Software & Standards
for Smart Networks & Services

Architecting Digital Sovereignty: Open Internet Stack for European 6G

Presented by: *Giovanni Rimassa – Martel Innovate*

04/02/2026

TALK OUTLINE

- The Computing Continuum Convergence
  - Cloud, Edge, IoT, HPC, AI, 5G/6G: focus on Telco Cloud
- Open Source, Standards, and Sovereignty
- The Open Internet Stack
- Final Takeaways
  - From cathedrals and bazaars to sublation and paradoxical emergence

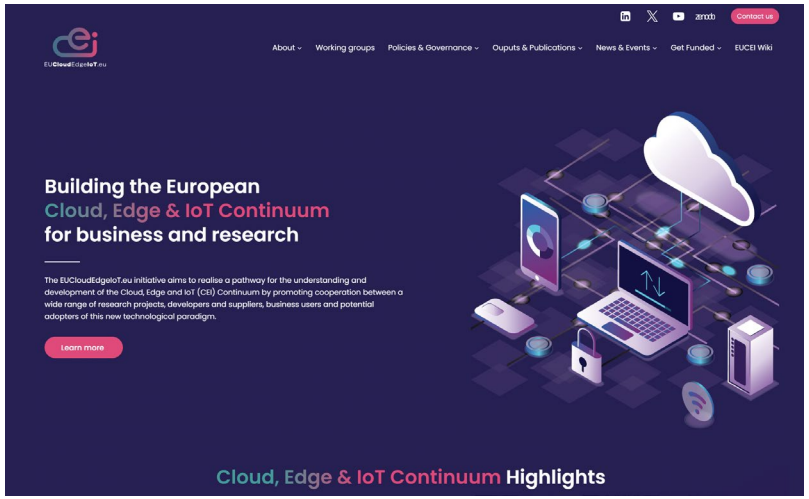
This symbol means a quick run-through →

THE COMPUTING CONTINUUM CONVERGENCE

IT ALL STARTED WITH CLOUD AND IOT…

A decade of Cloud Computing and Internet of Things convergence

- Edge Computing from battle ground to middle ground
- Artificial Intelligence as a cross-cutting concern
- The **EUCloudEdgeIoT** initiative: eucloudedgeiot.eu
  - Stream of CSA projects to guide and help the research effort
  - Currently active: *NexusForum.EU* and *CEI-Sphere*
- Towards the *Computing Continuum*: HPC, 5G/6G, …



NEXUSFORUM.EU RESEARCH AND INNOVATION ROADMAP

Interactive and Downloadable Versions

- Four main topic areas in the roadmap
  - **AI for Cloud-Edge**: Orchestration and Managing a Multi-Provider Continuum
  - **Cloud-Edge for AI**: Enabling and Facilitating AI Applications Across the Continuum
  - **Telco Cloud-Edge**: Telco as One of the Main Tenants and Infrastructure Providers
  - **Cloud-Edge Use Cases**: Requirements from Next-Gen Use Cases and Applications
- Further **disruptive impact initiatives**
  - Neuromorphic Systems
  - Space Edge (Satellites)
  - Quantum Computing / Quantum and Classical Computing Fusion
- Digital Sovereignty, Open Source, Sustainability, …

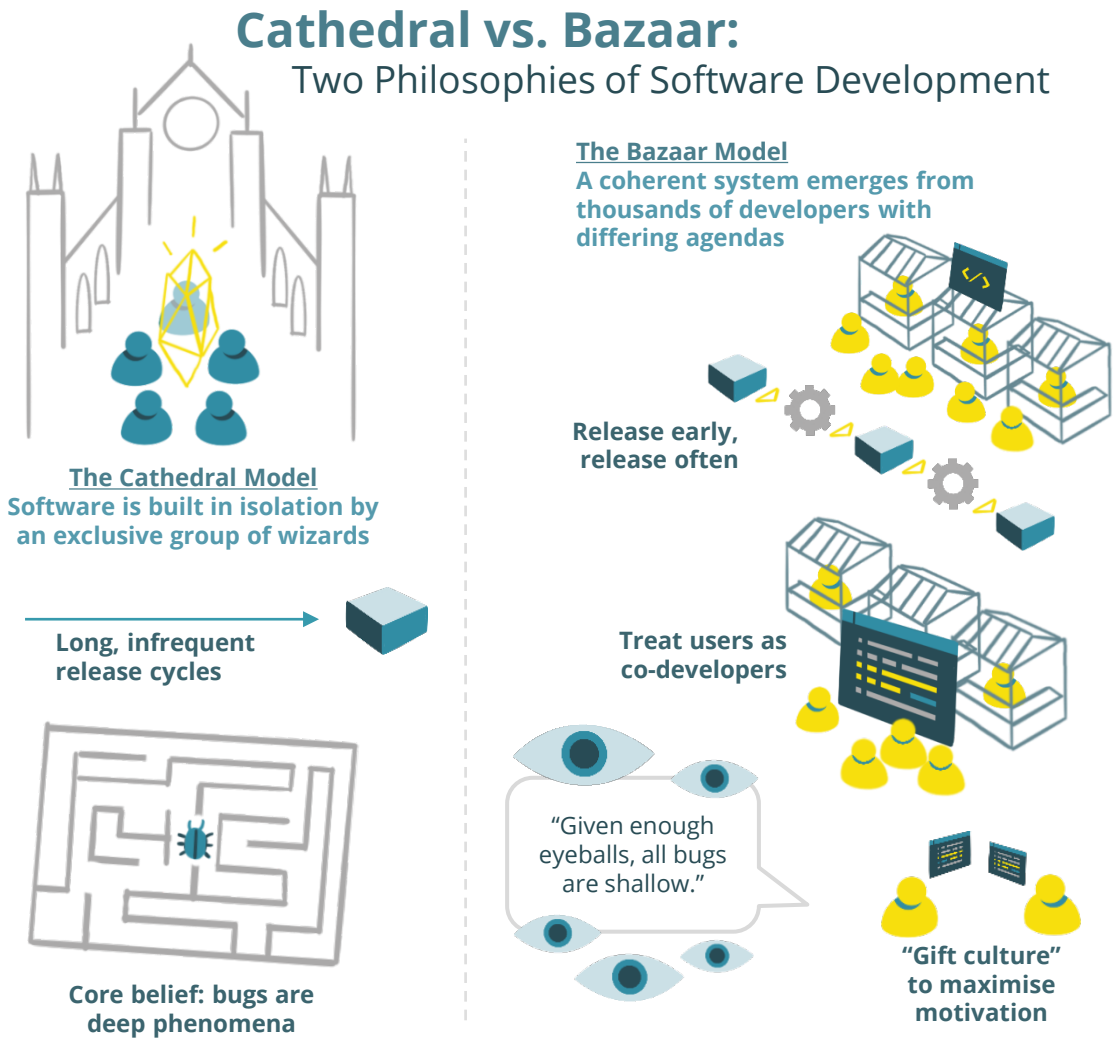
OPEN SOURCE, STANDARDS, SOVEREIGNTY

LOOKING BACK TO LAST YEAR'S CONVERSATION

- Open Source and Standards: ***Key Topic***
  - AI-generated "slide" from *SNS4SNS 2025* presentations of the first two sessions
  - Crude as it is, it reminds me of an old tale: *The Cathedral and the Bazaar* (`esr`)
- In the 1990s, Eric S. Raymond set the standard frame for the Open Source transformation occurring at the time
  - From "*Highly educated programmers on very expensive hardware*" (1980s)
  - To "*Anyone with a PC and a modem*" (1990s)

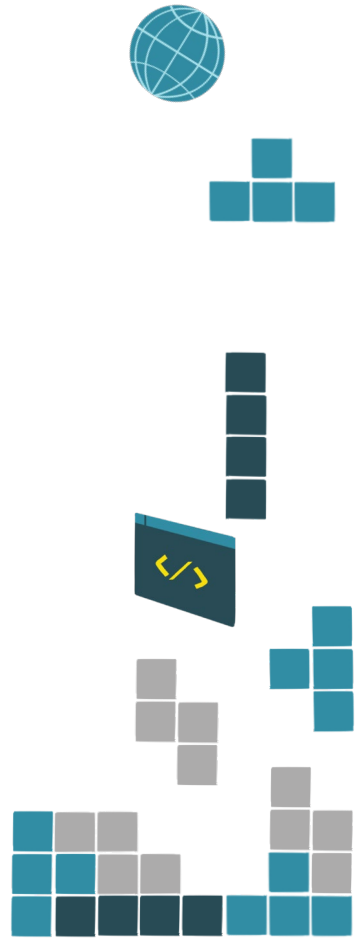
WHEN OPEN SOURCE WAS YOUNG, AND BUGS WERE SHALLOW

- The original essay had **Emacs** (of RMS fame) as cathedral and **Linux** as bazaar
- ESR praised some revolutionary traits of bazaar-style development
  - *"Release early, release often"*
  - *"Listen to your customers"*
  - *"Given enough eyeballs, all bugs are shallow"*
- Before agile dev and testing automation…
- Having Linux kernel development as champion of anarchy is funny today
  - It wasn't running the world like now
  - But it had serious shepherds, e.g. in 1997



IT'S NOT THE 90S ANYMORE: NOW *FRIENDS* IS PROBLEMATIC!

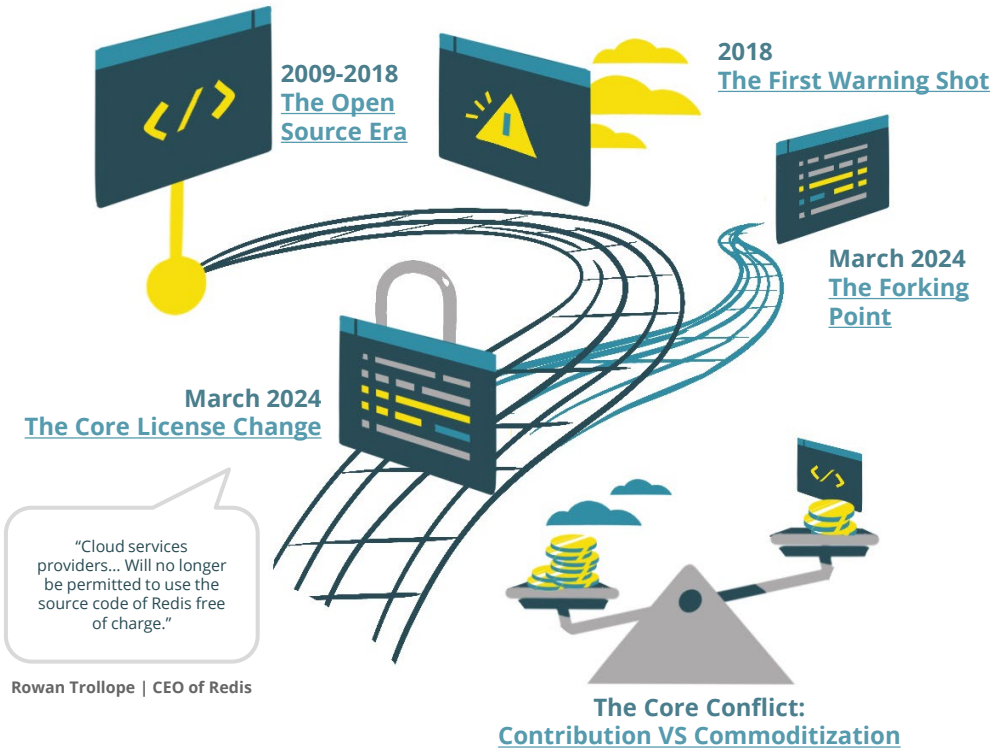
- Other things from the 90s might require some tweaks
  - Object-oriented programming does not fit distributed systems
  - Globalisation and "the end of history" didn't really happen
  - The Internet as a grassroot force for good was revealed as a pipe dream
  - Both cathedrals and bazaars risk becoming *walled gardens*
- Open-source software faces two radical threats
  - ***Cloud-native*** software engineering, practice, and business models
  - Systems/solutions based on ***Artificial Intelligence and Machine Learning***



DARK CLOUDS: THE REDIS CONTROVERSY

- Cloud-native software architectures
  - Isolated components (Microservices/FaaS)
  - No OOP: code and data are separated
- Open Source *relies on copyright law* (*1/2*)
  - It applies to the source code, **not** to the remote API endpoint. ***But reputation doesn't***!
  - Extensions without source code changes
- Look at what happened with Redis
  - Very popular in-memory key-value DB
  - Felt cannibalised by large cloud providers
  - Now it's not Open Source anymore, but Source Available (now dual-licensed again)!

From Open Source to Fork:
The Redis Licensing Saga

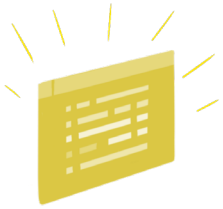


THE VON NEUMANN CURSE: YOUR CODE IS MY DATA

- *Shared program/data storage* is assumed
- Open source *relies on copyright law* (*2/2*)
  - Source code product of human ingenuity
  - Implementation quality is in the code
- Model-based AI/ML software systems
  - Implementation quality is in the data
  - Open weights? What about training sets?
  - This holds for DNNs but also for GOFAI
- With Large Language Models and vibe-coding, things will get much worse
  - Human write prompts, not source code

Open Source at a Crossroads:
Code vs. Data

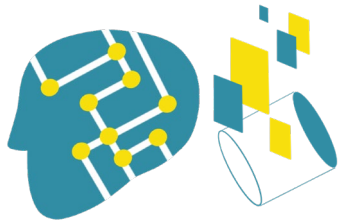
Traditional Software
(Code is King)



Value Resides in Code

Licensing is Code-Centric

AI/ML Systems
(Data is the New King)



Value Resides in Data

Traditional Licenses Break

The Way Forward
(An Unsettled Debate)

Path 1 | Adapt the Licenses

Path 2
Defend the Original Definition

Path 3
Invent New Models

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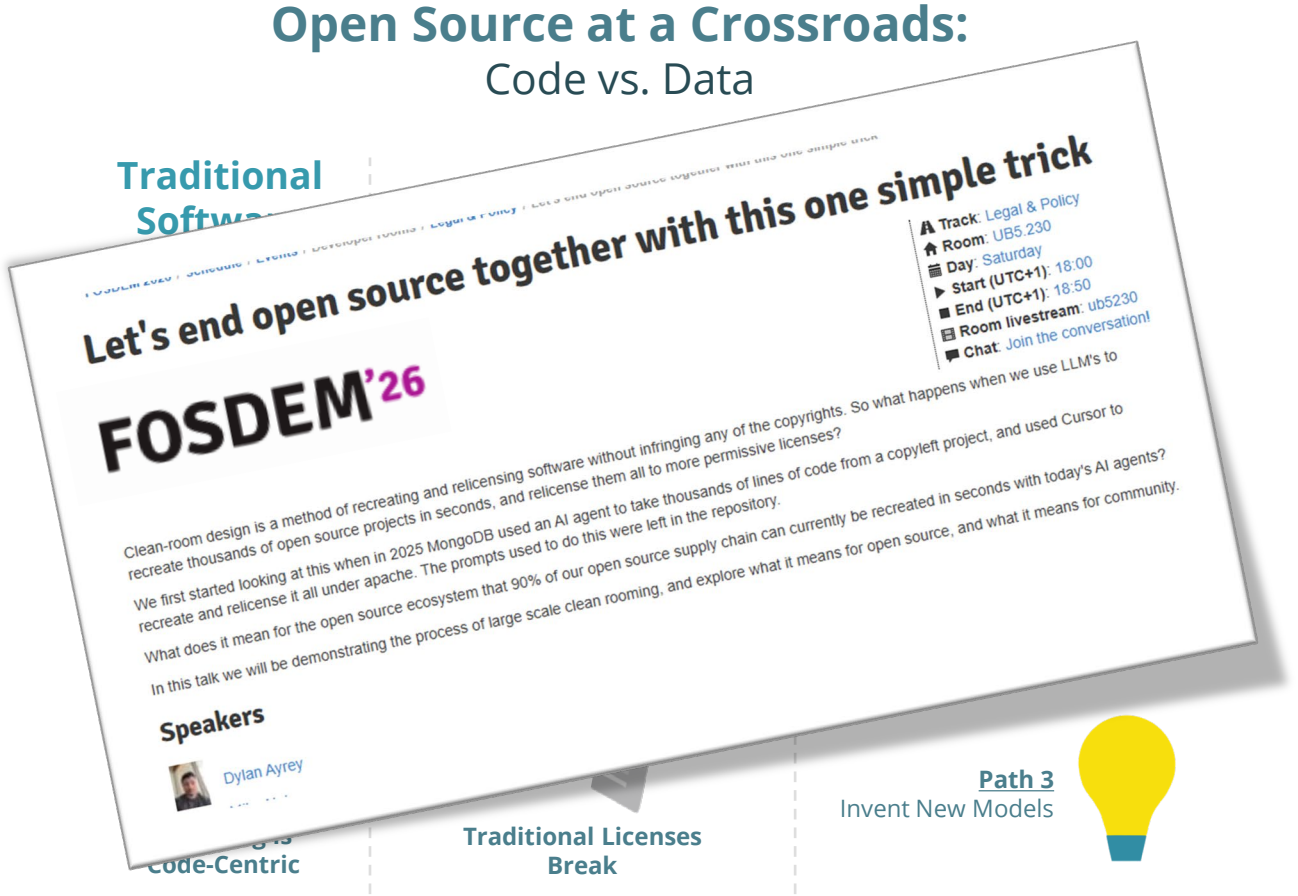
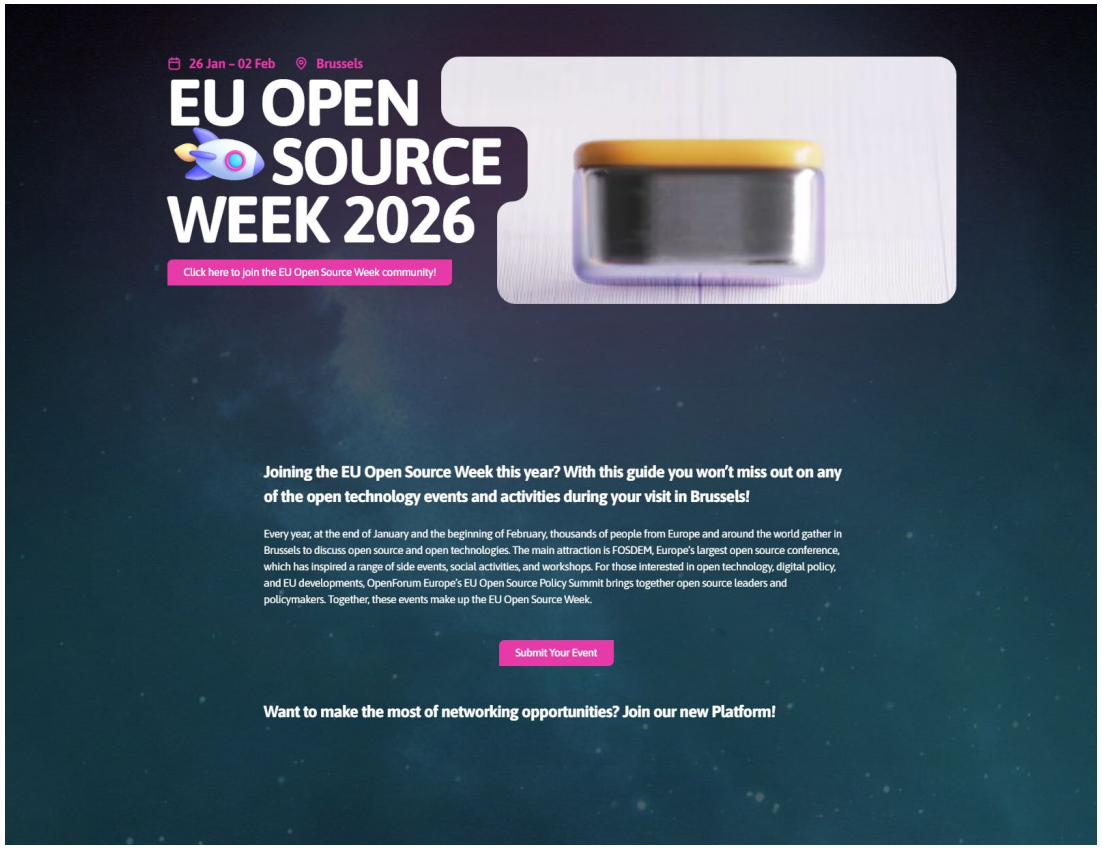


OPEN SOURCE GAINS EVER-INCREASING IMPORTANCE



- From spontaneous bazaar to critical infrastructure: XKCD provided irony
- Identified as a public good and a key enabler of industrial competitiveness and growth for Europe: Study in 2021
- Several strategic steps, increasingly connected to European ***digital sovereignty*** and ***competitiveness***
  - Open Source Strategy 2020-2023
  - Call for Evidence on *European Open-source Digital Ecosystems*
  - Policy and normative acts (CRA, but also others like Data Act, DNA, …)

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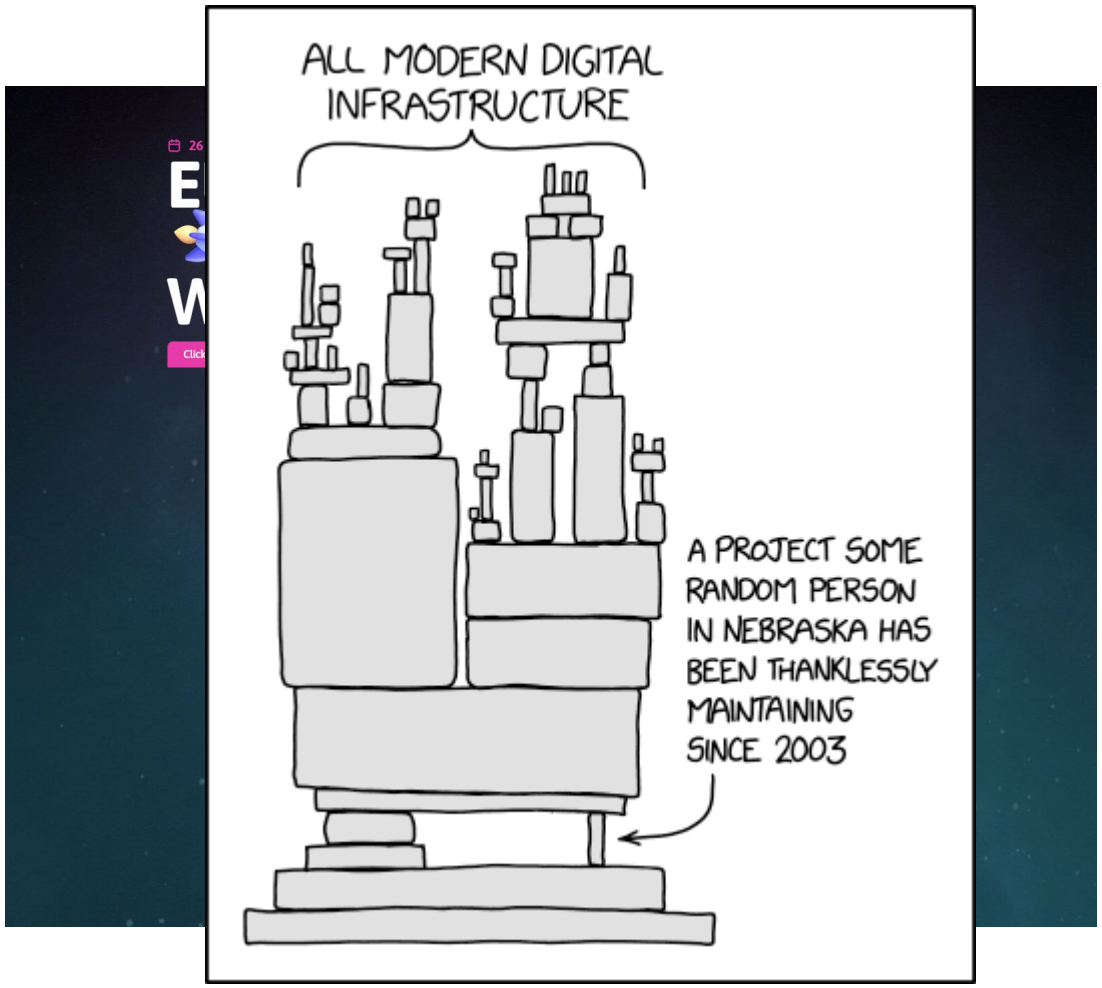

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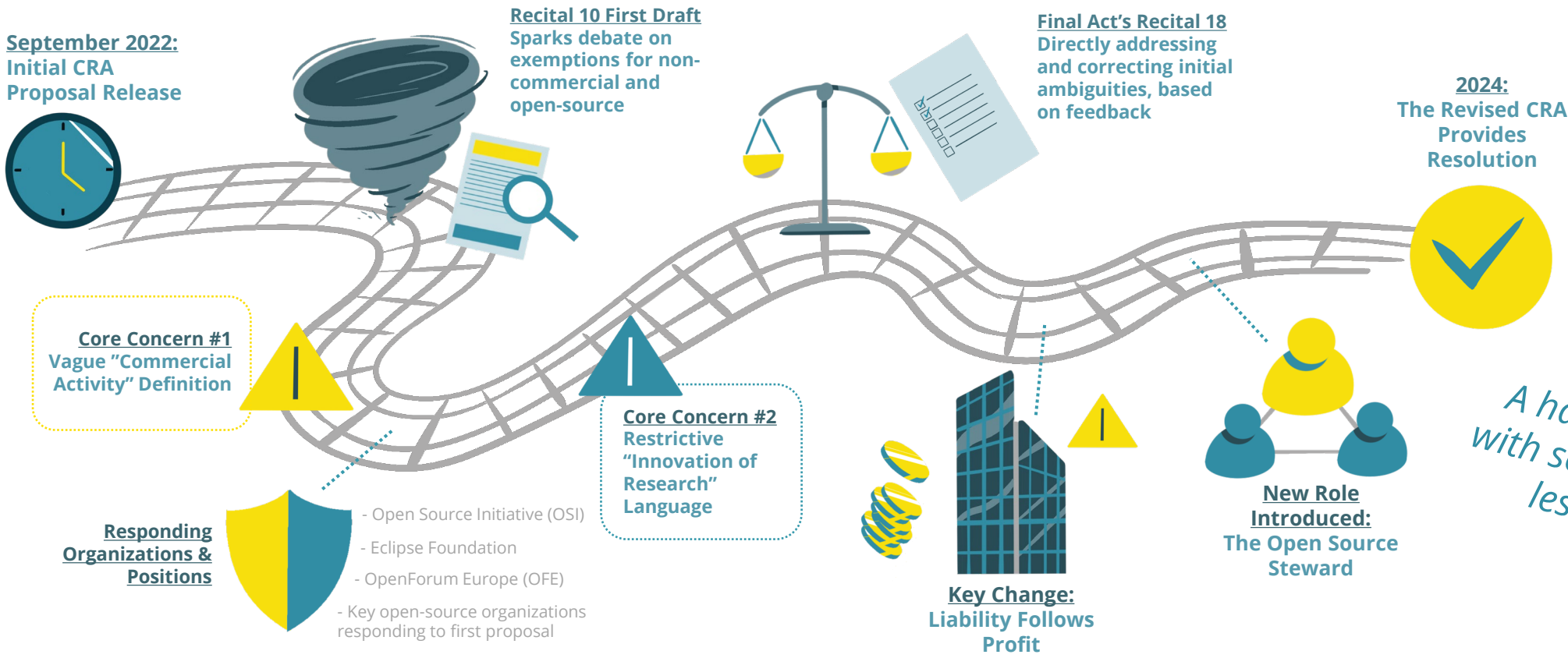
CRA AND OPEN SOURCE - A RESILIENT JOURNEY

The Cyber Resilience Act and Open Source:
A Timeline of Debate and Resolution



*A happy ending story with some **bazaar-style** lessons learned*

THE OPEN INTERNET STACK

HORIZON EUROPE CALLS AND VISION IN 2025/2026

2025 | Laying the Infrastructure

SNS-JU-2025-STREAM-C-01
6G R&D, Telco Cloud, Experimental Platforms

Leveraging and influencing Open Source projects

CL4-2023-03-DATA-08
3C Network, Supply-Side Pilot, AI Orchestration

Mandating cooperation with and integration of the Open Internet Stack

CL4-2025-03-DATA-09
Stakeholder Coordination, Roadmap Alignment, Governance

Managing the repository of Open Source building blocks for 3C pilot

CL4-2025-03-DATA-11
Open Source Framework, Common 3C Pilot Building Blocks

Open Internet Stack foundation is the core here, governed by contributing communities to supply the 3C pilot

2026 | Building the Open Source Ecosystem

CL4-2026-04-DATA-02
"Made in Europe" Open Source Solutions Development, Sovereign OS, Software Supply Chain

Directly populating the Open Internet Stack with new solutions

Open Internet Stack

CL4-2026-04-DATA-03
Cataloguing, Branding, Training, Support, Policy

Providing scaling, marketing and sustainability models for the Open Internet Stack Ecosystem

3C Network

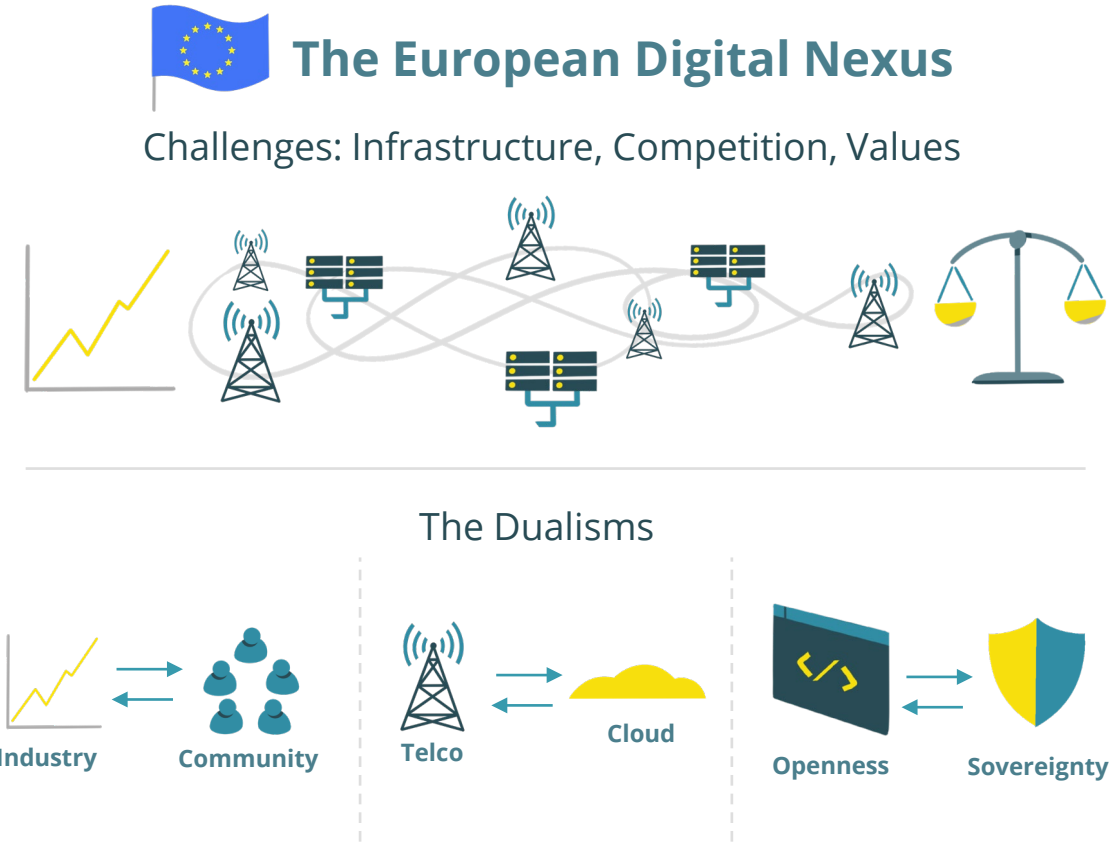
From Pilots to Ecosystem

The Open Internet Stack is one of the key ingredients

The Goal: A Converged 3C Network

FINAL TAKEAWAYS

LOOK UP, WHAT DO YOU SEE?



- Multi-faceted challenges/opportunities
  - Infrastructure evolution, international cooperation, embracing openness, the competition in Cloud, Connectivity, and many industrial verticals. *And our values*
- There are many dualisms to face
  - Open Source: industrial engine or community wellspring?
  - Telco – Cloud power dynamics
  - Balance openness and democratisation with sovereignty, geopolitics, security
- How do we *solve* them?
  Or wait, is this ***solutionism***?

ABOVE AND BEYOND, OR RATHER HERE AND NOW?

- Hard to resist the dialectic temptation
  - Hegel wrote *Aufhebung*, I read *superamento*, and I was yesterday years old when I learned the English word *sublation*
  - Dialectic certainly is a valid frame
- We're also not in the 1790s, however
  - The issue is with overcoming/transcending dilemmas; no need for Technoromanticism
- Conflictual reductionism is to be avoided
- But we need to remain situated and in-flow
- A more modern and fit-for-purpose frame could be ***Complexity Science***

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THANK YOU
FOR YOUR ATTENTION

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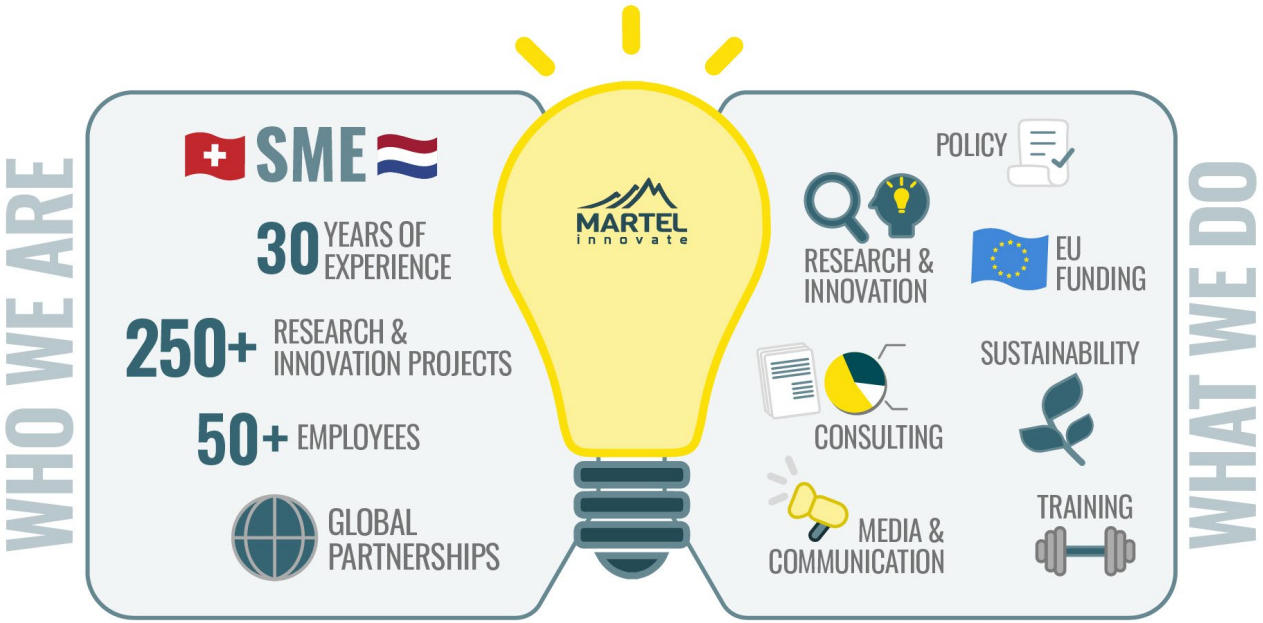
INNOVATION, WE MAKE IT HAPPEN

EXTRA CONTENT

ABOUT MARTEL

WE ARE A DYNAMIC DIGITAL INNOVATION AGENCY WITH 30 YEARS OF EXPERIENCE, EMPOWERING ORGANISATIONS ACROSS EUROPE AND BEYOND TO TRANSFORM NOVEL IDEAS INTO INNOVATIVE TECHNOLOGICAL SOLUTIONS, MEDIA STRATEGIES, AND MARKET SUCCESS

- **Specialised in EU funding**: we help identify calls, write successful bids and coordinate / manage projects – we are partners in many projects!
- **Dedicated Lab** for research, prototyping and technical validation – AI, Cloud, 5G/6G, NTN, etc.
- **Pioneers in Sovereign Digital Infrastructure and Open Source** – not only in projects (!)
- **Policy influence:** strategic policy monitoring for the EC and international bodies
- **Impact specialists** leading **high-profile communication and dissemination** strategies
- We have **global reach and partnerships** - Japan, South-Korea, India, Singapore, etc.



ABOUT ME

Giovanni Rimassa

Chief Innovation Officer – Martel
Vice President – Digital for Planet

- Typical blend of academia and industry
  - Research in multi-agent systems and middleware
  - Startup founder, then in SW dev, now in Consulting
  - SW Engineer, then Product Manager, now Executive
  - SME employers, corporate clients
- Long history with Open Source, distributed (intelligent) systems, and EC-funded projects
  - Subcontractor of Telecom Italia Lab in an FP4 project
  - Engaged in standards, open-source middleware, and FP5 projects on multi-agent systems
- Not strictly in Telecom, but converging with it

EUCLOUDEDGEIOT COMMUNITY – PROJECTS AND INITIATIVES

Cloud Computing

SERRANO
CHARITY
Cloud for Holography and Augmented Reality
PHYSICS
DataCloud
AI SPRINT

Next Generation IoT

IntellIoT
VEDLIoT
Very Efficient Deep Learning in IoT
TERMINET
in
enious
IoT-NGIN
assist-iot

META-Operating Systems

aerOS
EUROPEAN IOT-EDGE-CLOUD
FLUIDOS
ICOS
nebulous
NEMO
nephele

Cognitive Cloud

AC3
Sovereign EDGE.EU
DECICE
COGNIFOG
CLOUDSKIN
ML SysOps
ACES
EDGELESS
CODECO

Swarm Intelligence

INCODE
SMARTEDGE
OASEES
ToRDIS
OpenSwarm

Open Source for Cloud Services

Riser
VITAMIN-V
OpenCUBE
AERO

Software Technologies

XANDAR
PIACERE
VeriDevOps
FOCETA
ELEGANT
COSMOS
DevOps for Complex Cyber-physical Systems

& More

TEADAL
TRUSTEE
Spade
physical-cyber drones ecosystem
agriculture • forestry • environment
TRANSACT
CROSSCON

Initiatives

Nexus FORUM.EU
EUROPEAN ALLIANCE FOR INDUSTRIAL DATA, EDGE AND CLOUD
gaia-x
Alliance for IoT and Edge Computing Innovation
HiPEAC
ECCO
European Cybersecurity COmmunity
NESSI

ADDRESSING EUROPE NEEDS FOR DIGITAL INFRASTRUCTURE

- EC White Paper from February 2024:
  "*How to master Europe's digital infrastructure needs*"
  - Assesses the European situation and recognises (almost) exactly the ongoing convergence between Cloud, Edge, IoT, and 5G/6G connectivity
  - Proposes a way forward based on three pillars

- **Pillar I**: *Creating the "3C Network" - "Connected Collaborative Computing"*
- **Pillar II**: *Completing the Digital Single Market*
- **Pillar III**: *Secure and resilient digital infrastructures for Europe*

MULTI-DIMENSIONAL, SOVEREIGN CATHEDRAL/BAZAAR COMBO?

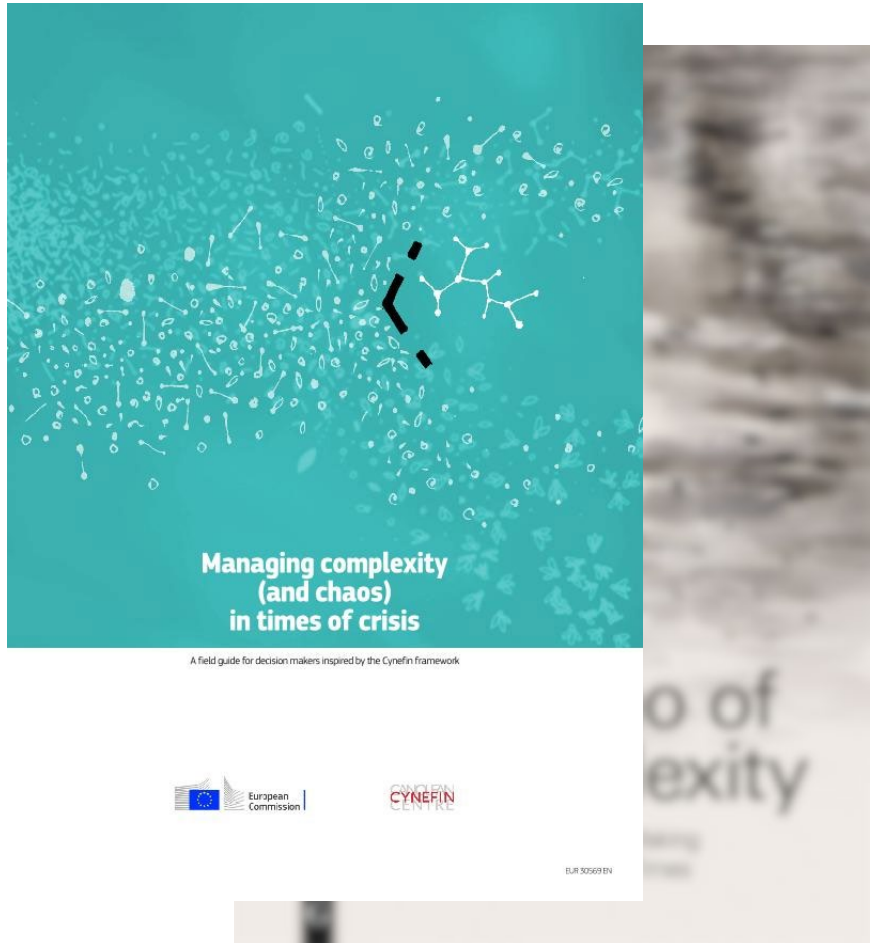
- All 2025 calls had sovereignty constraints (e.g., OCD needed)
- Two large calls, high funding and heavy-duty deployment
  - *SNS-JU-2025-STREAM-C-01: 6G Telco Cloud and Service Provision Enablers*
  - *CL4-2025-03-DATA-08: Large-scale pilots for supply end-to-end infrastructures …*
- One call with good funding, FSTP-enabled
  - *CL4-2025-03-DATA-11: Open Internet Stack: development of technological commons/open-source 3C building blocks*
- A CSA to keep them in harmony
  - *CL4-2025-03-DATA-09: Alignment of stakeholders towards the supply-side large-scale pilot of end-to-end infrastructures …*

SOME CONTEXTUAL COMMENTS

- Cooperation mandated in DATA-08, DATA-09, and DATA-11
  - DATA-08 and STREAM-C-01 have 45 MEUR + 15 MEUR
- Amount of FSTP in DATA-11: “up to 70%” (out of 10 MEUR)
  - The call suggests 9-12 months and 50-150 kEUR per recipient
- DATA-09 connects the supply LSP to OIS, but also to demand
  - It “*should be prepared, managed and coordinated by key stakeholders in the field, while it would be important that the coordinator adopts a neutral position.*”
- The industry-community dynamics is set, and will grow in 2026

COMPLEXITY

- Complex Adaptive Systems are part of the Computing Continuum landscape: see, e.g., HiPEAC Vision on (CPS)^2 and 3CN vision as well
  - Complexity for management and social science
  - *Managing complexity (and chaos) in times of crisis* (Field Guide by The Cynefin Co and JRC)
  - *The dao of Complexity* by Jean Boulton
- Here are some general elements
  - Modify the context *here* rather than set goals *there*
  - Continuously verify and update plans
  - Run many “safe-to-fail” parallel trials
  - Embrace the paradoxical nature of reality
  - Diversity and openness are essential traits



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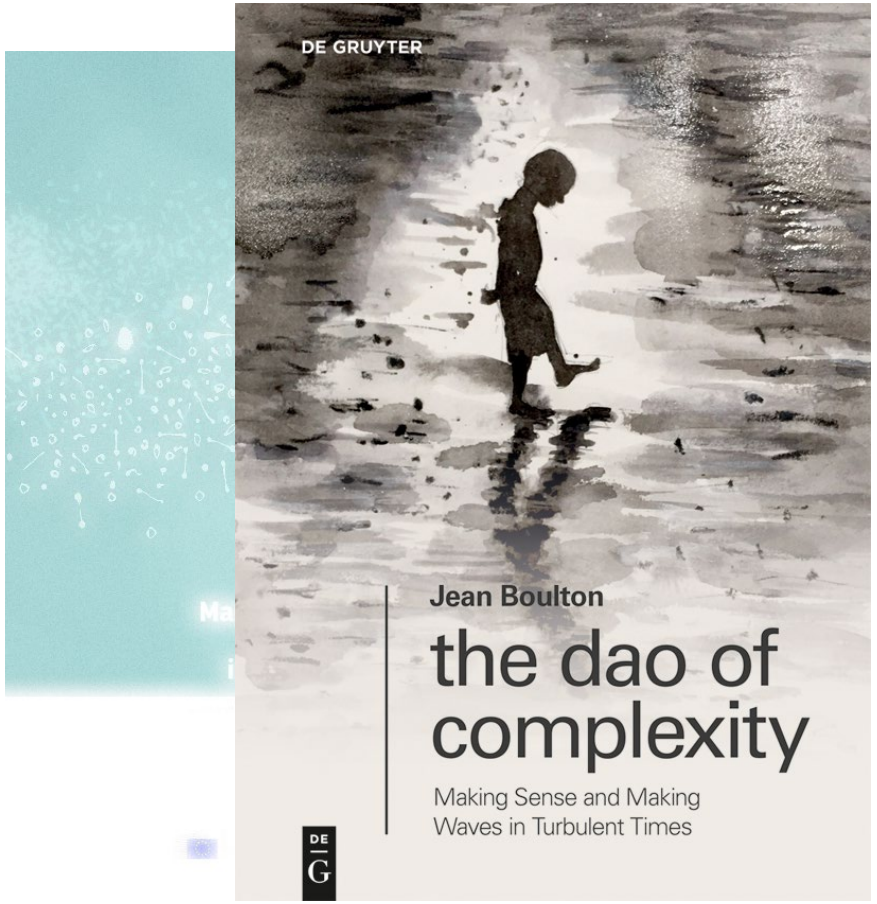

“For socio-economic, and ultimately even geopolitical impact, the Open Internet Stack needs emergent combinations of industry and community outcomes, to be multi-party managed by embracing complexity”