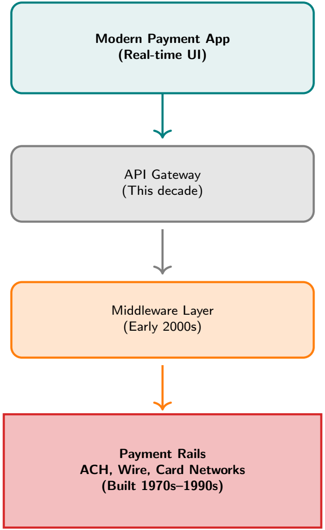
Why does the infrastructure moving trillions daily run on technology older than the internet?

The tension we will explore:

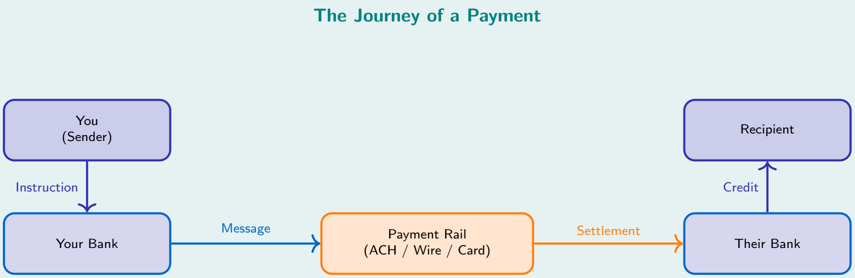
- Modern apps promise instant payments, but behind them run systems built in the seventies and eighties
- Payment rails carry trillions daily — but many operate in batch mode designed for an era before personal computers
- Modernizing these rails without breaking global commerce is like rebuilding a bridge while traffic flows

This dilemma defines infrastructure modernization:

- Replace too fast and risk catastrophic failure
- Wait too long and lose competitiveness to faster alternatives
- The rails are invisible when they work — catastrophic when they fail



Have you ever wondered what happens to your money between 'sent' and 'received'?



Three invisible stages:

1. Your bank verifies and debits your account
2. Payment rail routes and clears the instruction
3. Their bank credits the recipient after settlement

Takeaway

Between your tap and their notification lie multiple institutions, message formats, clearing steps, and settlement finality checks.

What are the main payment rail systems and how do they differ?

Major payment rails worldwide:

Rail	Speed	Use Case
ACH / SEPA	Hours–days	Payroll, bills
Fedwire / TARGET2	Minutes	Large interbank
SWIFT	Varies	Cross-border messages
Card Networks	Seconds (auth)	Consumer purchases
Real-time (RTP/FPS)	Seconds	Instant retail

Key

dimensions that differentiate rails:

- Settlement speed (real-time vs batch)
- Finality (irrevocable vs reversible)
- Value limits (small retail vs large wholesale)
- Operating hours (business hours vs continuous)

Payment Rail Characteristics

Batch Rails
Low cost, slow, reversible

Real-time Gross
Immediate, final, expensive

Messaging Layers
Carry instructions only

Card Networks
Auth + settlement separate

Instant Payment
24/7, low-value, final

Key Insight

No single rail serves all use cases — speed, cost, finality, and value limits create distinct market segments.

Payment rails are not interchangeable — each was designed for specific transaction types, and switching between them is costly.

How does a cross-border payment navigate through correspondent banking step by step?

The correspondent banking chain: **Step 1:** Your bank debits your account and sends a SWIFT message to an intermediary bank that has accounts in both currencies

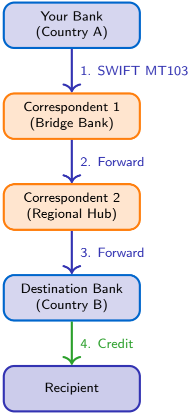
Step 2: The first correspondent bank debits its nostro account and forwards the instruction to a second correspondent closer to the destination

Step 3: The second correspondent repeats the process, each time crossing another currency or jurisdiction boundary

Step 4: The final correspondent credits the destination bank, which credits the recipient

Each hop adds:

- Fees (currency conversion, service charges)
- Delay (manual checks, time zones, cut-off times)
- Risk (failure at any link breaks the chain)



Key Insight

A single cross-border payment may pass through multiple correspondent banks, each adding cost and delay, because most banks do not have direct relationships in every currency and jurisdiction.

Correspondent banking chains can involve two to five intermediaries — explaining why cross-border payments are slow and expensive.

How are domestic and cross-border payment clearing systems architected?

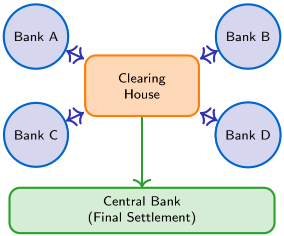
Domestic clearing architecture:

- Central clearing house receives batches from all participating banks
- Calculates net positions for each bank (who owes what overall)
- Settlement via central bank accounts (real-time gross or deferred net)
- Final balances posted after settlement window closes

Cross-border clearing architecture:

- No single global clearing house — instead, bilateral correspondent relationships
- SWIFT carries messages, but settlement happens in local systems
- Multi-currency clearing systems (like CLS for foreign exchange) reduce settlement risk via simultaneous delivery
- Each jurisdiction has its own rules, cut-off times, and finality standards

Domestic Clearing



Key Insight

Domestic clearing benefits from a central hub; cross-border clearing relies on a web of bilateral relationships, creating complexity and risk.

The architecture of payment clearing reflects sovereignty — every country runs its own systems, and connecting them requires intermediaries.

What happens when a major clearing system goes down for even one hour?

Impact of clearing system failure: Immediate effects:

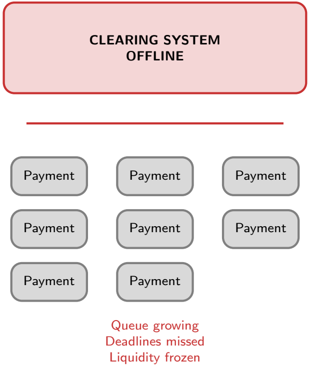
- New payments cannot be initiated or cleared
- Existing payments stuck in queue, creating uncertainty
- Banks cannot calculate end-of-day positions
- Regulatory reporting deadlines at risk

Cascade effects:

- Liquidity trapped — banks cannot move funds to cover obligations elsewhere
- Securities settlement delayed (payment vs delivery links break)
- Corporate payrolls and vendor payments miss deadlines
- Customer confidence erodes rapidly

Historical examples:

- TARGET2 outage: several hours, hundreds of billions in delayed settlements
- Downtime costs estimated at millions per minute in systemic liquidity impact



Key Insight

Payment infrastructure is critical infrastructure — an hour of downtime affects payrolls, trade settlement, and systemic liquidity across the economy.

Clearing systems achieve extraordinary uptime precisely because failure is unacceptable — economies depend on continuous payment flow.

Where are the biggest bottlenecks in global payment infrastructure?

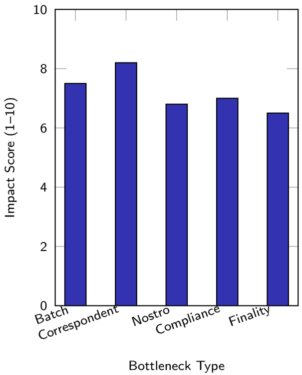
Five structural bottlenecks: **1. Batch processing:** ACH and card networks operate in cycles, not continuously, creating artificial delays

2. Correspondent banking: Multi-hop chains add cost and time, especially for small-value cross-border transfers

3. Nostro account pre-funding: Banks tie up capital in foreign currency accounts, reducing liquidity

4. Manual compliance checks: Anti-money laundering and sanctions screening interrupt automated flows

5. Settlement finality timing: Deferred net settlement creates credit risk until end-of-day close



Key Insight

The bottlenecks are structural, not technological — batch cycles, manual checks, and multi-hop routing are design features, not bugs.

Eliminating these bottlenecks requires redesigning settlement architectures, not just upgrading servers — explaining why progress is slow.

Who controls the rails and what power does that give them?

Control and governance of payment rails: **Central banks:** Control real-time gross settlement systems (Fedwire, TARGET2) and set operating rules, giving them ultimate power over domestic finality

Private networks: Card networks (Visa, Mastercard) and SWIFT operate under member governance but wield market power through network effects

Regulatory leverage: Governments can exclude participants from SWIFT or card networks for sanctions enforcement, making rails geopolitical tools

Market concentration risk: Dependence on a few global rails creates single points of failure and gives operators pricing power

Who Controls What

Central Banks:
RTGS systems, settlement finality

Private Networks:
Card rails, SWIFT messaging

Regulators:
Access rules, sanctions enforcement

Operators:
Pricing, operating hours, message formats

Key Insight

Control over payment rails is both technical and geopolitical — exclusion from SWIFT or card networks can isolate entire economies.

Payment infrastructure is sovereign infrastructure — control over it translates to economic and geopolitical power.

Three criteria for evaluating payment infrastructure modernization

The Infrastructure Modernization Test:

Criterion 1: Can the new system coexist with the old during transition?

- Migration cannot stop payment flows
- Interoperability during dual-running is mandatory
- Rollback capability if new system fails

Criterion 2: Does it reduce settlement risk?

- Faster finality reduces credit exposure
- Atomic settlement (delivery vs payment) eliminates principal risk
- Real-time visibility prevents reconciliation errors

Criterion 3: Is it more resilient, not just faster?

- Redundancy and failover paths prevent single points of failure
- Cyber-resilience against attacks
- Can operate under stress (peak loads, partial outages)

Modernization Evaluation

1. Coexistence:
Can old and new run together?
Is rollback possible?

2. Risk Reduction:
Faster finality?
Atomic settlement?

3. Resilience:
Redundancy built in?
Handles peak loads?

Infrastructure modernization must be judged on safety and resilience, not just speed — a faster system that fails more often is a step backward.

Your Challenge

Scenario: A mid-size regional bank operates a domestic batch-based clearing system that processes retail payments overnight. A regulator has mandated that all retail payments must settle within one hour by next year. You are the infrastructure architect.

Your task: Design a migration plan for moving from batch to real-time clearing. For each of the three biggest risks you identify, specify your mitigation strategy.

Consider:

- How will you ensure both systems can run in parallel during migration?
- What happens to payments already in the batch queue when you switch over?
- How do you test real-time processing under peak load without risking live transactions?
- What rollback plan do you have if real-time clearing fails in production?
- How will you manage liquidity if banks now need intraday funding instead of end-of-day settlement?

Deliverable: A one-page migration plan listing three risks and three mitigations, using the criteria from slide nine.

Reflection

This exercise mirrors real regulatory mandates driving instant payment adoption worldwide — the technical challenge is substantial, but the deadline is non-negotiable.

Real infrastructure modernization happens under regulatory pressure, tight deadlines, and zero tolerance for failure — exactly this scenario.