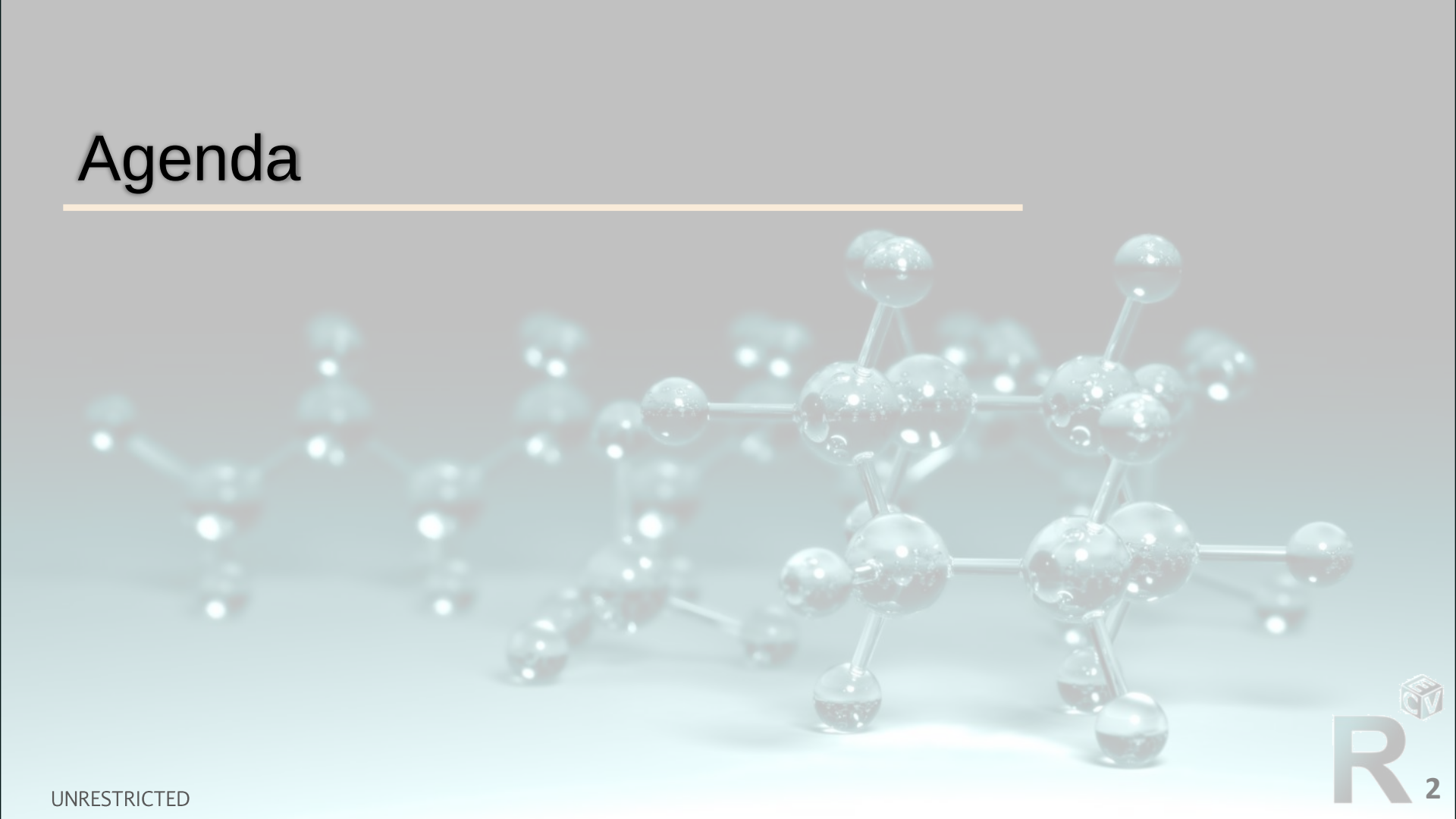
Smart Contract Templates Summit

June 29th, 2016

New York and London

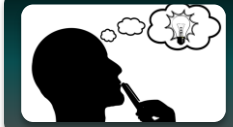
Agenda



NY	LDN		
08.00	**13.00**	Arrival and breakfast / light lunch	
08.30	**13.30**	**Welcome. Agenda and goals for the summit**	David Rutter *Founder, R3*
08.40	**13.40**	**Smart Contract Templates progress to date**	Dr. Lee Braine *Investment Bank CTO Office, Barclays*
09.00	**14.00**	**FinTech's role in derivatives markets**	Clive Ansell *Head of Market Instructure and Technology, ISDA*
09.30	**14.30**	**Legal documentation automation in investment banking**	Darren Jones *Head of Investment Bank Legal Automation, Barclays*
10.00	**15.00**	**A lawyer's view of smart contracts**	Sean Murphy *Partner, Norton Rose Fulbright*
10.15	**15.15**	Coffee break	
10.30	**15.30**	**Introduction to the Ricardian Contract**	Ian Grigg *Consultant Architect, R3*
10.55	**15.55**	**Smart legal contracts: prose, parameters, code**	Dr. Chris Clack *Senior Lecturer, University College London*
11.15	**16.15**	**Introduction to shared ledger architecture**	Richard Gendal Brown *CTO, R3*
11.25	**16.25**	**Architectural considerations for Smart Contract Templates**	Nick Palmer *Investment Bank Lead Architect, Barclays*
11.55	**16.55**	**Priorities for Smart Contract Templates**	Clemens Wan *Associate Director, R3*
12.10	**17.10**	**Summary of key points from the summit**	Clemens Wan *Associate Director, R3* Gavin Thomas *Tech COO, R3*
12.15	**17.15**	**Next steps**	Dr. Lee Braine *Investment Bank CTO Office, Barclays*
12.30	**17.30**	**Close**	
	17.30	Networking and drinks (London only)	

Summit Goals

David Rutter
Founder, R3



Lead to a base understanding of legal, architectural and business considerations

Elicit challenges, concerns and issues

Elicit preferences for future strategies whether legal, architectural or general design

Identify candidate next steps

Smart Contract Templates:
Progress to Date

Dr. Lee Braine
Investment Bank CTO Office, Barclays

Smart Contract Templates: Progress To Date

Presentation at R3 Smart Contract Templates Summit
New York and London

Lee Braine, Investment Bank CTO Office, Barclays

29 June 2016

Contents

Reminder of Demo Day in April

Software prototype

Financial products

Academia (with UCL)

What we mean by “smart contract”

Q & A

Reminder of Demo Day in April

Challenge – each bank maintains its own separate ledgers and systems, huge duplication of effort and cost

Solution – shared ledgers and smart contracts

Piece in jigsaw puzzle – smart contract templates

Focus – smart legal agreements, where legal prose is connected with code via parameters

General benefits – cost reductions, efficiency improvements, risk reductions

Specific benefits – simplify legal documentation processes, drive standards adoption via reusable templates, mutualise costs via common components

Reminder of Demo Day in April

Software demo – prototype of web application to edit templates, edit agreements, enter trades, affirm trades, and view trades

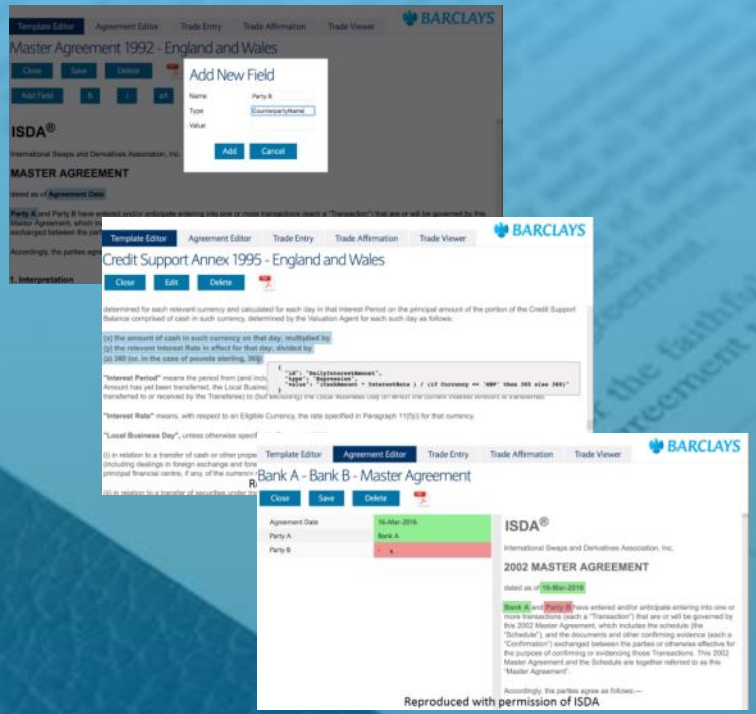
Agnostic – Smart Contract Templates are agnostic of platform (Corda, Ethereum, Hyperledger, etc); first demo was on Corda platform

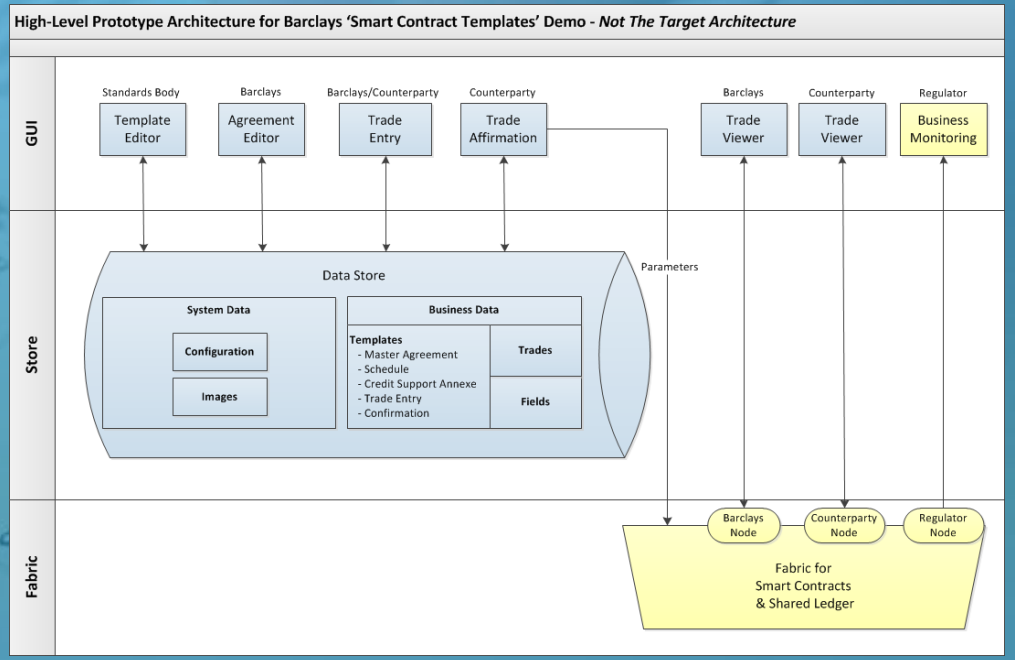
Collaboration – Barclays Investment Bank, R3, University College London, ISDA, Société Générale, Techstars; more collaboration required

Reference – "Barclays' Smart Contract Templates", Barclays London Accelerator 2016, The O2, http://www.ibtimes.co.uk/barclays-smart-contract-templates-heralds-first-ever-public-demo-r3s-corda-platform-1555329

Prototype Software

Web application (JavaScript, HTML5, CSS, Markdown) with RESTful API to Corda

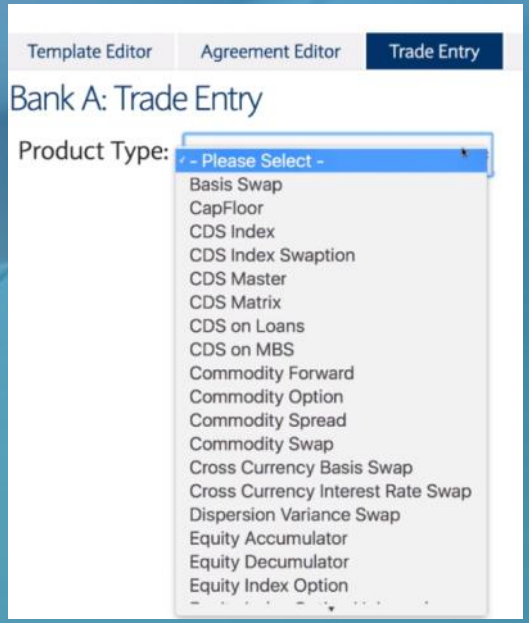




Example financial products

Focus on standardised agreements, e.g.:

- Interest rate swap – demonstrated in prototype
- Equity swap – started exploring*
- Swaption – started exploring*
- Etc.



* http://www.risk.net/risk-magazine/feature/2457777/barclays-taps-blockchain-for-equity-swaps-options-swaptions

Academia (with UCL)

Specification for Common Language for Augmented Contract Knowledge (CLACK)

Academic paper (drafted, to be published)

Supports development of Smart Contract Templates

What we mean by “smart contract”

Working definition – “smart contract” is an agreement whose execution is both automatable and enforceable

Automatable – executable by computer (although some parts may require human input and control)

Enforceable – legal enforcement of rights and obligations (our preference) vs tamper-proof execution

Structure – Ricardian Contract (legal prose, parameters, code)

Future evolution – increasing sophistication (higher-order parameters, domain-specific languages, meta-languages, etc)


Questions?
Signature
Date

FinTech's Role in Derivatives Markets

Clive Ansell

Head of Market Infrastructure and Technology, ISDA

FinTech's Role in Derivatives Markets

Clive Ansell
Head of Market Infrastructure and Technology
ISDA

Ian Sloyan
Director, Data and Reporting
ISDA

Contents

- **About ISDA**
- **ISDA's role**
- **Industry challenges**
- **Solutions**
- **Smart contracts**

About ISDA

Since 1985, ISDA has worked to make the global derivatives markets safer and more efficient. Today, ISDA has over 850 member institutions from 67 countries. These members comprise a broad range of derivatives market participants, including corporations, investment managers, government and supranational entities, insurance companies, energy and commodities firms, and international and regional banks. In addition to market participants, members also include key components of the derivatives market infrastructure, such as exchanges, intermediaries, clearing houses and repositories, as well as law firms, accounting firms and other service providers. Information about ISDA and its activities is available on the Association's web site: www.isda.org.

ISDA's Role

- **ISDA fosters safe and efficient derivatives markets to facilitate effective risk management for all users of derivative products**
- **Market Infrastructure and Technology objectives:**
  - **Process simplification**
  - **Increased quality of data**
  - **Fair access**
  - **Robust derivatives market infrastructure**
  - **Consistent regulatory compliance**

Industry Challenges

- **Complexity**
- **Capacity**
- **Regulatory compliance**
- **Robust market infrastructure and processes**
- **Cost and efficiency**

Solutions

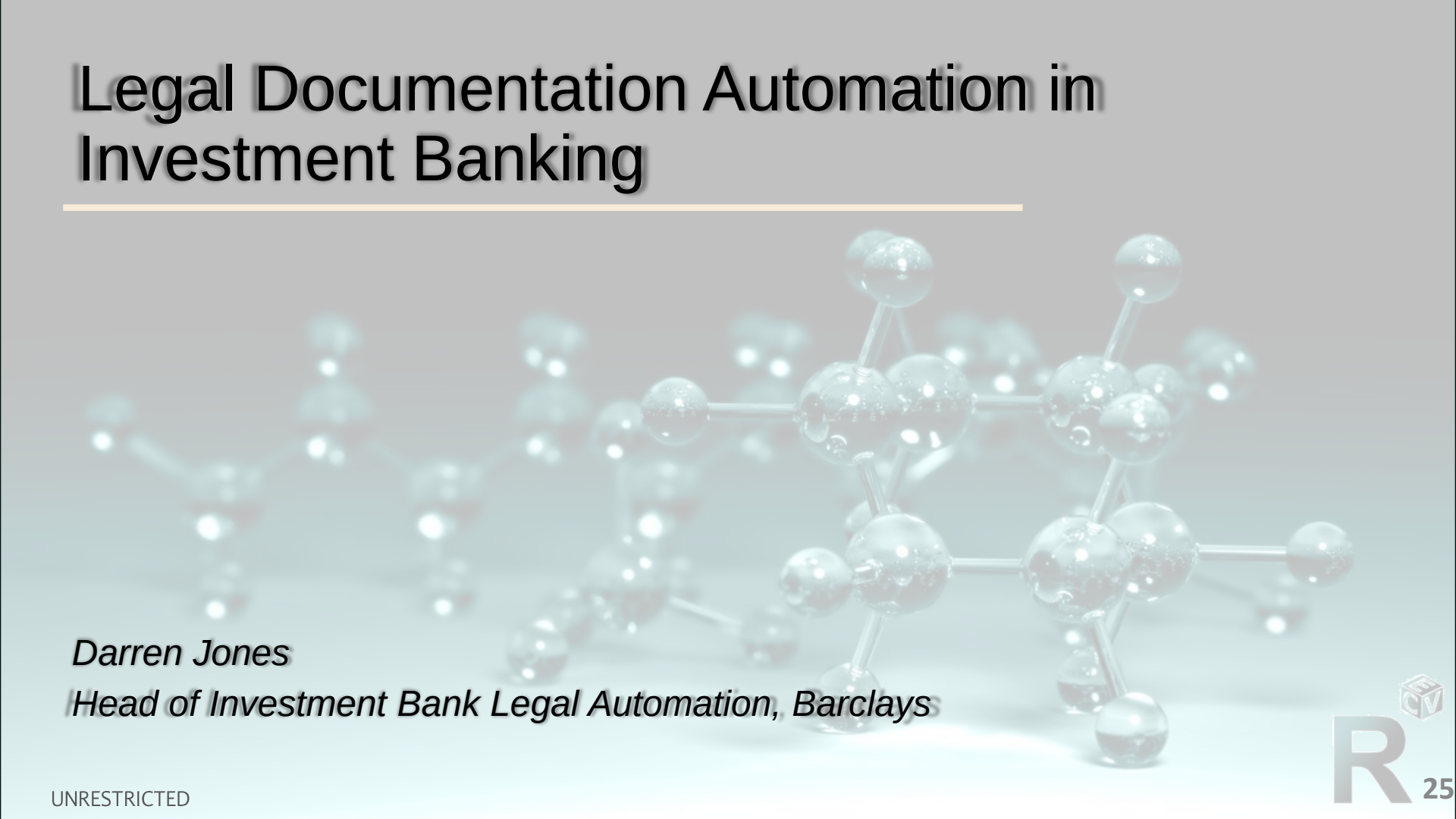
- **Standardisation**
  - **Process**
  - **Data**
  - **Documentation**
- **Collaboration**
  - **All market participants**
- **Mutualisation**
  - **Identify opportunities and benefits**
- **Technology**
  - **FinTech**
    - **RegTech**
    - **DLT**

Smart Contracts

- **Leveraging ISDA's documentation library**
- **FpML**
- **ISDA's plans**

Questions?

Legal Documentation Automation in Investment Banking



Darren Jones

Head of Investment Bank Legal Automation, Barclays

Legal Documentation Automation in Investment Banking

Darren Jones - Head of Investment Bank Legal Automation

BARCLAYS

Presentation at R3 Smart Contract Template Summit
New York and London

29 June 2016

Utilising Technology in Legal

By analysing Legal as a business and embracing automation, we realise the following benefits:

Business	▪ Enhanced systems and controls ▪ Increased productivity (without the need for additional employees) ▪ Increased transparency of Legal effort ▪ Business expansion ▪ Meaningful MI ▪ Focus on strategic work streams / Regulatory initiatives ▪ Consistency across legal documents ▪ Effective knowledge management ▪ Increased green credentials (by reducing unnecessary printing & archiving)
Personnel	▪ Improved job satisfaction through increased value add ▪ Better business partners (focusing on challenging and interesting issues) ▪ New skills for lawyers ▪ Clean & open workspace ▪ Better working hours & more leisure time

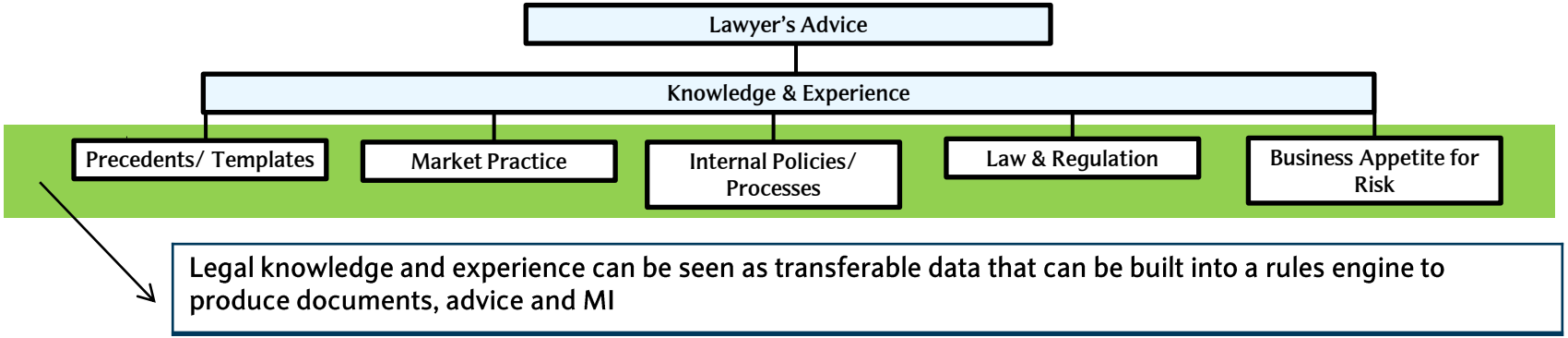
The Future of Legal Services

Disruptive technologies will radically change the legal profession and increased processing power and storage will allow for many manual tasks to be automated

Technology	Benefits
Contract Lifecycle Management Systems	▪ Improve visibility and control of workflow ▪ Real-time risk management analytics
Document Generation	▪ Increase efficiency and productivity ▪ Better knowledge management and retention
Cloud Based Negotiation	▪ Streamlined negotiation ▪ Complete and easily accessible audit trail
E-signatures	▪ No faxing, scanning or delays ▪ Sign documents anywhere from any device
Optical Character Recognition (OCR)	▪ Dealing with the legacy population! ▪ Creating data from paper
Big Data and the AI Lawyer	▪ Litigation prediction ▪ Intelligent searching for e-discovery and due diligence
Distributed Ledgers & Smart Contracts	▪ Possibility to incorporate all of the above (save for OCR)

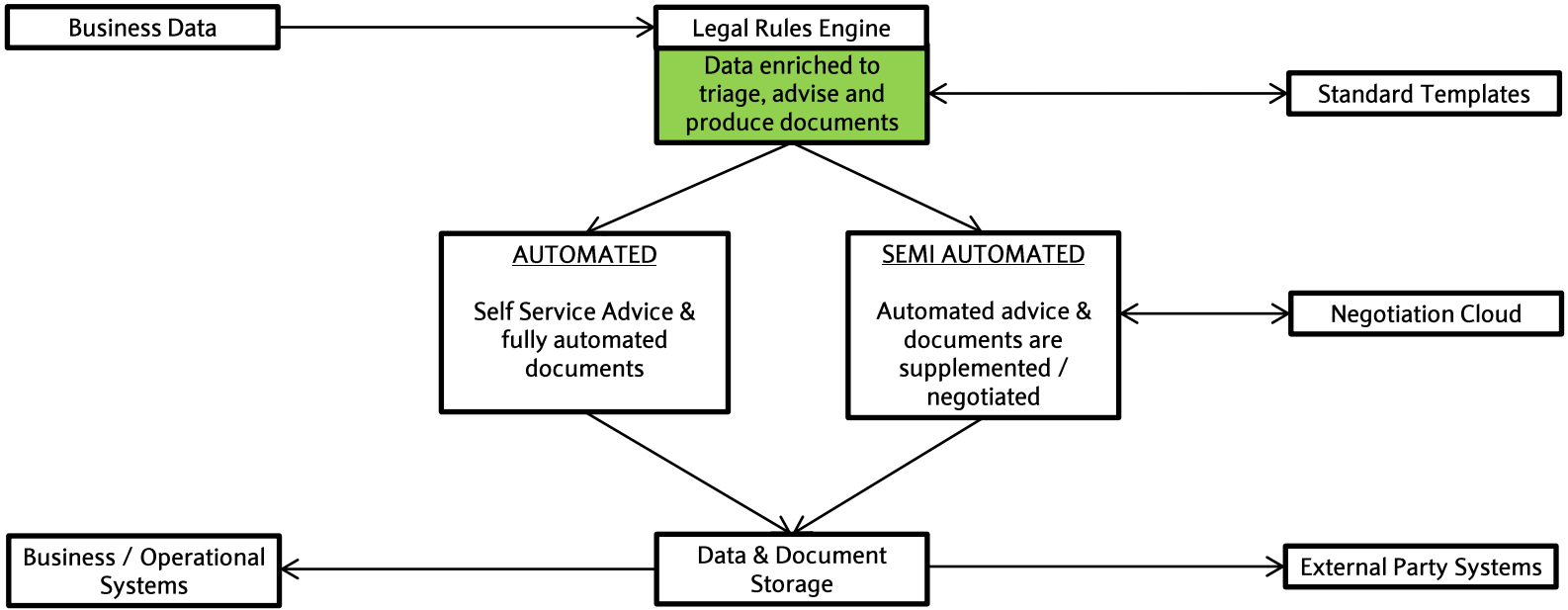
Changing Mindsets and Perceptions

Internal cost and efficiency challenges and external regulation have highlighted the need for a new way of working, a focus on innovation and the deconstruction of the traditional role of the lawyer

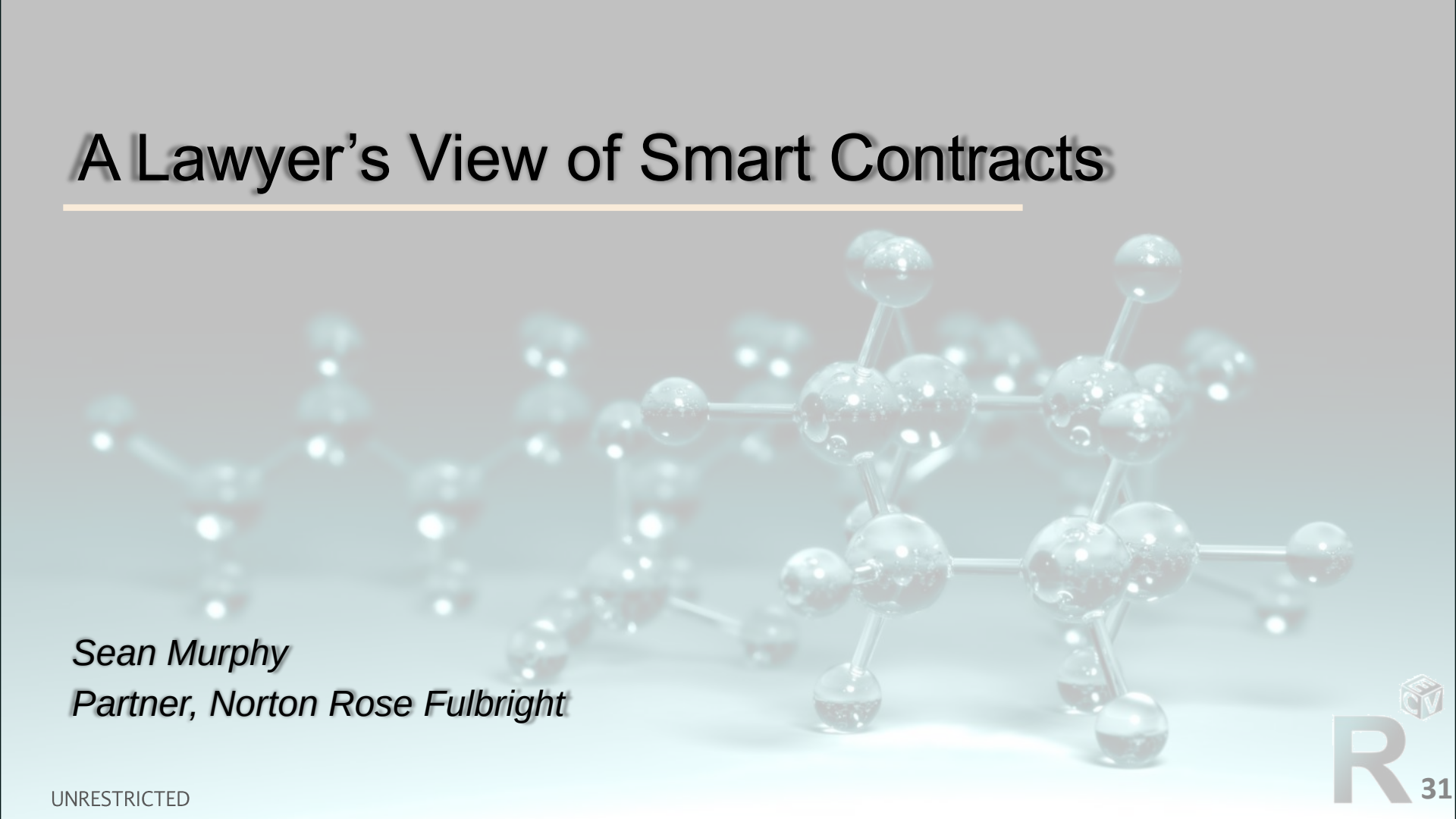


Changing Mindsets and Perceptions

- Review, standardise, modularise and simplify
- Accept exceptions!



A Lawyer's View of Smart Contracts



Sean Murphy
Partner, Norton Rose Fulbright

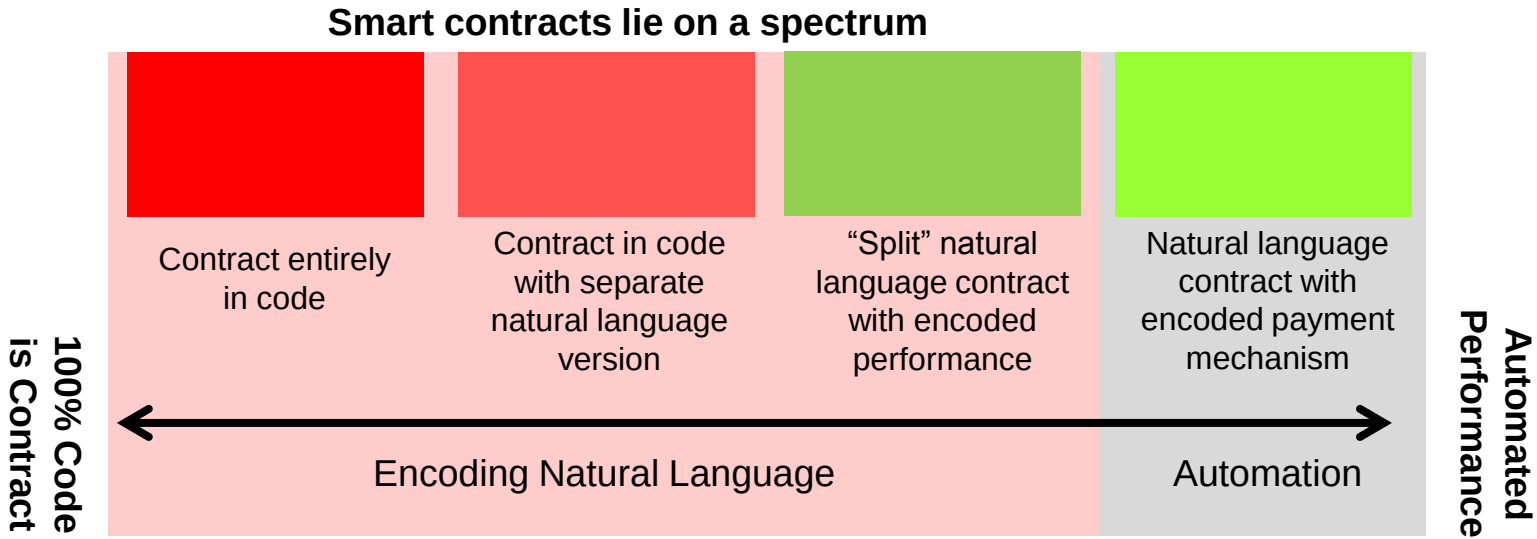
Financial institutions
Energy
Infrastructure, mining and commodities
Transport
Technology and innovation
Life sciences and healthcare

NORTON ROSE FULBRIGHT

A lawyer's view of smart contracts

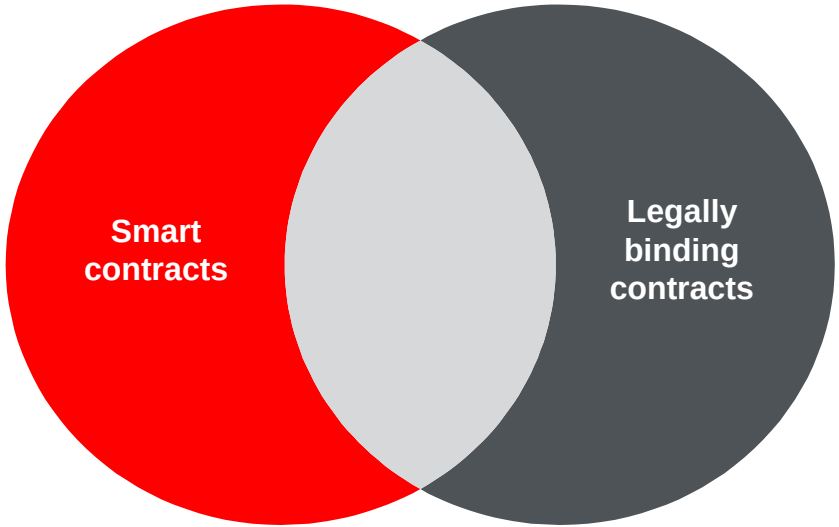
Sean Murphy, Partner
29 June 2016

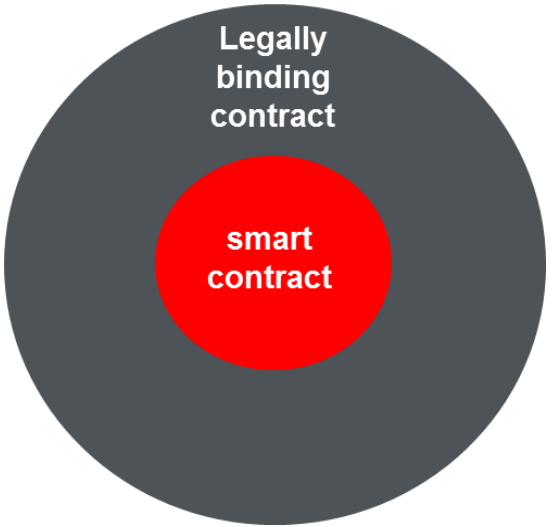
What is a smart contract?



Code is contract: challenges

- Is there a contract?
- What are its terms?

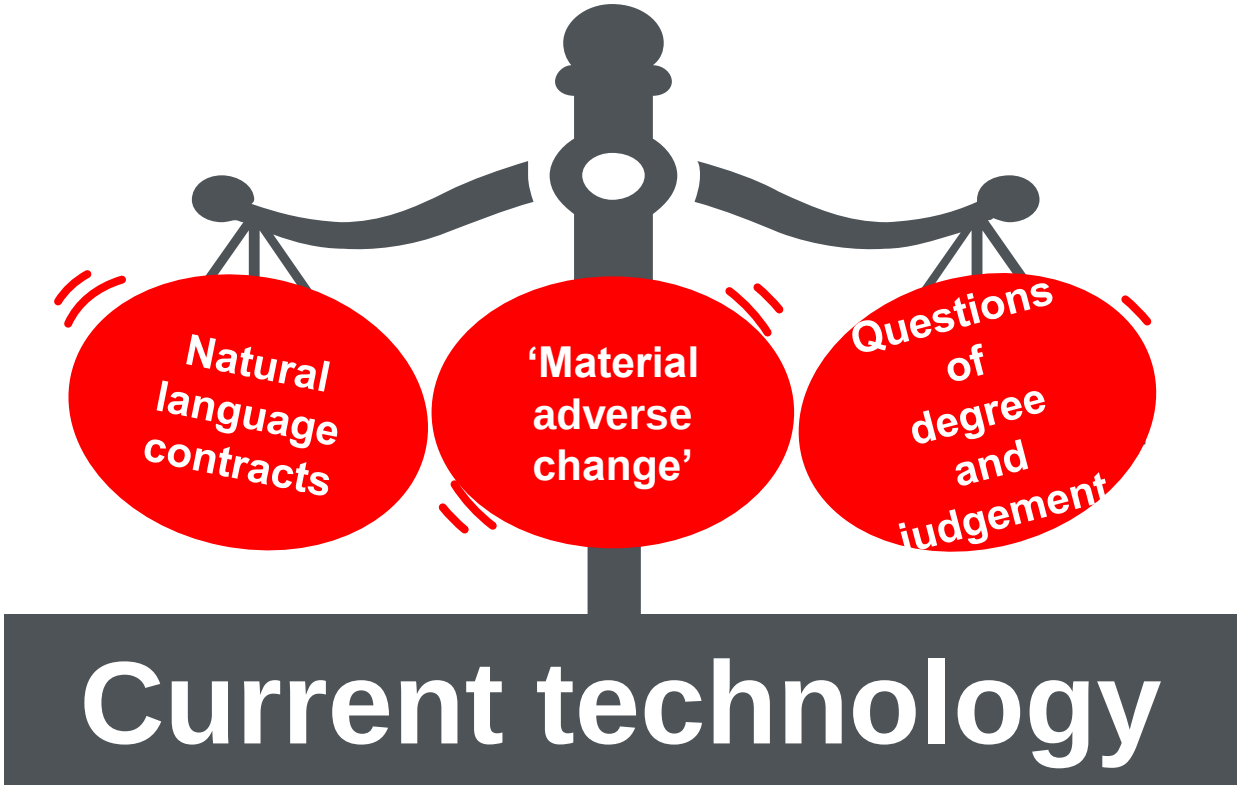




Automated performance: challenges

- Legal formalities
- Proof of signature
- Longer term smart contracts
- Coding as the parties intended
- Amendments
- Confidentiality

Are there limits to smart contracts?



The split contract model

- Code and natural language at odds
- Bugs in coding

Dispute resolution

- Dispute resolution - can draw on existing dispute resolution mechanisms:
  - online dispute resolution platforms (e.g. EU Regulation 524/2013 provides for the establishment of an EU-level model for B2C disputes)
  - expert determination
  - choice of law and jurisdiction clauses
  - automatic operation of dispute resolution

Regulation

- Regulatory considerations:
  - what exactly is it that should be regulated?
  - which activities?
  - AML and KYC considerations
  - governance, systems and controls obligations

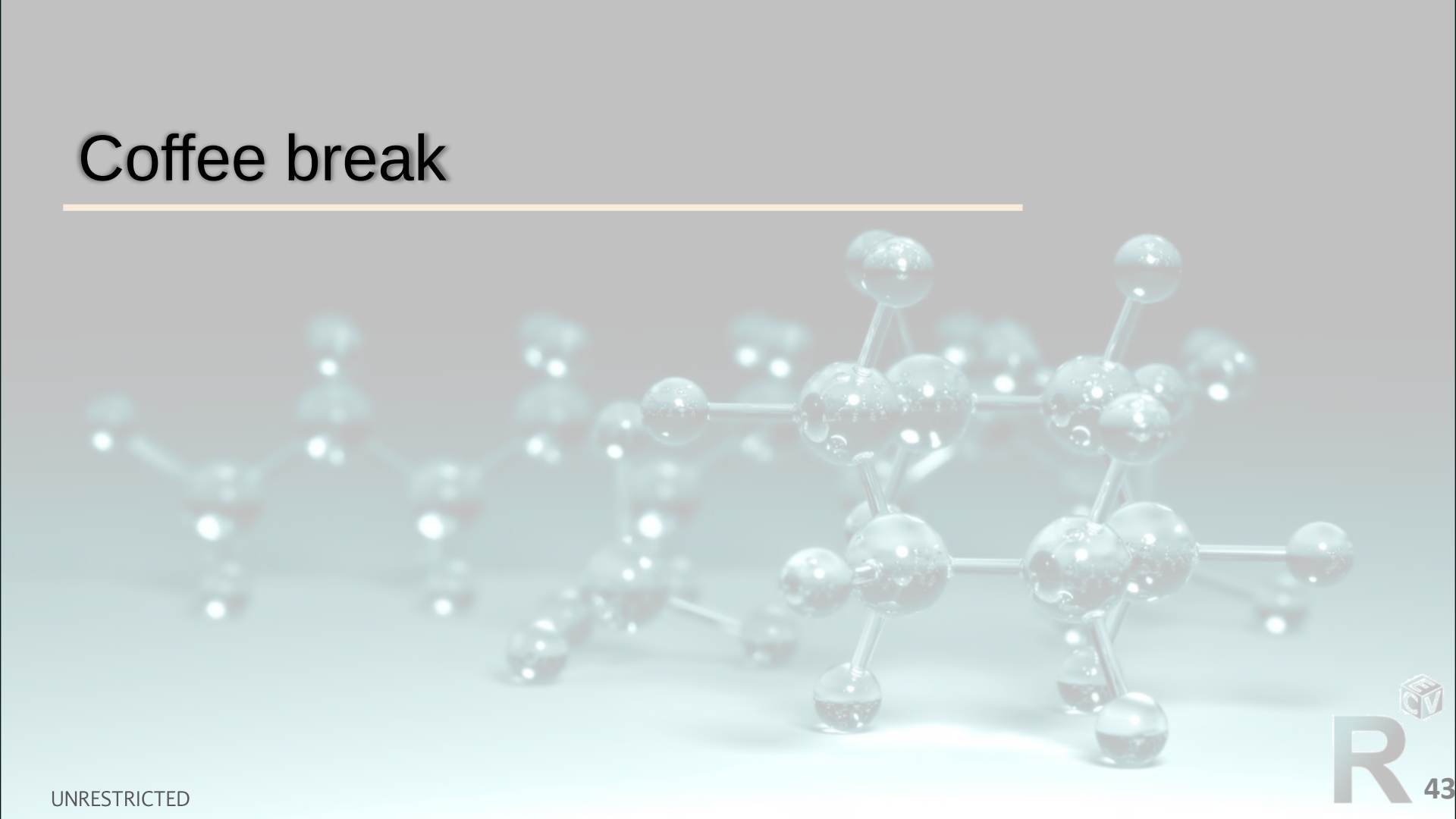
Discussion points

- How can amendments be dealt with?
- What dispute resolution mechanisms are practical?
- In the light of the Ethereum DAO, what steps should be taken to deal with security concerns in relation to smart contracts?


NORTON ROSE FULBRIGHT

Disclaimer

Coffee break



Introduction to the Ricardian Contract:
A retrospective

Ian Grigg
Consultant Architect, R3

Introduction

On the Internet, how do you:

- issue a financial instrument?
  - that hundreds or millions can rely upon?
- securely negotiate a financial agreement?
  - and not end up in a mess?
- capture all the legal significance of a deal?
  - reduce confusions, empower traders, resolve disputes?

The *Ricardian Contract* is...

A tool to capture the essence of any deal on the Internet, reliably, securely, and honestly.

This presentation will show:

- how it came to be
- why it had to be in the form it is
- how it expands to ‘blockchain’ finance

Ian Grigg

1995 - invented
1996 - first released in Ricardo
2004 - paper
2015 - extended for blockchains
2015 - consultant architect at R3

iang@iang.org or iang@r3cev.com

The **ZERO** Coupon Bond is the *Atomic Element* of Finance

- NPV
- CashFlow
- options
- Black-Scholes
- Interest Rates
- ...

Z by Uyen T. Nguyen: licensed under CC BY

eCash, zeros, finance, oh my!

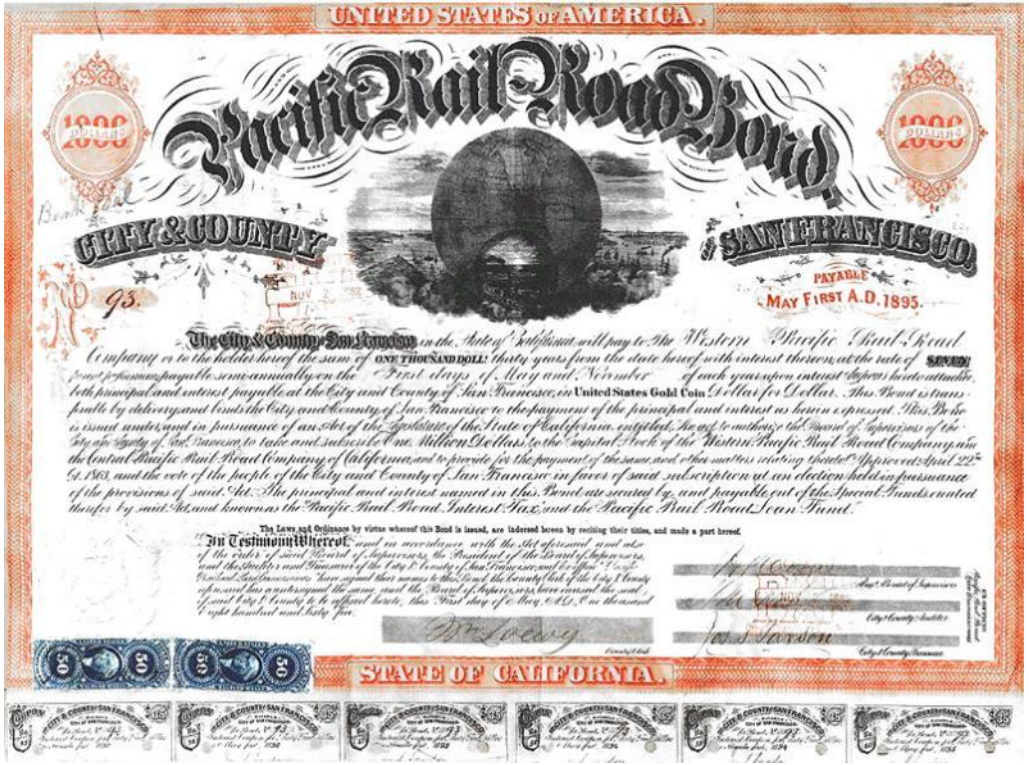
1983: blind signature 1994: eCash - dollar for paying on Internet

DigiCash showed how to issue $1 on Internet
Finance shows how to build zeros into any financial instrument
eCash is a dollar, and a zero pays a dollar…
Therefore, eCash is a zero!
Therefore we can issue *anything* on the Internet...

Systemics Goal - issue **anything** on net

1) Research…
2) Pick an MVP
   ⟶ Bonds!
3) Deep Dive

- Parameters
  Issuer, face, date, …
- Coupons
  by induction, sub-bonds
- Fine print
  legal prose → T&Cs



Pacific Rail Road Bond, 1865: public domain. Source https://en.wikipedia.org/wiki/File:San_Francisco_Pacific_Railroad_Bond_WPRR_1865.jpg

My bond is my contract

A bond is nothing more, nothing less than … a contract.

Which lawyers model as a set of elements:

- a party and a counterparty
- offer & acceptance
- consideration:
  - goods/services <-> money
- terms and conditions

New Goal – reduce Contract to Bytes

Contract at beginning, performance to follow

Law first, accounting second → divide and conquer

Goal reduced – convert

terms & conditions *legal-babble*

Into

Tag-values, SQL, expressions, DSL, *technobabble*

Resistance level

Clauses not clear, not standard, not even settled

Rewrite the terms:

- on a debacle…
- because we can…
- hide clauses in fine print…

No two bonds were alike.

Conclusion – impossible to convert directly...

The War of the Wordsmiths

What to do?

- Get rid of the wordsmiths? Not likely…
- Train the wordsmiths? Ditto...
- Use algebra to convert? No:
  - vagueness, uncertainty, unpredictability… efficient!
- Subsets? No, it was all equally important / not important
- Duplicate prose with bytes?
  - not good if contracts are a weapon…

What's left? Simplify ….

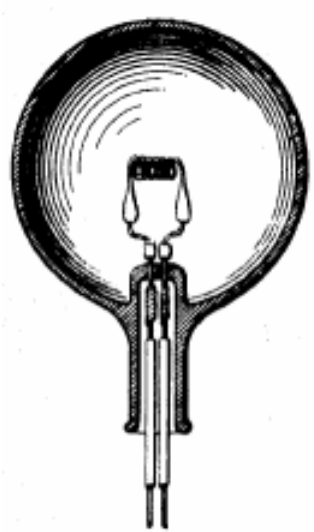
Lightbulb - The Contract *IS* the Issue

Flip the logic upside down

- keep prose document *as is*
- let the program extract its parts from document
- place the users -issuer+holder- first
- and the developer second

As developer, I don’t need to convert the bond

1. capture into signed digital document
2. read out 10 or so values
3. identify the document for accounting



Light bulb from Edison Patent 223,898, 1880: public domain. Source https://en.wikipedia.org/wiki/File:Light_bulb.png

1. How to sign a digital, readable doc

PGP showed us how to doc-sign as a Feature:

- clear start line
- clear start of Sig
- signature block

(PGP was the 1990s email encryption program)

```
- -----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

05.02.11
'Alice' is the owner of the GPG key with fingerprint:
4F16 E4D6 BB9B D4A0 39F8  9644 DF23 CB88 2400 ACE3
'Bob' is the owner of the GPG key with fingerprint:
05CA A3B0 9322 1874 9D1A  2357 9C07 2DDC 4394 91B7

This contract is for the exchange of 20 Bitcoins at a
rate of USD $3.25 per bitcoin, for a total of $65 USD.

Bob agrees to send $65 USD, plus any fees charged by
Paypal, via a Paypal payment with transaction type 'Payment
Owed' (to reduce chargeback risks) to the paypal account
'alice@lol.com' within 24 hours of both parties
signing this contract. Alice agrees to send 20 bitcoins
to 1Dj1SocbbH9Lbb9aTdqSHB9AAjhdxNNZha within 4 hours
of receiving this Paypal payment.
- -----BEGIN PGP SIGNATURE-----
Version: GnuPG v1.4.11 (GNU/Linux)

iJwEAQECAAYFAk2/PKAACgkQ3yPLiCQArOOc/AP9GL0EgVQMTHZqOX5ynNVGBFb2
6eB7QzRdNQH8Zcj6R0y7fzbpYPbgwX+G3EYtsDjS4G3M8LdlFFCcJ/JLJGle191e
KLpXp/BWMRayn3KcFYoGogmONtxk1wOVoXF+wiK9jZYFIdjI87qh8iUOCboFVqQk
T3OG7odEKJOjNwYP+j0=
=2mDw
- -----END PGP SIGNATURE-----
```

signed PGP message by OpenBazaar: Creative Commons Attribution 4.0 International

2. How to read values - Markup

```
[issue]
;
;  This section identifies general aspects of this contract.
;
issue_type = currency
issue_name = Systemics Pre-paid Services Dollar

[currency]
currency_symbol = $
currency_tla = PSD

[unit]
;
;  The Unit of Account is the PSD. This currency is denominated
;  in PSD, with an underlying unit of contract of iota, which
;  is equal to PSD 0.0001.
;
unit_power = 4
unit_mediate_power = 2
unit_major = $
unit_mediate = c
unit_minor = p
unit_major_unit = PSD
unit_mediate_unit = cent
unit_minor_unit = iota
```

tag-value pairs, parseable by program

Slightly smart decimalisation

www.webfunds.org/ricardo/contracts/systemics/Systemics_PSD_a.html

```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

;
;  Prepaid Services Dollar, Issue A.
;
;  Being, a Contract to settle USD-denominated services.
;
;  Between, Systemics Inc. and Users.
;

[definitions]

definitions_dollars = *
{
  Prepaid Services Dollar ("PSD") means the electronic
  currency, denominated in United States of America dollars
  ("USD"), as facilitated by this Ricardian contract.  Other
  dollars, which may be used as exchange for PSD, are referred
  to as Account Dollars.
}

definitions_units = *
{
  The unit of the PSD is the iota, which is defined as having
  the value of PSD 0.0001.
}

definitions_purpose = *
{
  The purpose of PSD is to facilitate the payment of services
  provided by Systemics Inc.
}

definitions_issuer = *
```

Explanatory Comment

Heading

Prose clauses

3. Identifying my Bond

How to identify the document?

- Dematerialisation → get rid of paper → automate everything
- IT trend to automation → must ‘allocate’ a number
- Allocation for bonds → registry?
  - National? International? for bonds? derivatives?
- Costs, admin, delay, rules, death by a thousand cuts…

This is not the open entry, no barriers market I wanted!

3. The Hash as identifier

PGP again provided the clue

cryptographic message digest or **Hash**

Turns any ‘document’ into number:

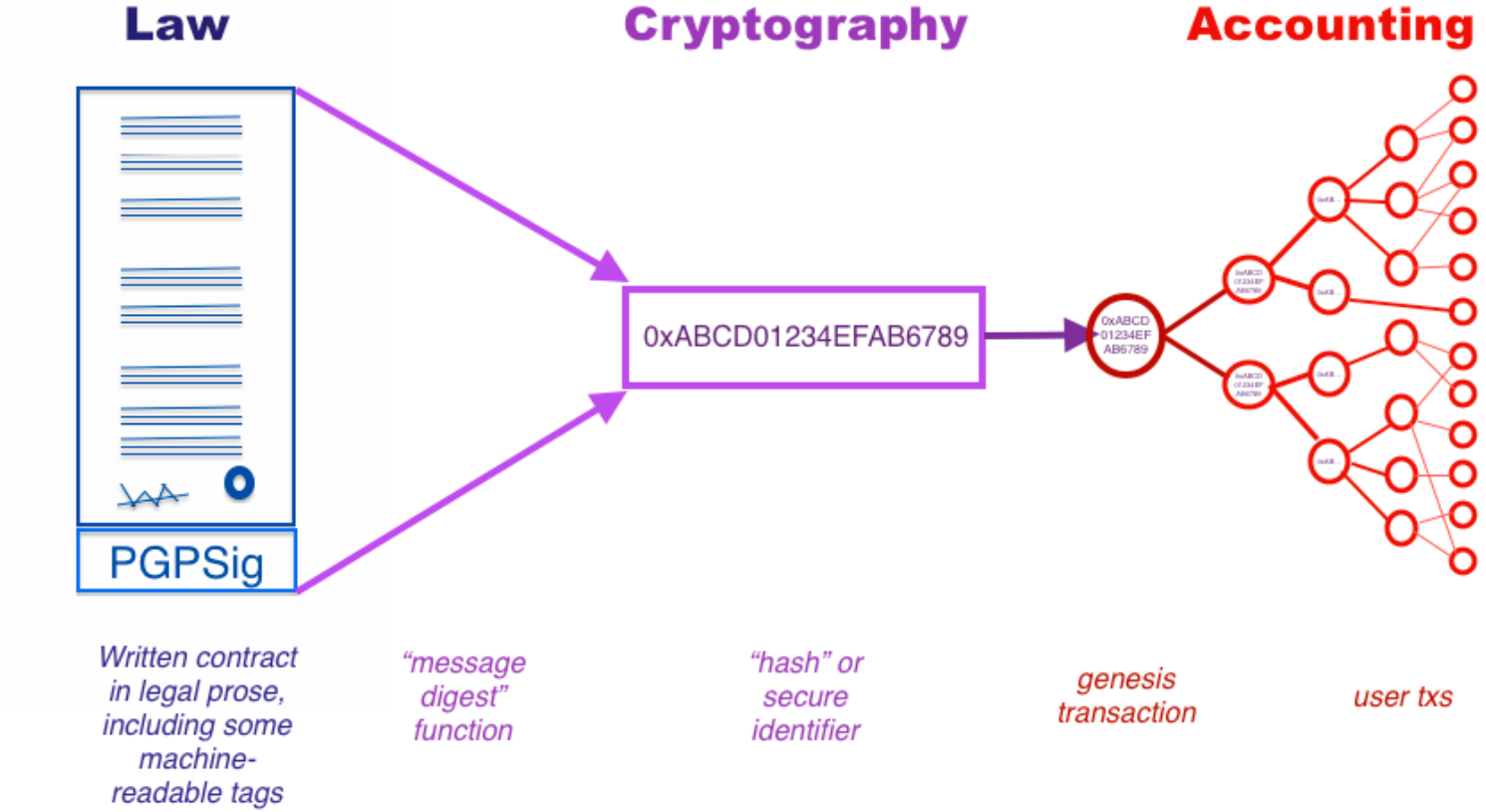
1Q2TWHE3GMdB6BZKafqwxXtWAWgFt5Jvm3

(Hal Finney’s Bitcoin account)

Hashes are:

- Secure, unique, global, free
- 1:1 with your document

The Ricardian Contract

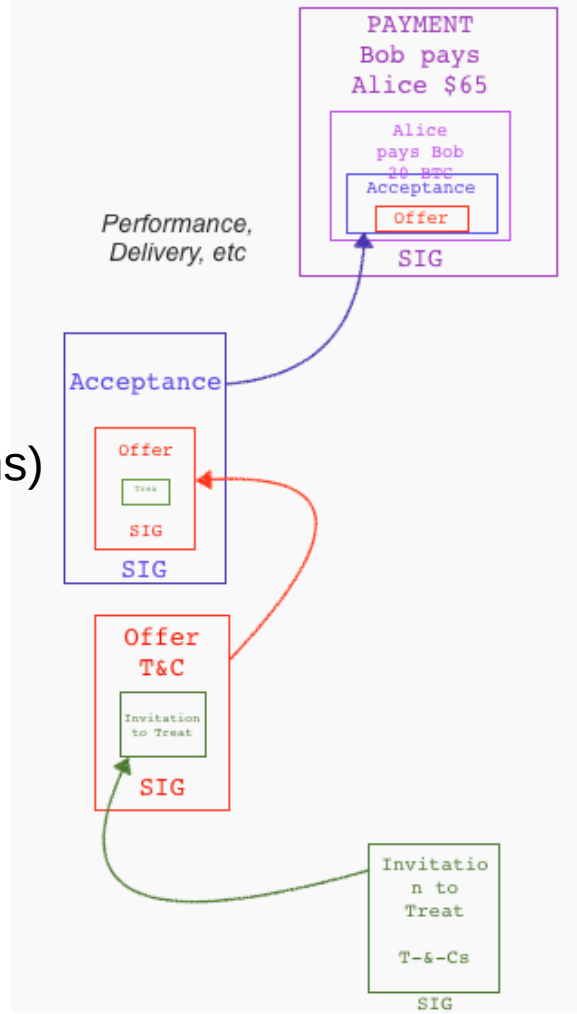


The Ricardian Contract

- Captures any legal prose contract
  - any financial deal
  - no harder to read or write than any other contract
  - (too) brutally honest
  - not good for hiding intent
- Signed and Hashed
  - self-identifying, self-verifying
  - hash makes participation in any digital agreement trivial
  - add keys & server locs for self-assertion, self-routing
- Easy to implement – 1000 lines of code

Ext 1 - Contracting

- One Riccy can:
  - include another Riccy (OpenTransactions)
  - refer to another Riccy by hash
- Use the form for any purpose
  - config, params, packets (OT)
  - Internet shopping (OpenBazaar)



Ext 2 - Complexity

Code - as text - but what about binary?

Prose - as text - but what about Masters, Annexes?

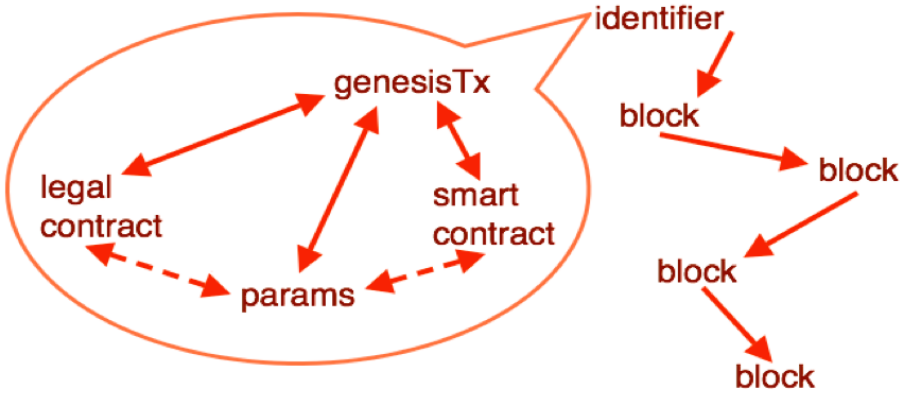
Simple answer - refer to code, text by hash - in params

Ricardian triple:

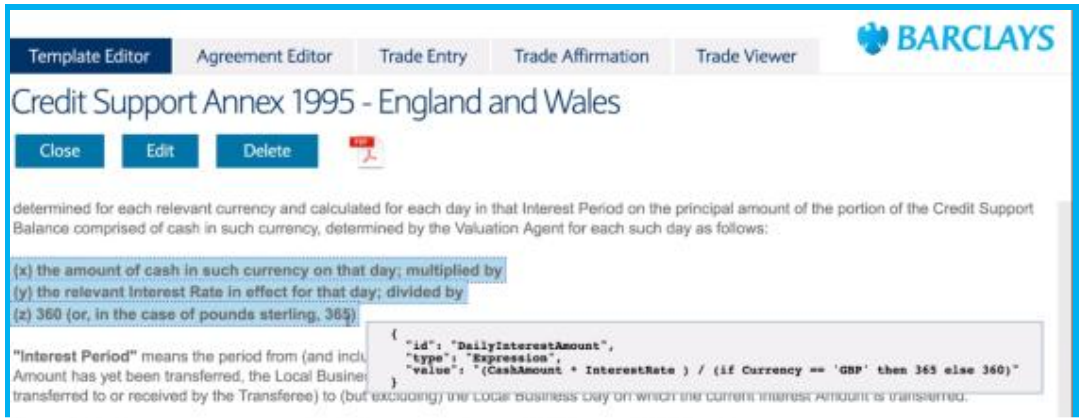
{ Prose, Params, Code }

Can manage anything:

blockchains, smart contracts, identities, IoT, network objects



The Future -1-3



Barclays' Smart Contract Templates browser, 2016

1. Implementing the triple – R3's Corda
2. Jurisprudence:

   Enforceability? Admissability? Precedent? Dispute Resolution?
3. Contract browser – Barclays' Smart Contract Templates

The Future - 4

4. Prose versus Code
    - duplication *versus* sole coverage
    - verify conformance between code and prose
    - derive code from prose or v.v.?
    - insert code into prose or v.v.?
    - tight couplings of code function <-> prose clause

who's right?

References

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Bryce "zooko" Wilcox-O'Hearn (2001) "Names: Decentralized, Secure, Human-Meaningful - Choose Two."
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Smart Legal Contracts:
Prose, parameters, code

Dr. Chris Clack

Senior Lecturer, University College London

Smart Legal Contracts: Prose, parameters, code

Dr. Christopher D. Clack

The Centre for Blockchain Technologies
Department of Computer Science
University College London

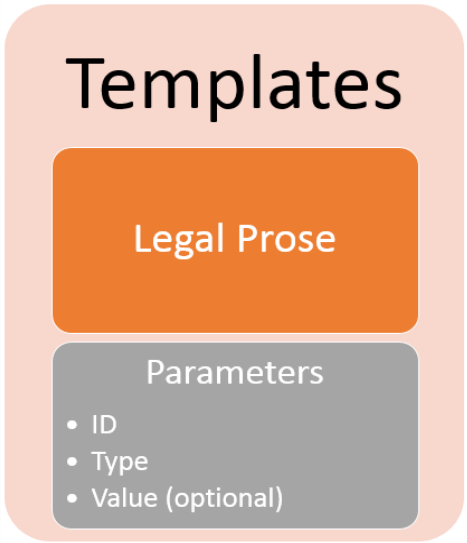
Consultant to Barclays

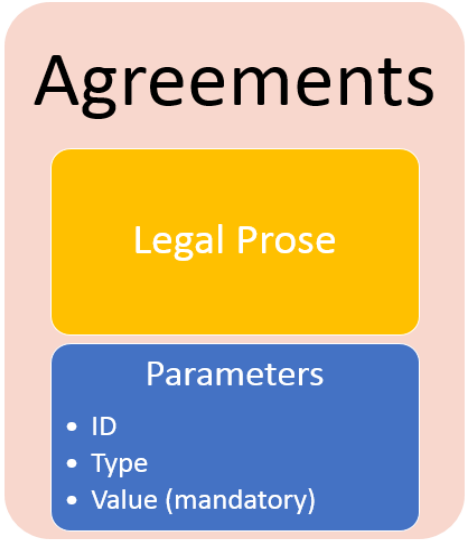
Presentation to R3 Smart Contract Templates Summit
29 June 2016

Contents

- Smart Contract Templates
- Legal Prose, Parameters, Code and their Evolution
- Potential Roadmap
- CLACK Language
- Discussion Points

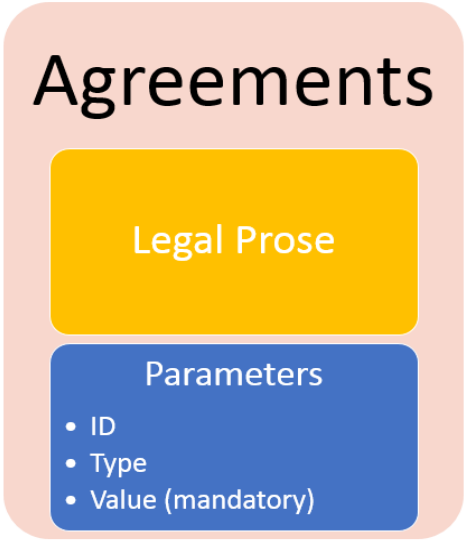
Smart Contract Templates





- A template is an electronic representation of a legal contract (eg issued by a standards
- An agreement is a fully-instantiated template (including any customised legal prose and parameters)

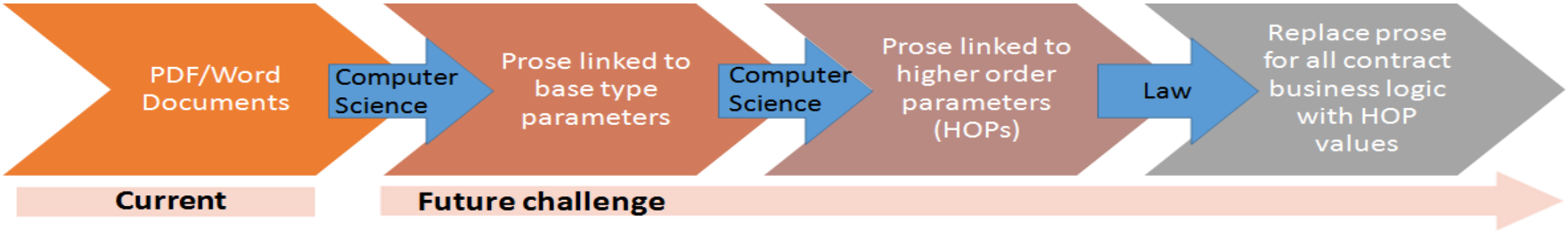
Agreements – Parameters and Legal Prose



- The legal contract includes both prose and parameters
- Parameters provide the link from prose to code
- A parameter might be named in one document, given a value in a second document, and used in a third document

- An agreement can be understood in two ways:
  - it specifies operational details of actions to perform
  - it specifies non-operational details of rights and obligations

Evolution of Parameters and Legal Prose



2002 MASTER AGREEMENT

dated as of **16-Mar-2016**

```
{
  "id": "Agreement Date",
  "type": "Date",
  "value": "16-Mar-2016"
}
```

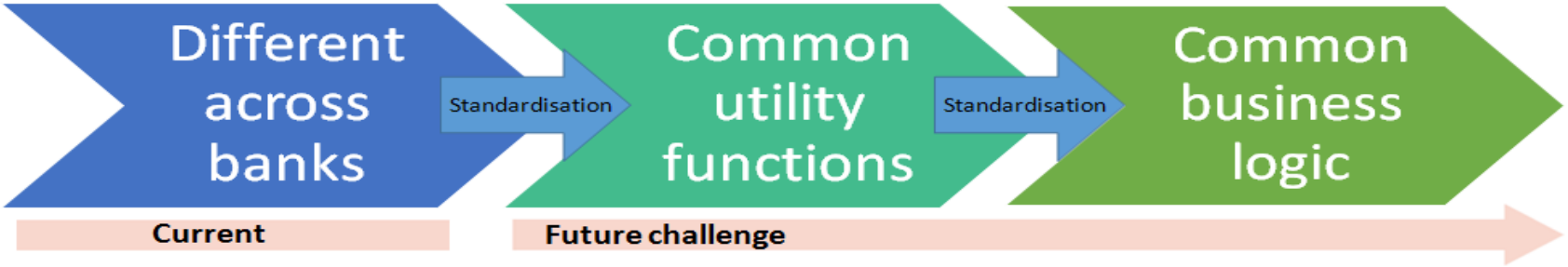
Example of prose linked to base type parameter

(x) the amount of cash in such currency on that day; multiplied by
(y) the relevant Interest Rate in effect for that day; divided by
(z) 360 (or, in the case of pounds sterling, 365)

```
{
  "id": "DailyInterestAmount",
  "type": "Expression",
  "value": "(CashAmount * InterestRate ) / (if Currency == 'GBP' then 365 else 360)"
}
```

Example of prose linked to higher order parameter

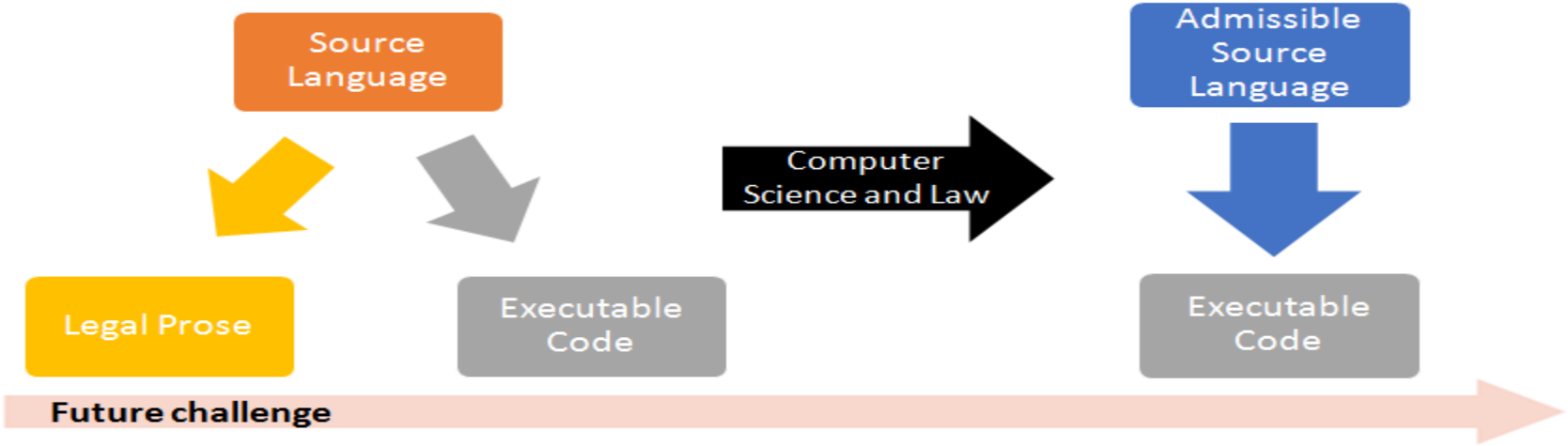
Evolution of Code



Example of common utility function:
valuation function for derivative

Example of common business logic:
global liquidity rules for cash sweeping

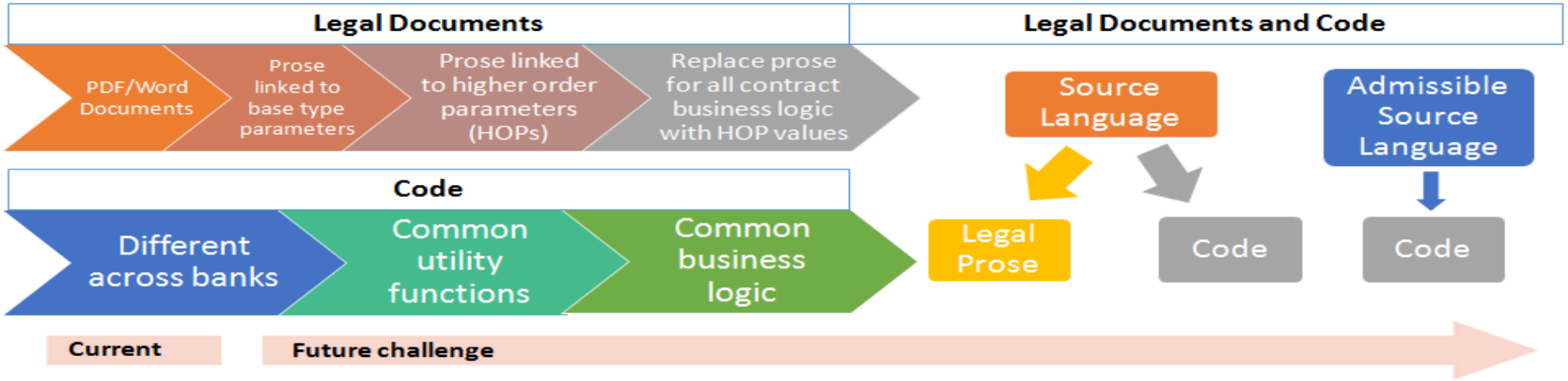
Long-term Research



- Source language which can be compiled to both legal prose and executable code
- Compiled legal prose is admissible in court

- Structured source language which is itself admissible in court
- Language can be compiled into executable code

Potential Roadmap



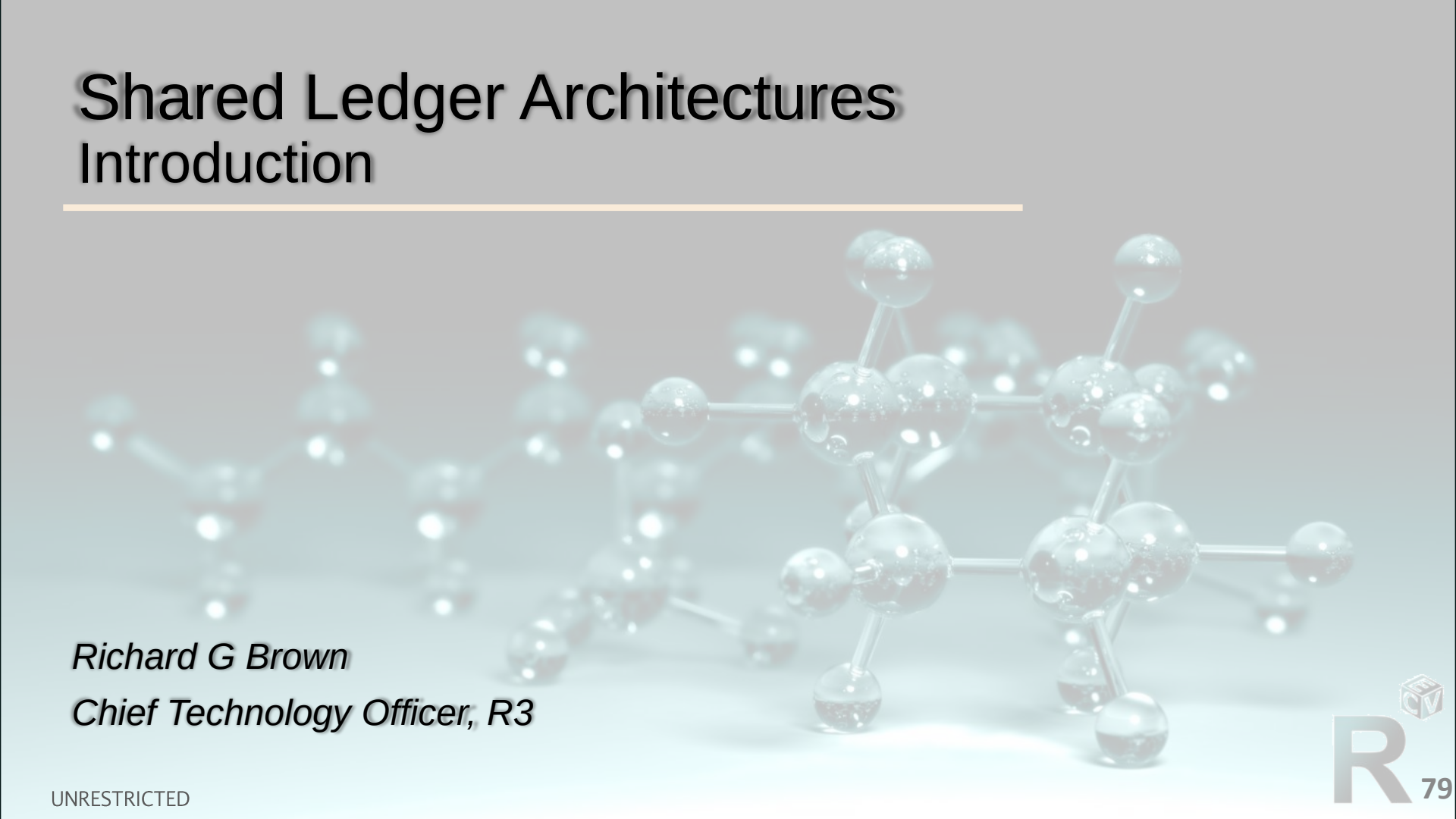
CLACK Language

- **C**ommon **L**anguage for **A**ugmented **C**ontract **K**nowledge (“CLACK”)
- Specifies document containers (for legal prose, parameters, etc), library objects, etc
- Assists design and implementation of Smart Contract Templates
- Academic paper to be published
- Will be available at http://clacklang.org/

Discussion Points

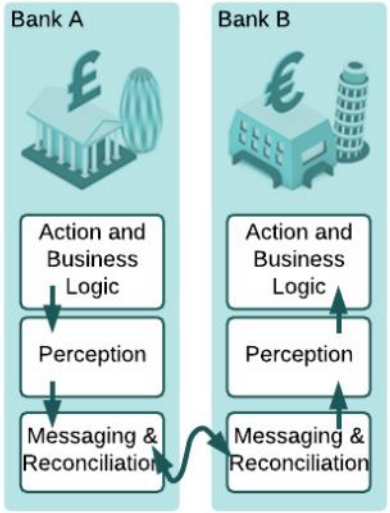
- Would higher order parameters be useful?
- What is the constraint for the roadmap: computer science or law?
- How long until a source language could generate both admissible legal prose and executable code? Any preferences for research directions?
- How long until an admissible source language could also generate executable code? Any preferences for research directions?

Shared Ledger Architectures
Introduction

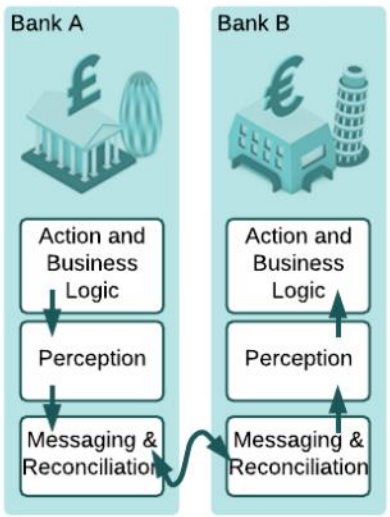


Richard G Brown

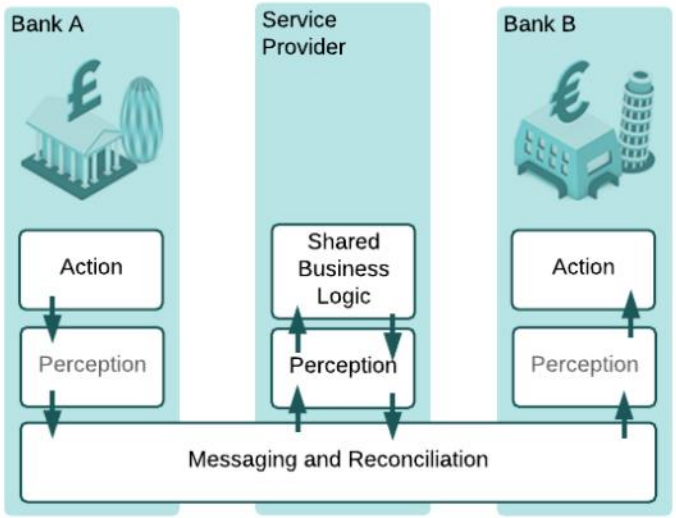
Chief Technology Officer, R3



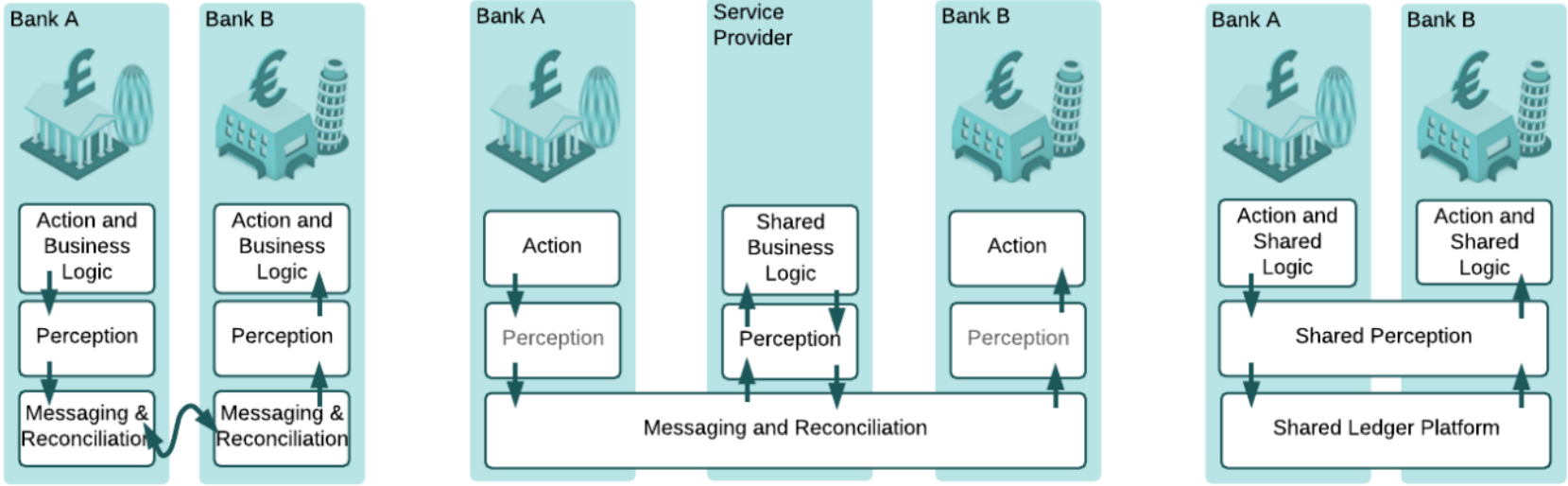
Bilateral - Reconciliation



Bilateral - Reconciliation



Third Party / Market Infrastructure



Consensus

Versailles - 1919 : licensed under Creative Commons Attribution-Share Alike 2.0 Generic
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Validity

XHTML : This file is ineligible for copyright and therefore in the public domain because it consists entirely of information that is common property and contains no original authorship
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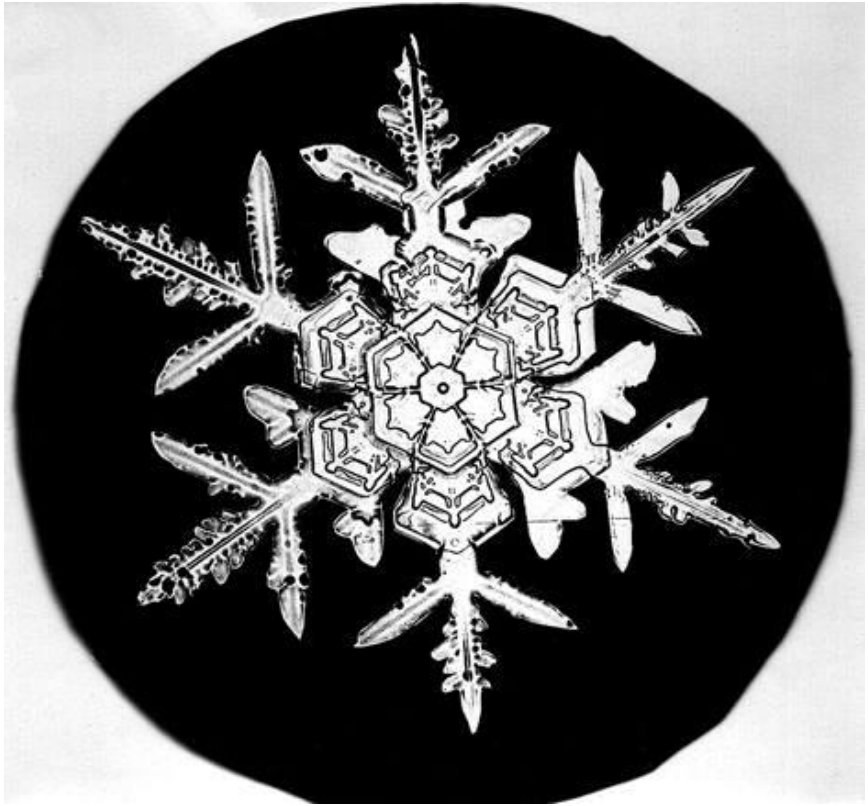
Uniqueness



Snowflake : licensed under Public Domain
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Immutability

Medusa Gorgon : licensed under the Creative Commons Attribution-Share Alike 2.0 Generic
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Authentication

“I know that what I see is what you see…"

- Consensus
- Validity
- Uniqueness
- Immutability
- Authentication

… the “blockchain menu”

Architectural Considerations for Smart Contract Templates

Nick Palmer

Investment Bank Lead Architect, Barclays

Architectural Considerations for Smart Contract Templates

Nick Palmer – Investment Bank Lead Architect

BARCLAYS

Presentation at R3 Smart Contract Template Summit
New York and London

29 June 2016

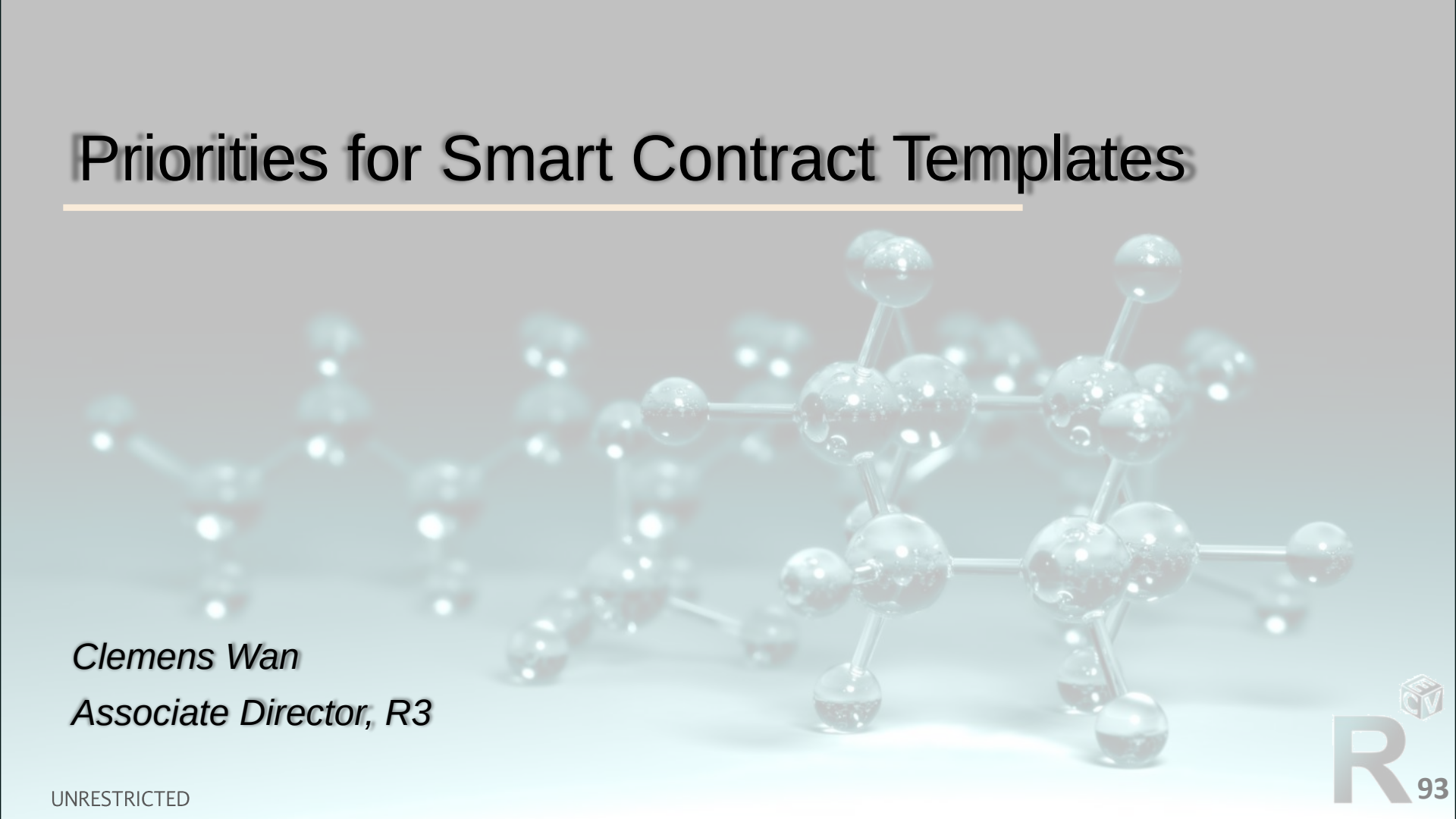
Let's consider…

- **Creation of approved templates**
  - multiple standards bodies producing templates?
  - accommodation of local templates?
  - single, compatible or distinct workflows?
  - easily extensible to a resource-based paradigm?
  - updatable, versioned, audited, signed?
  - scale of data challenge based on minimal write, extensive read?
  - one or more repositories?
  - centralised or distributed?
  - strategies for unique identification?
  - data privacy/visibility, jurisdiction, location?

Let's consider…

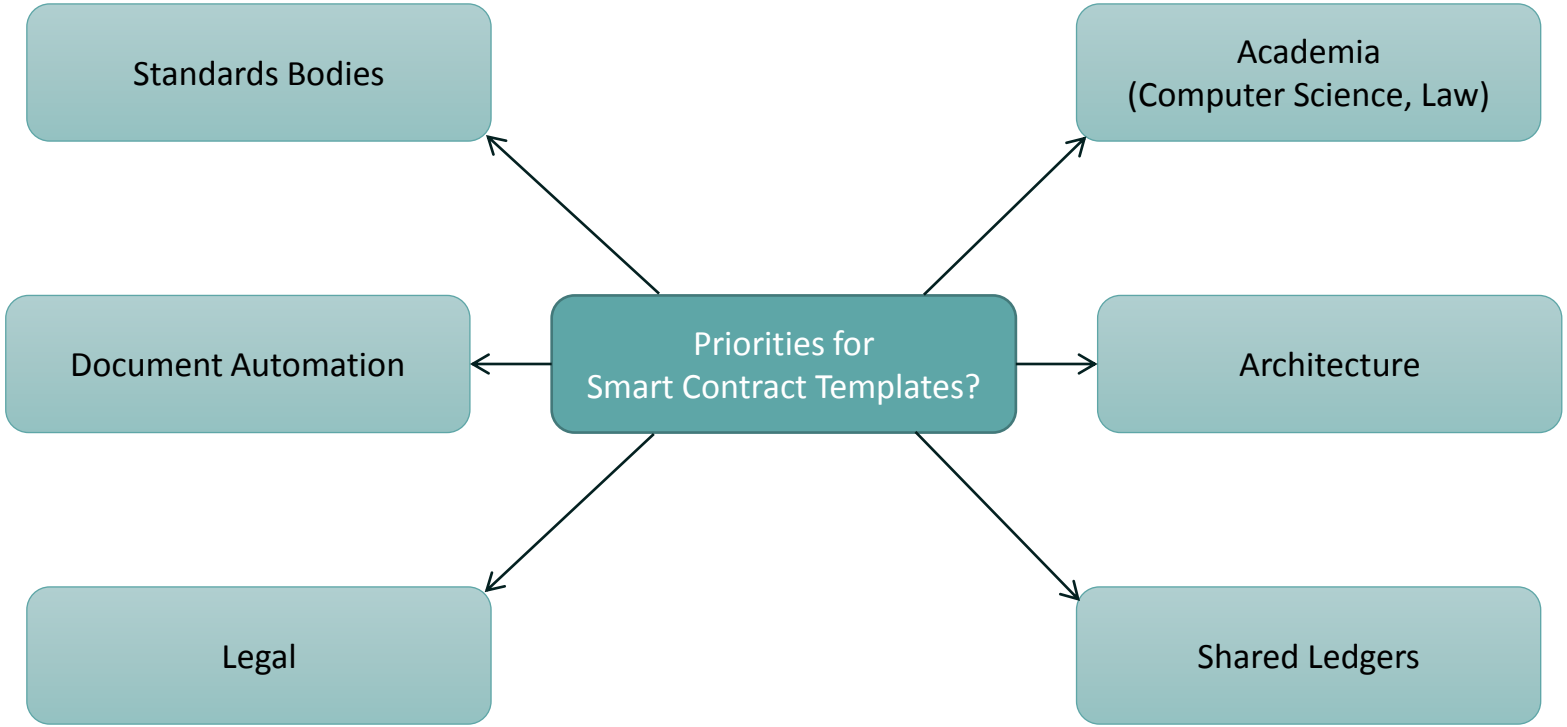
- **Assembly of approved agreements**
  - multipart with each component individually managed?
  - instances of parameterised:
    - standard templates
    - local (non-standard) templates
    - non-template documents
  - who are the permissible actors? market participants? clients? regulators?
  - shared or consistent workflows? subset of consistent states? coordinated protocol?
  - updatable, versioned, audited, signed – at what level?
  - locally stored or shared, partitioned? shareable with other parties? immutable?
  - centralised or distributed?
  - data privacy/visibility, jurisdiction, location?

Priorities for Smart Contract Templates

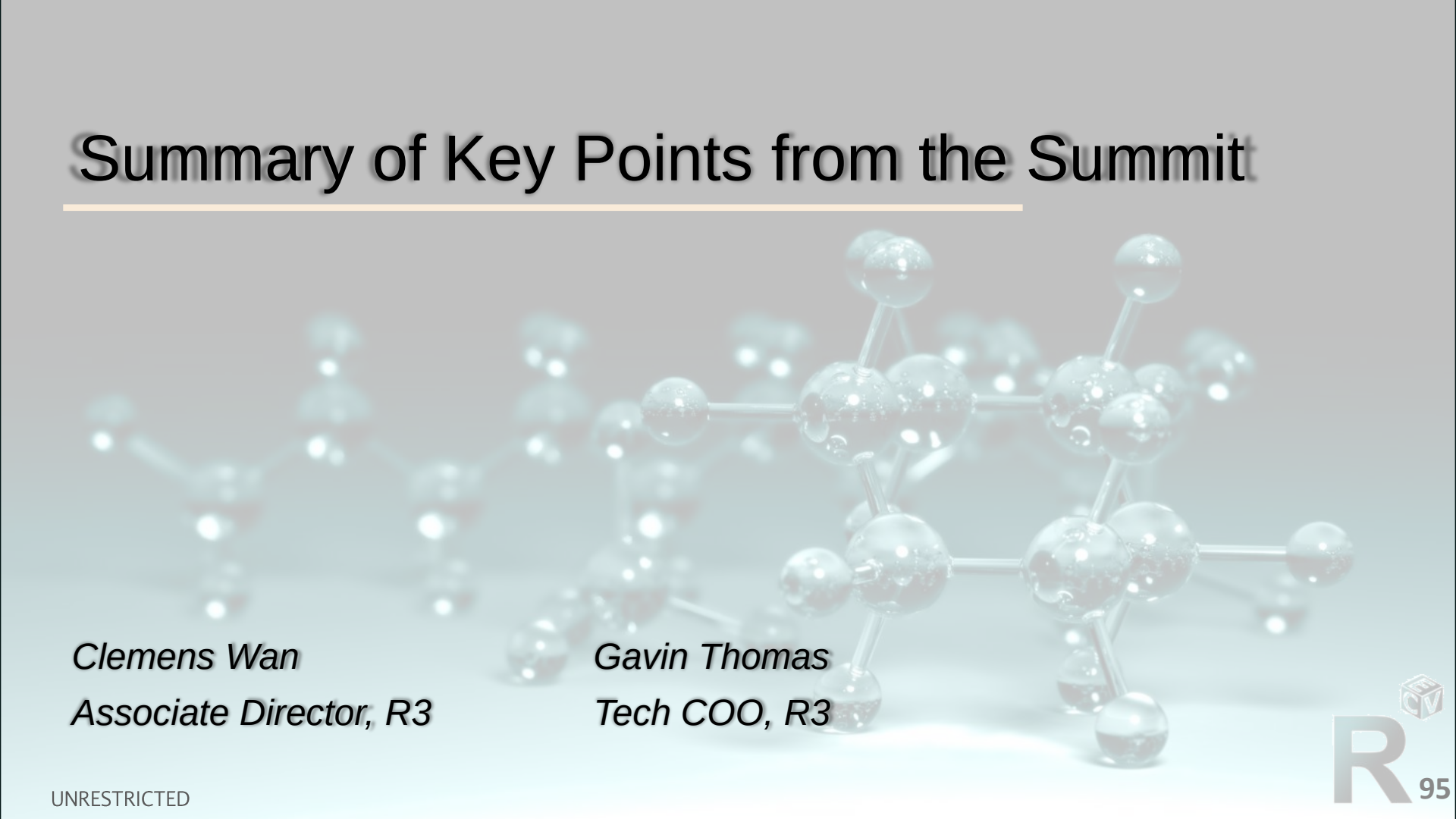


Clemens Wan

Associate Director, R3



Summary of Key Points from the Summit



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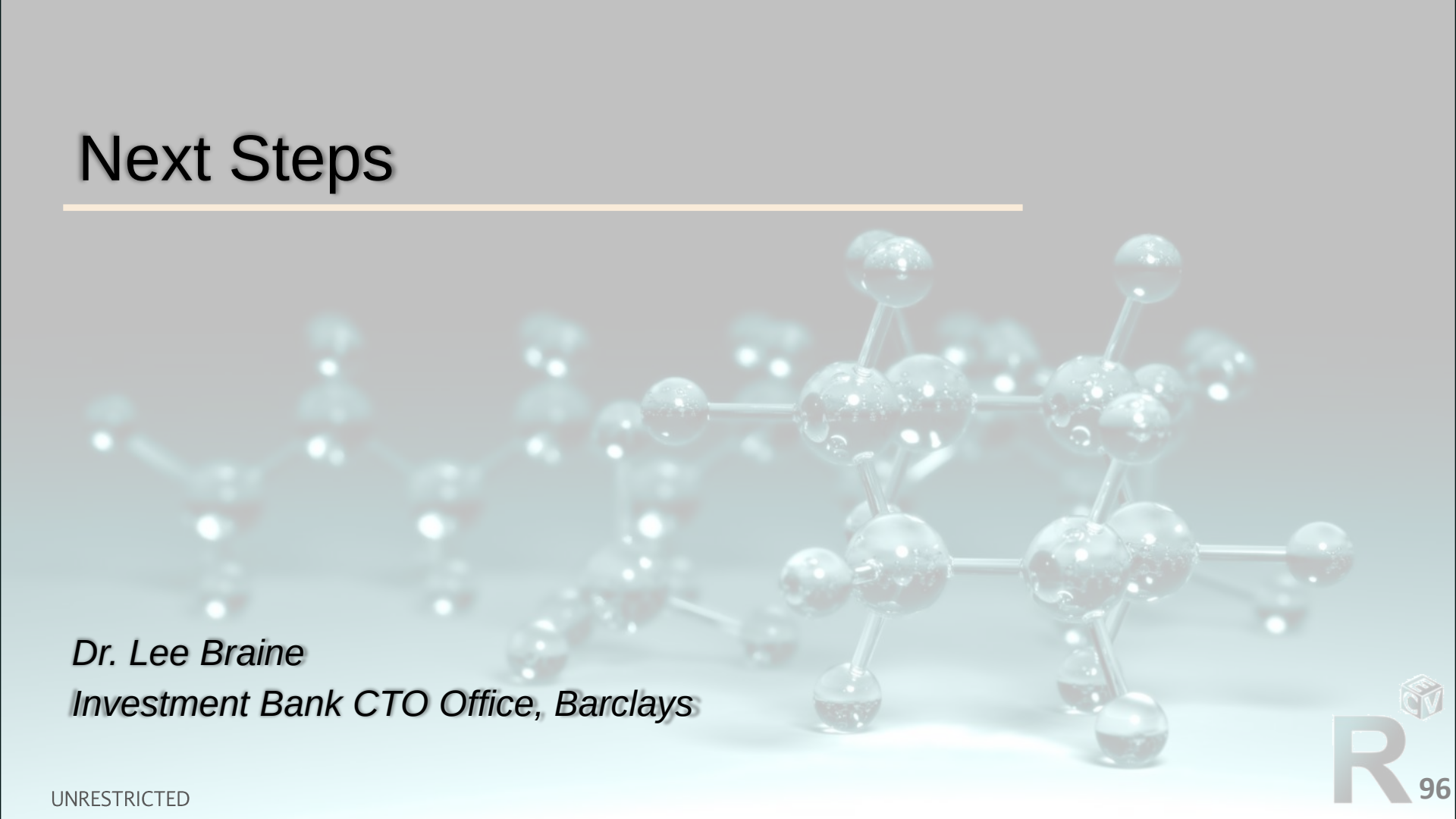
Gavin Thomas
Tech COO, R3

Next Steps



Dr. Lee Braine
Investment Bank CTO Office, Barclays

Networking and drinks (London only)