

Cyberphysical Intelligence as AI-Driven CRIS Infrastructure

Adaptive Metadata Generation
and Governed Interoperability in
Forensic Psychiatry

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Overview

1. Clinical context
2. CPS
3. CRIS gap
4. CPS-I
5. CRIS integration
6. Interoperability
7. Governance
8. Outcomes

Institut National de Psychiatrie Légale Philippe-Pinel

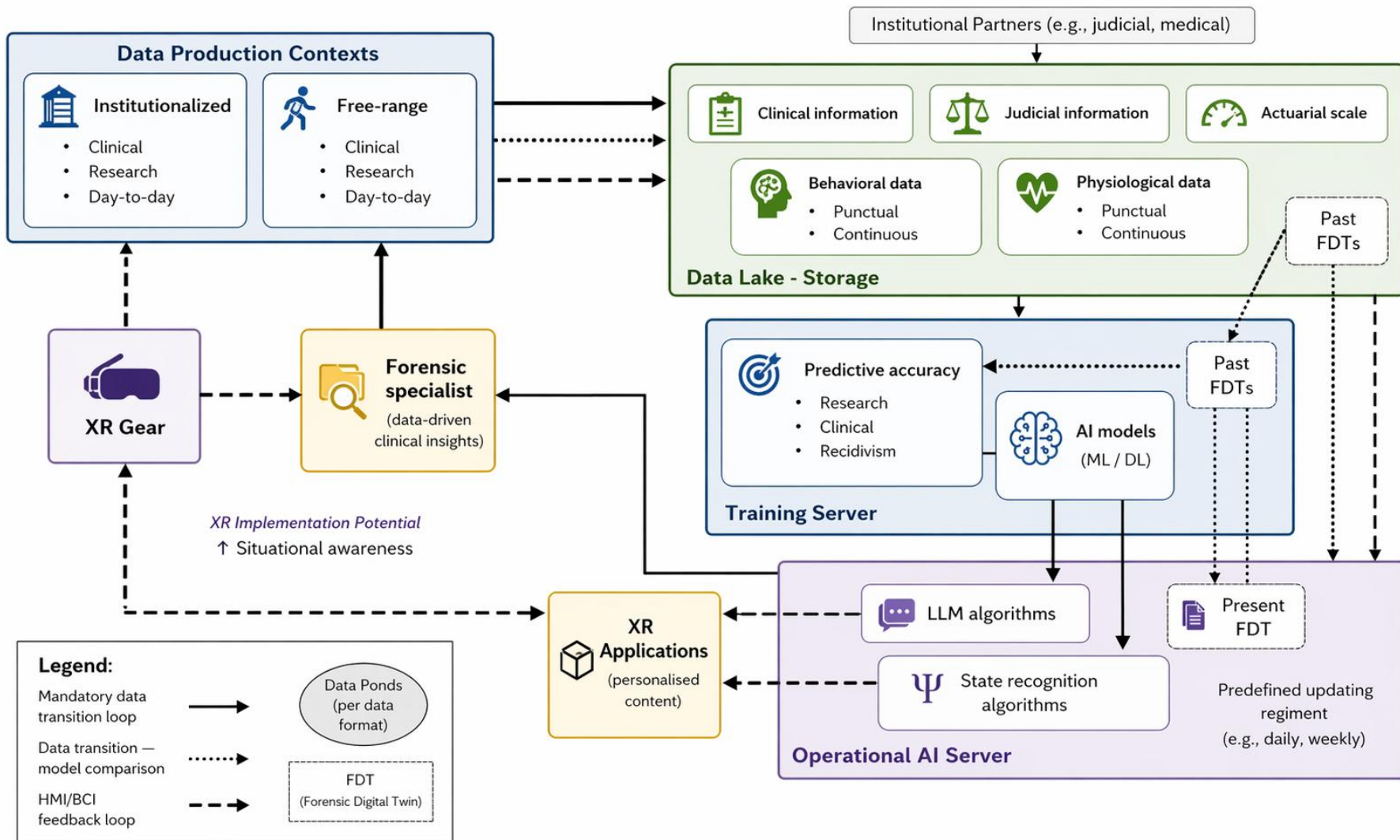
- Maximum security
- 270-bed forensic hospital
- XR infrastructure
- Data lake
- CPS development



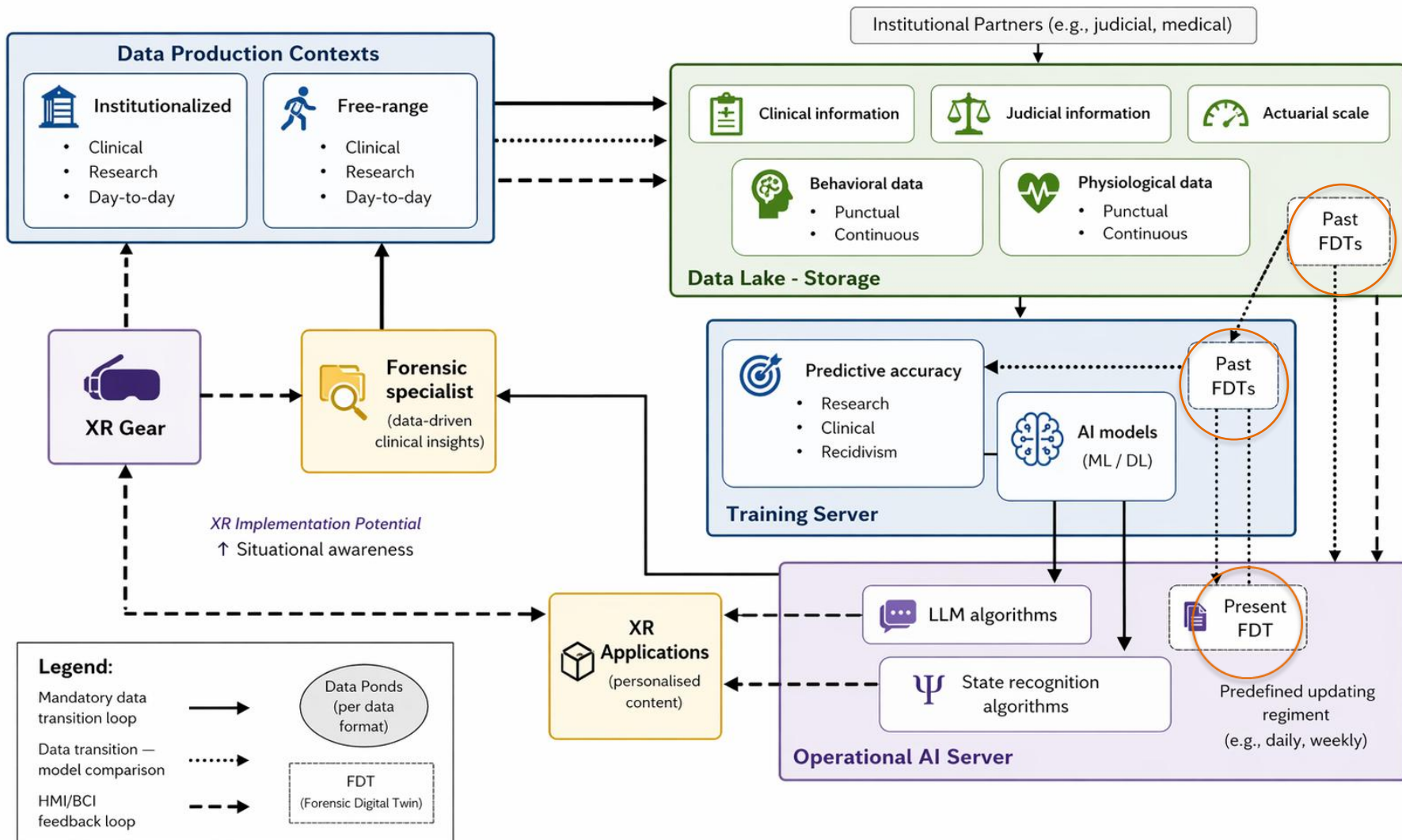
CIINeF: A CPS in Forensic Psychiatry

- CIINeF: *Centre d'Immersion et d'Intégration Numérique Forensique* (Centre for Forensic Immersion and Digital Integration)
- Multimodal sensing
- XR environments
- Real-time feedback
- Adaptive clinical intervention

CIINeF Dataflow



CIINeF Dataflow



Forensic Digital Twin

The background of the slide features a large, light blue, stylized fingerprint in the center. Surrounding the fingerprint is a circular network diagram composed of four nodes (small circles) connected by curved lines, forming a square-like shape with rounded corners.

- Dynamic model
- Continuous updates
- Behavioral trajectories
- Prediction & intervention

Self-Regulation

A faint, light blue background graphic featuring a stylized human brain. Overlaid on the brain is a network of thin, curved lines connecting several circular nodes, resembling a neural or cognitive network diagram.

- Emotion/behavior regulation
- Impulsivity context
- Multimodal measurement
- Adaptive feedback

Situation Awareness

A light blue background graphic featuring a stylized human brain. Overlaid on the brain is a network of white lines and circles, resembling a neural network or a data flow diagram. The lines connect various points, some of which are represented by small circles, creating a complex web-like structure.

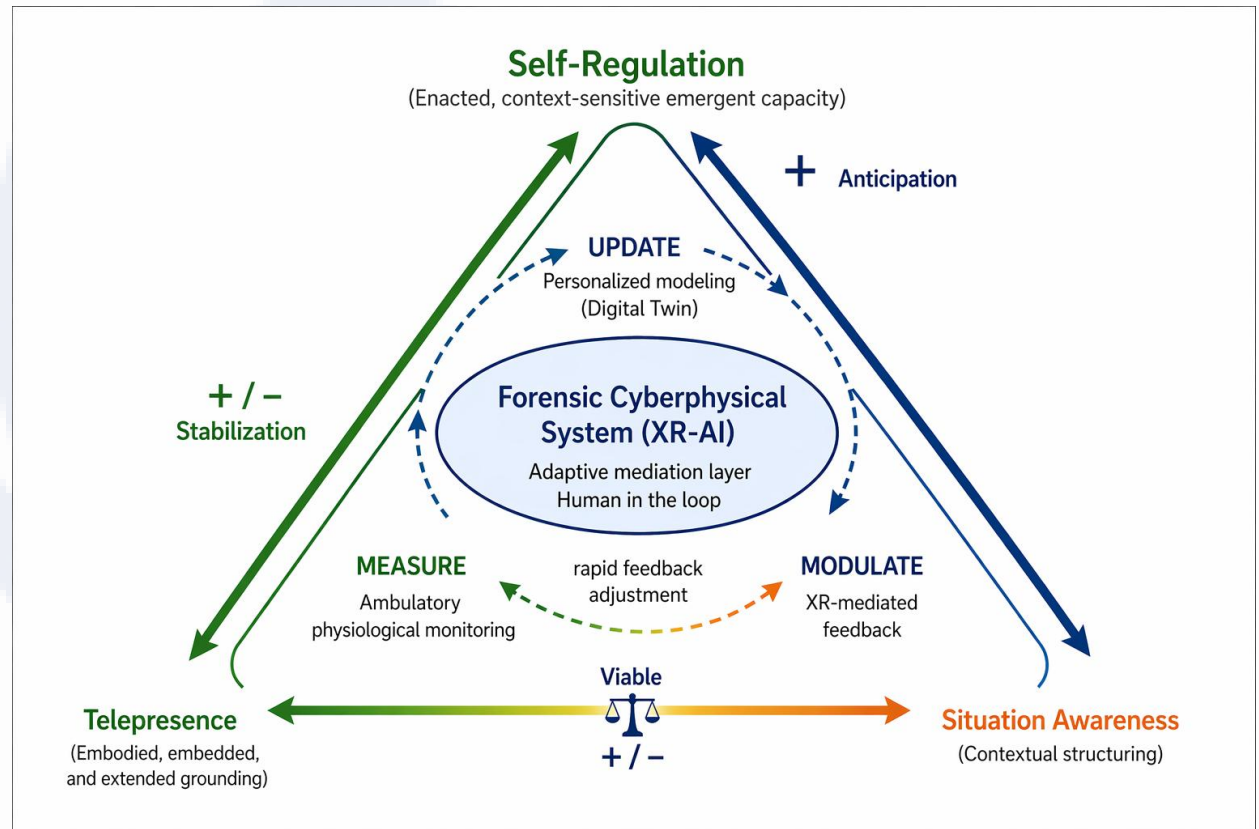
- Perception
- Comprehension
- Projection
- XR-supported

Presence

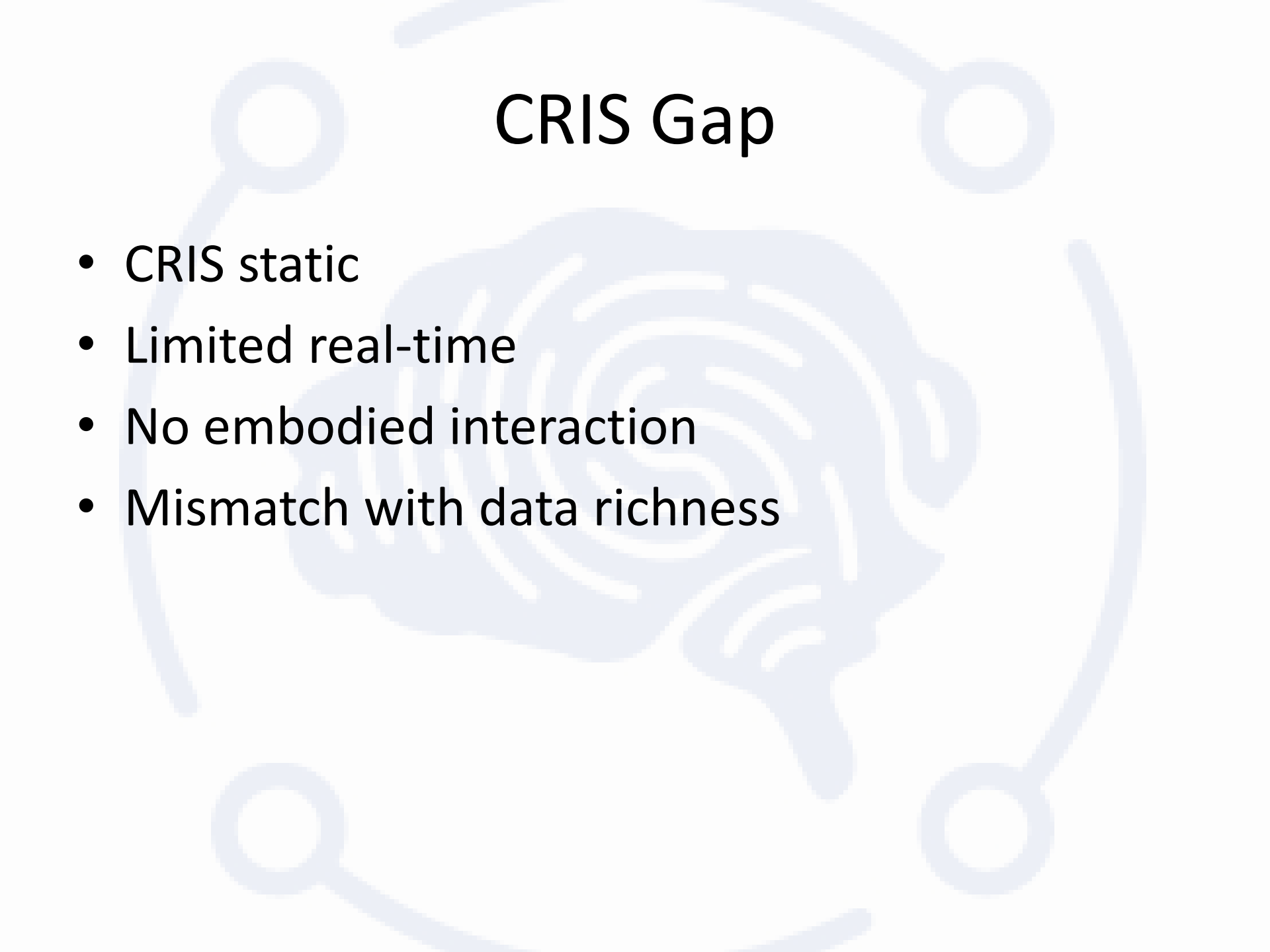
- Sense of being there in the world, real or simulated
- Embodied engagement
- Measured via gaze, posture, physiology from mobile measurement devices

Integrative Framework

- Presence
- Situation awareness
- Self-regulation
- Dynamic CPS coupling

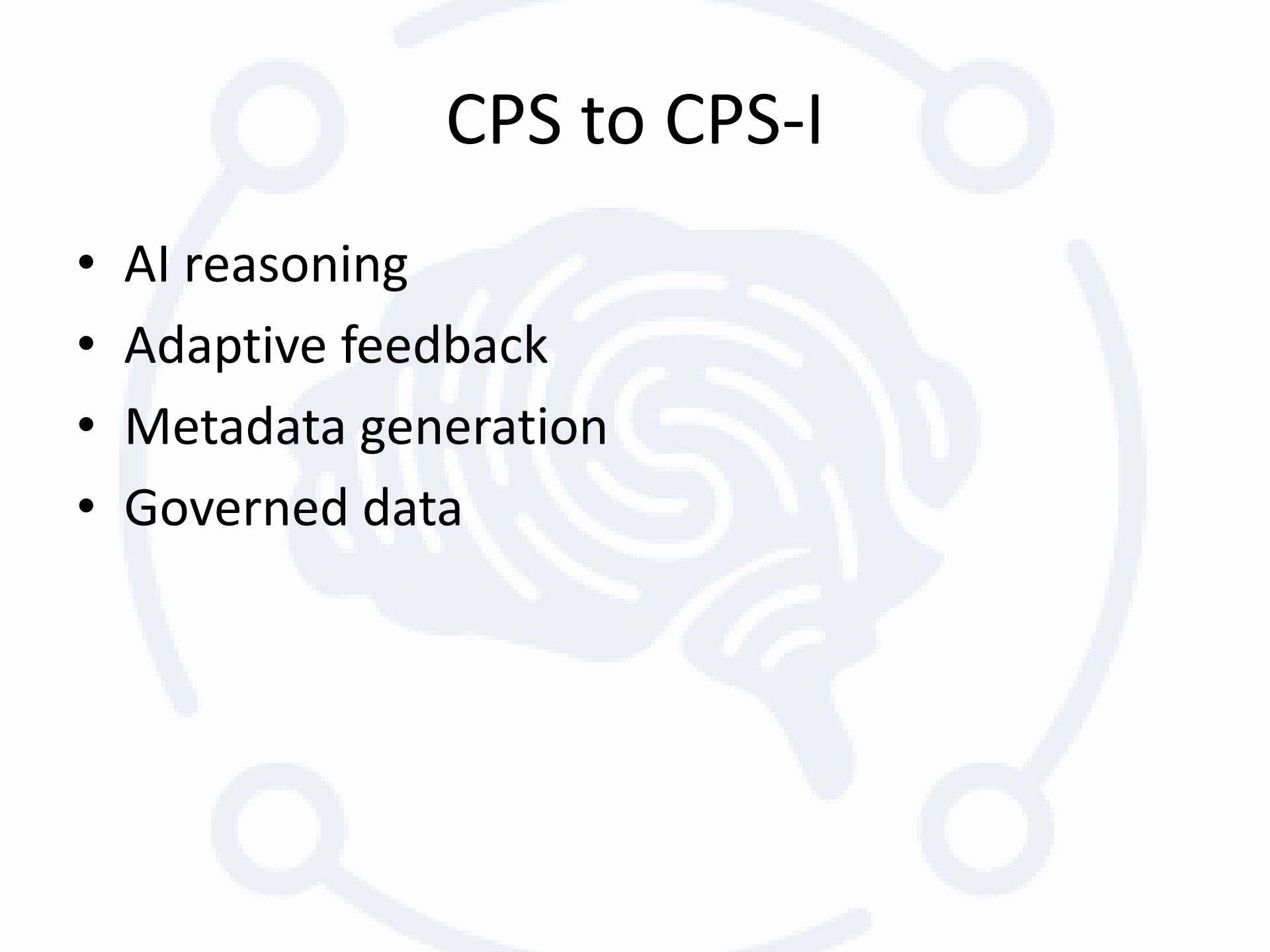


CRIS Gap



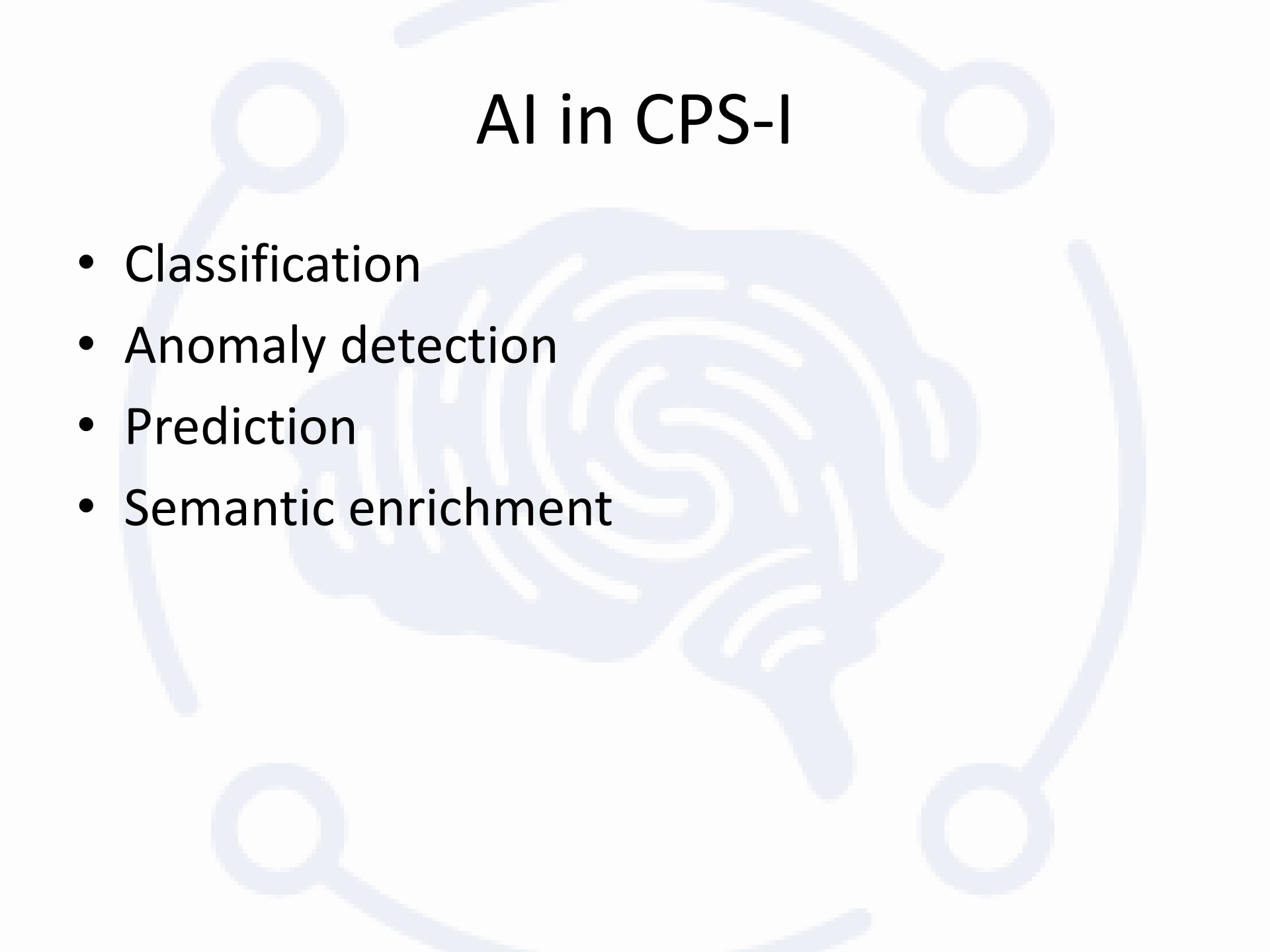
- CRIS static
- Limited real-time
- No embodied interaction
- Mismatch with data richness

CPS to CPS-I

A light blue background graphic featuring a stylized human brain. Overlaid on the brain is a network diagram consisting of four circular nodes at the corners, connected by curved lines. A central spiral pattern is also visible within the brain's outline.

- AI reasoning
- Adaptive feedback
- Metadata generation
- Governed data

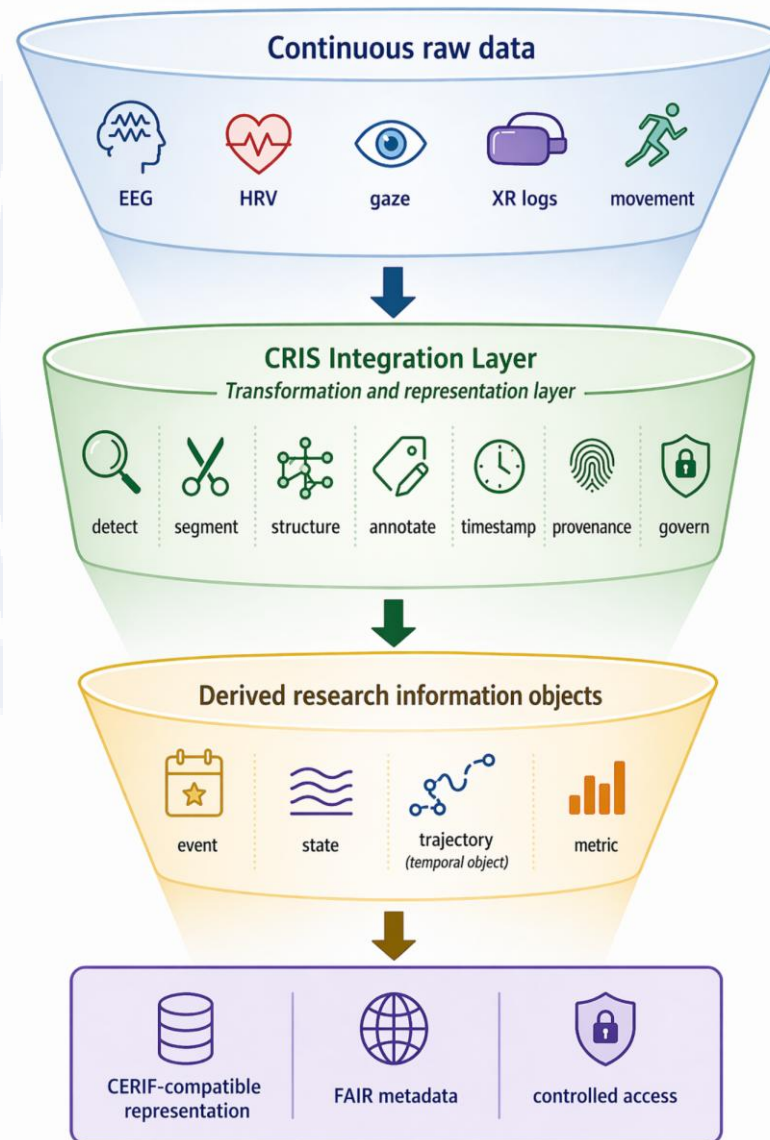
AI in CPS-I

A light blue background graphic featuring a stylized human brain. Overlaid on the brain is a network of white lines and circles, resembling a neural network or a cognitive map. The lines connect various points, some of which are represented by small white circles. The overall design is clean and modern, with a focus on the intersection of AI and cognitive systems.

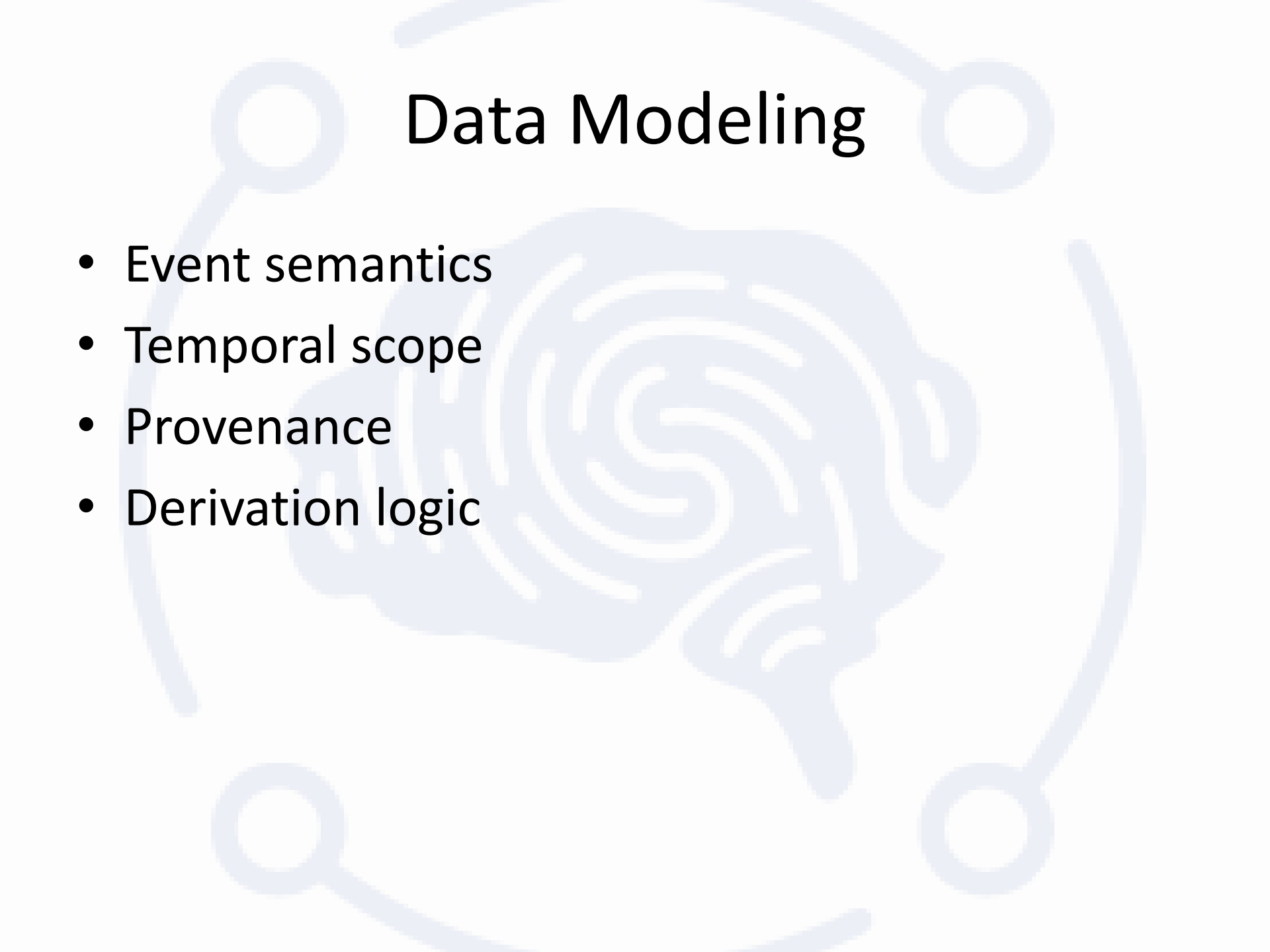
- Classification
- Anomaly detection
- Prediction
- Semantic enrichment

CRIS Integration Layer

- No raw data
- Derived entities
- States, events, trajectories
- CRIS-compatible



Data Modeling



- Event semantics
- Temporal scope
- Provenance
- Derivation logic

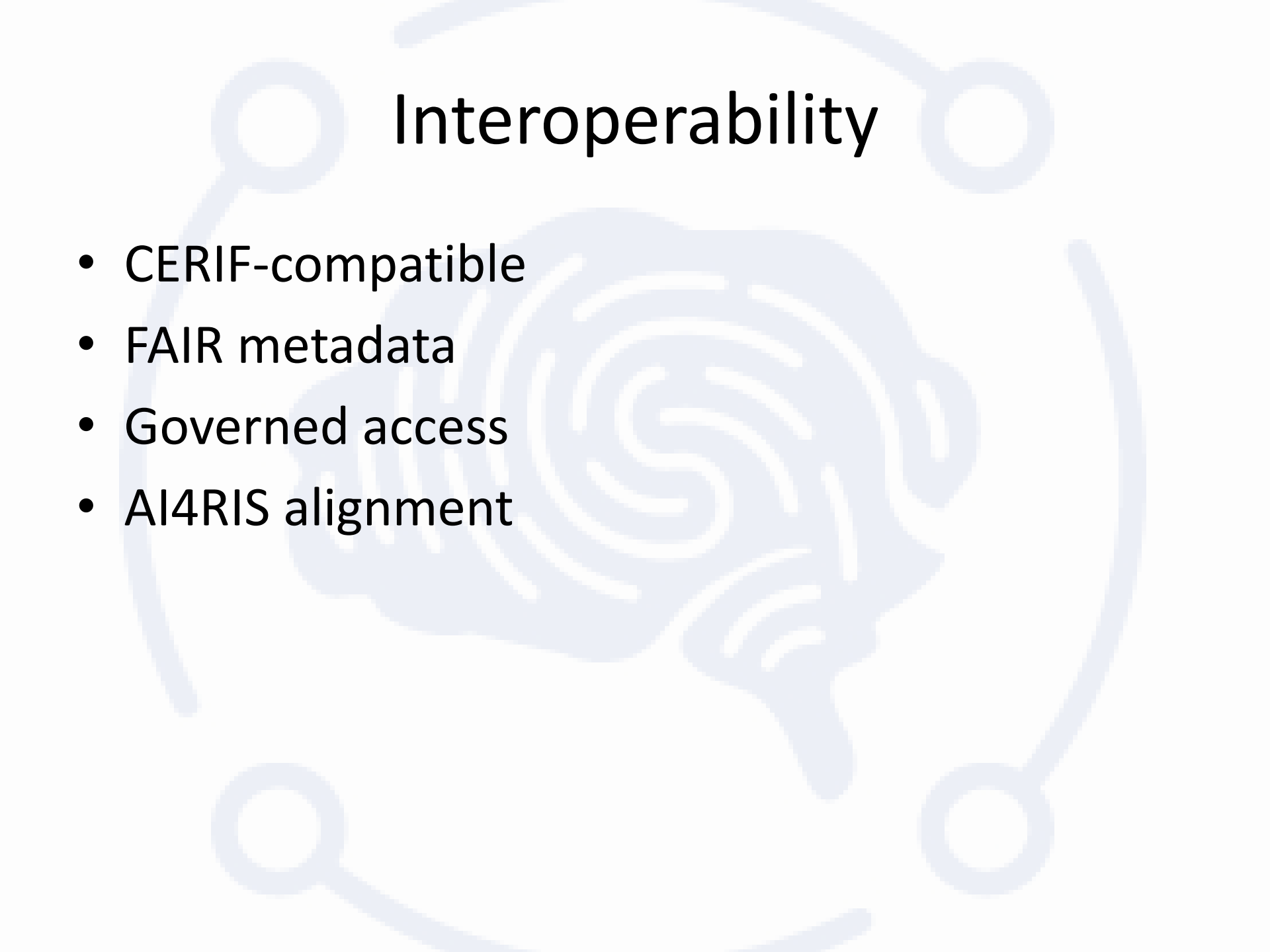
CRIS Mapping

- Events → activities
- States → datasets
- Trajectories → temporal objects
- Indicators → outputs

CPS-I as CRIS

- XR traces
- Digital twin objects
- Continuous metadata
- Real-time documentation

Interoperability



- CERIF-compatible
- FAIR metadata
- Governed access
- AI4RIS alignment

Security



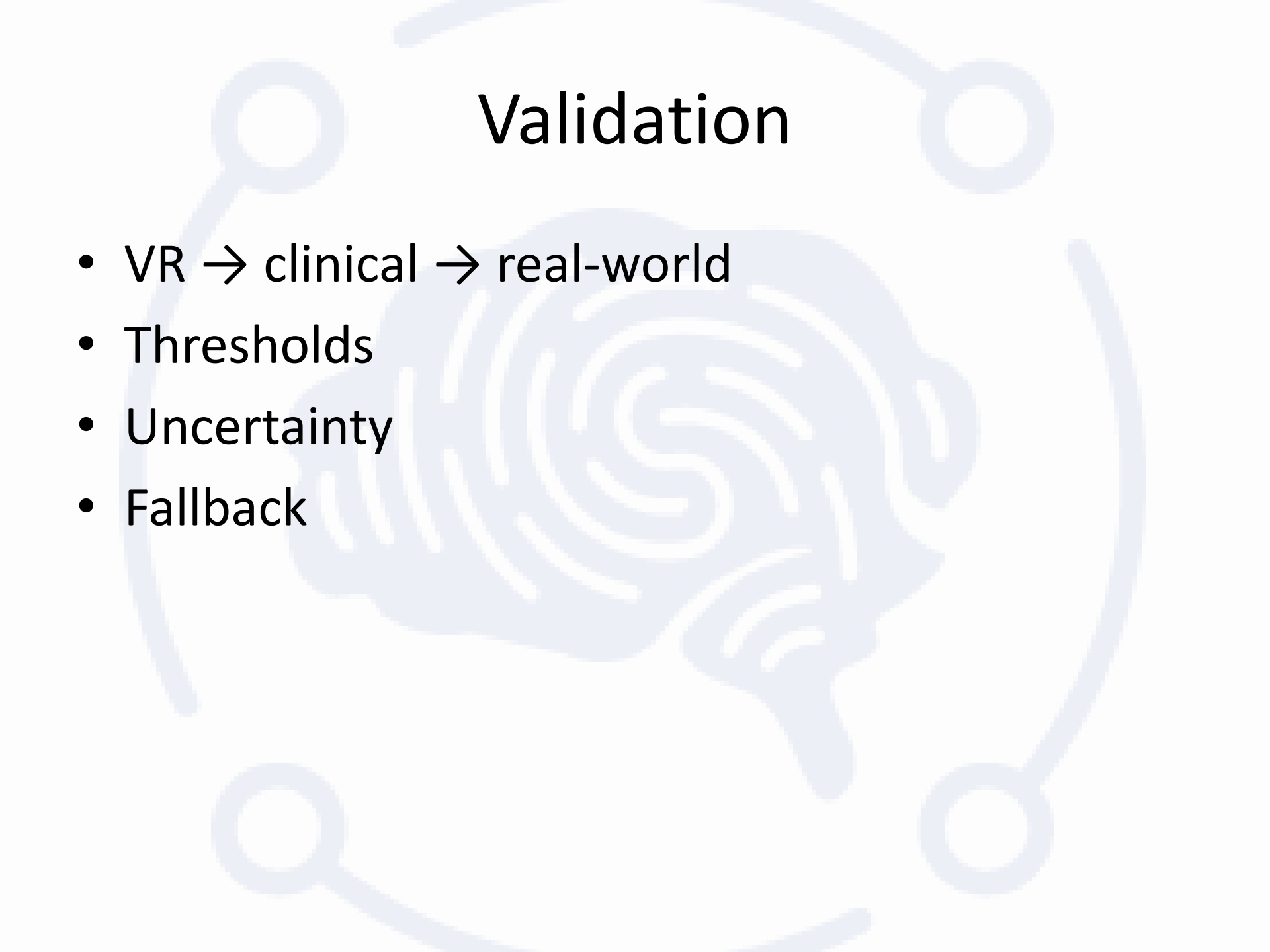
- No raw data exposure
- Access control
- Encryption
- Audit logs

Ethics



- Proportionality
- Adaptive monitoring
- Balance safety/autonomy

Validation

A light blue background graphic featuring a stylized brain with a network of lines and nodes overlaid on it, suggesting a complex system or neural network.

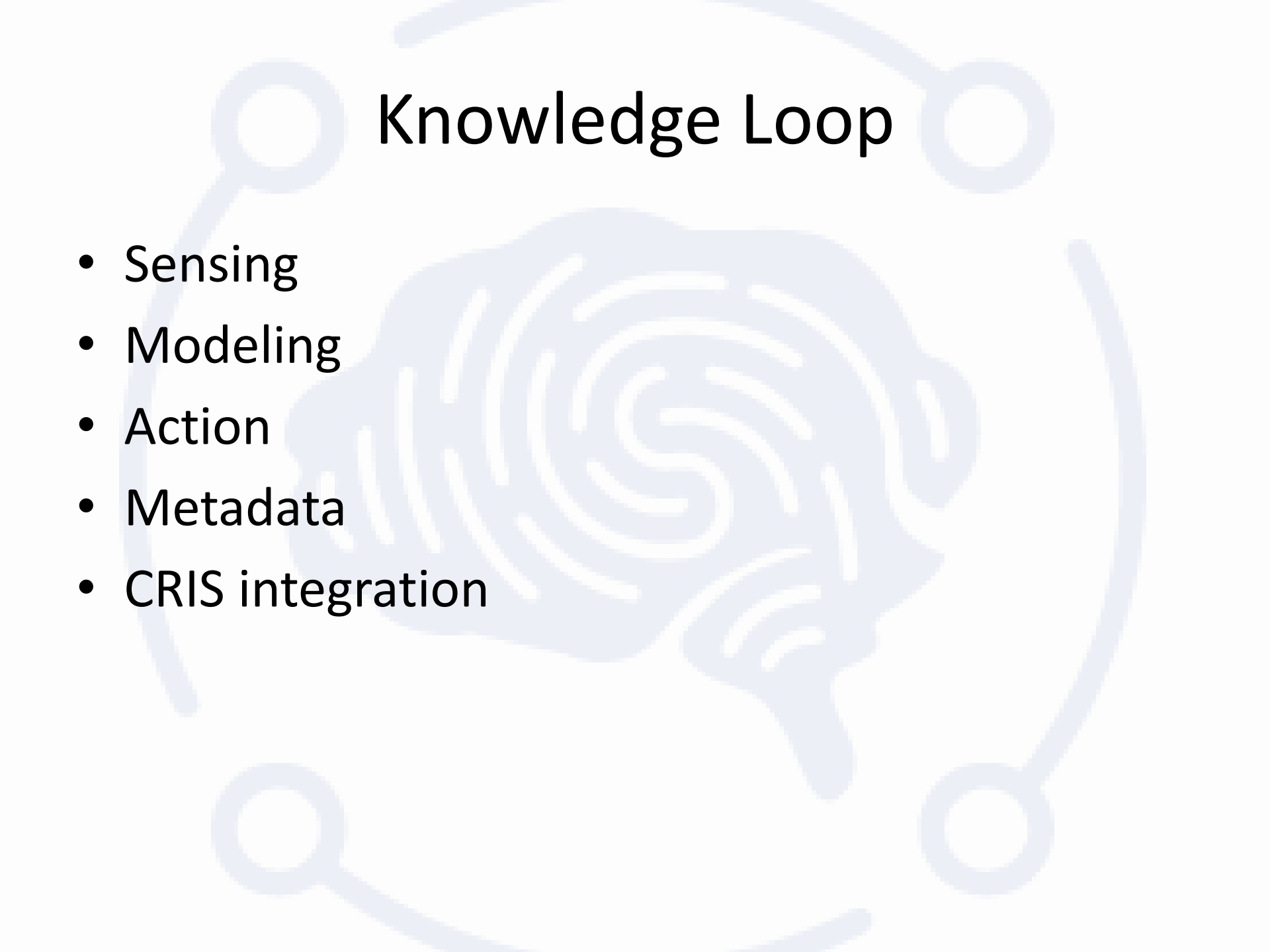
- VR → clinical → real-world
- Thresholds
- Uncertainty
- Fallback

Human Oversight



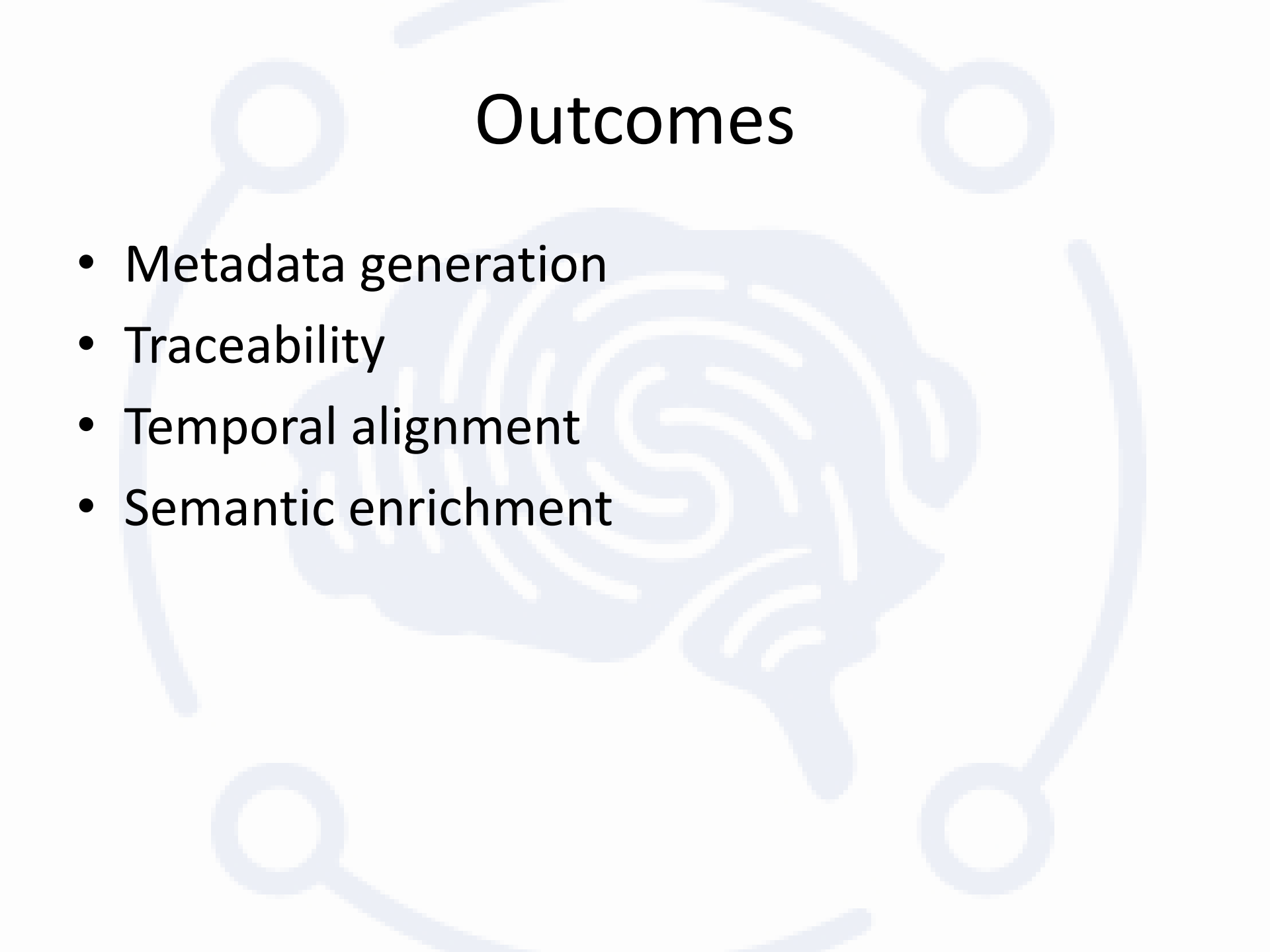
- Human-in-loop
- Selective monitoring
- Auditable decisions

Knowledge Loop



- Sensing
- Modeling
- Action
- Metadata
- CRIS integration

Outcomes



- Metadata generation
- Traceability
- Temporal alignment
- Semantic enrichment

Roadmap

The background of the slide features a light blue, stylized brain. Overlaid on the brain is a network diagram consisting of four circular nodes, one in each corner, connected by curved lines. Additionally, there are several concentric, wavy lines centered over the brain, resembling a ripple effect or a signal field.

- VR calibration
- Clinical integration
- Real-world deployment
- Interoperability workflows

Positioning

- CRIS = static
- CPS-I = dynamic
- Extension of CRIS

Conclusion

- Data → knowledge
- CPS → CPS-I
- Toward epistemic infrastructures

ACKNOWLEDGEMENTS

- Fonds de Recherche du Québec