiple categories
- Some DPI effects are unique, but others are amplified effects of traditional digitalisation
- Time horizon is correlated with categories, but is not a defining factor

4. Finally, we identified **additional factors** that impact value creation (4 enablers and 3 tradeoffs)

Figure 3: Factors that impact value creation and tradeoffs



Source: Author's elaboration

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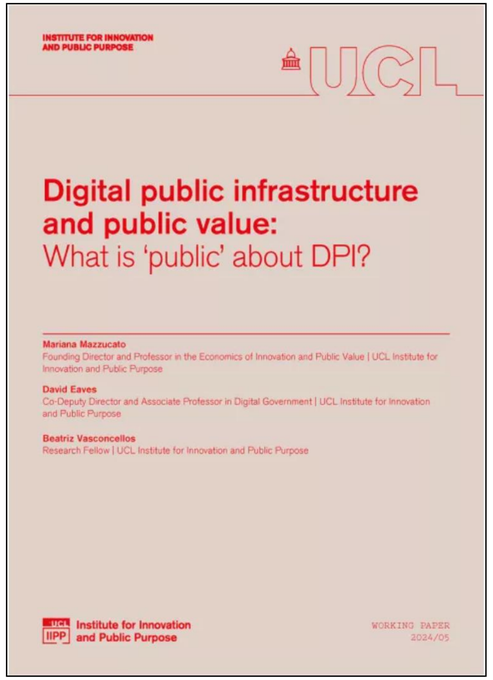

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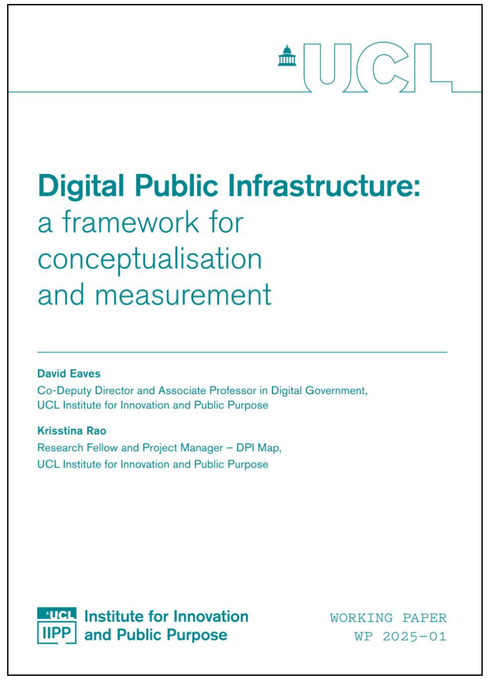

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