

The Adaptive Immune Receptor Repertoire (AIRR) Data Commons: iReceptor and the AIRR Community

Brian Corrie

Technical Director, iReceptor

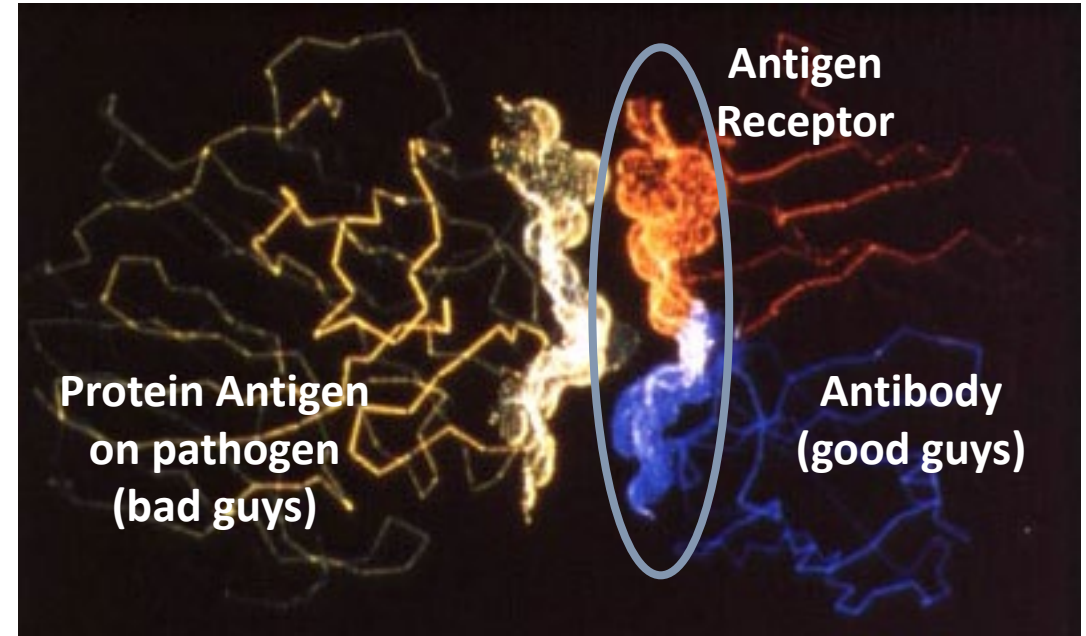
Simon Fraser University, Vancouver, Canada



Introduction

- Immunogenetics
 - **Genetics** of our **immune** system
- Goal: **Personalized** Immunotherapy
 - Help **my** immune system fight **my** disease
 - Cancer, autoimmune, and infectious disease
- How does the immune system work?
 - Antibody-producing cells (good guys) bind to protein antigens on pathogens (bad guys)
 - Antigen Receptor: **Adaptive** → Evolves to bind pathogens → **Hard to Understand**
- What's changed? Adaptive Immune Receptor Repertoire Sequencing (AIRR-seq)
 - Massively parallel sequencing of the immune response (2009)

Adaptive Immune System



Challenges

- Driver: Data Deluge from Next Gen Sequencing of Immune Response
 - $\sim 10^{13}$ possible antigen receptors in the human population
 - $\sim 10^8$ cells/person at a single time point (not all different of course)
 - $> 10^6$ sequences per biological sample (statistical sampling of $\sim 10^8$ cells)
 - > 1 time point/subject as immune system adapts
 - Many subjects/study, many studies/lab, 100s of labs
- Researcher needs: AIRR-seq data that is **FAIR**
 - **Find** data of interest from multiple labs/institutions
 - Federate the data of interest (**Accessible** and **Interoperable**)
 - **Reuse** federated data in new analyses to derive new insight (**FAI** leads to **Reuse**)



The iReceptor Approach

iReceptor Scientific Gateway

Interactive web based data
discovery, exploration, and analytics



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AIRR Data Commons

Distributed repositories,
standards based



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Based on standards developed
by the international AIRR
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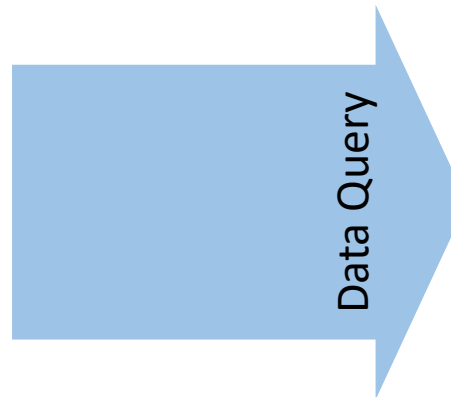
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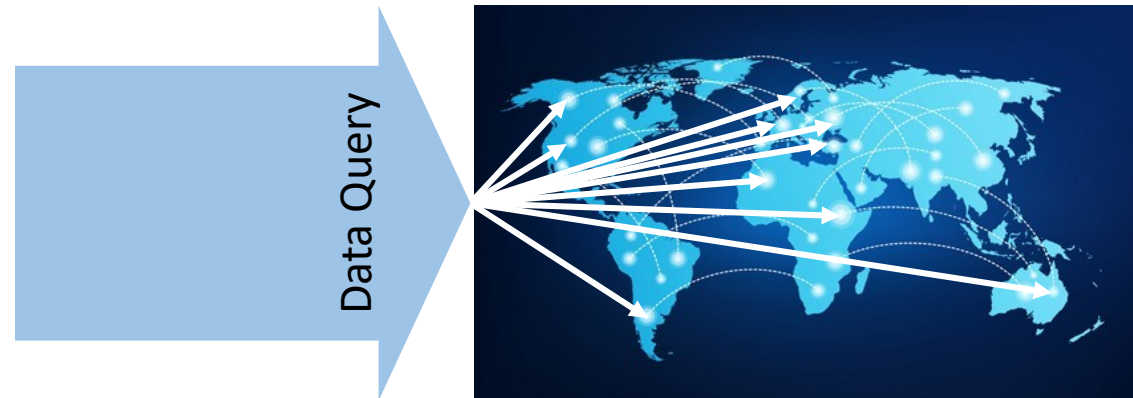
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Federation
Data

Data Query

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iReceptor Scientific Gateway My take home point is... AIRR Data Commons

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...without an
AIRR Data Commons
based on
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How do we get to an AIRR Data Commons?



Have a strong community - AIRR Community

- International, grass roots community
 - Scientists, bioinformaticians, computer scientists, data privacy experts
 - Established in 2015, currently 150 members
- Extremely active Working Groups!

Minimal Standards WG
C. Busse (DKFZ), F. Rubelt (Roche)

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AIRR III (2018)
NIH, Rockville



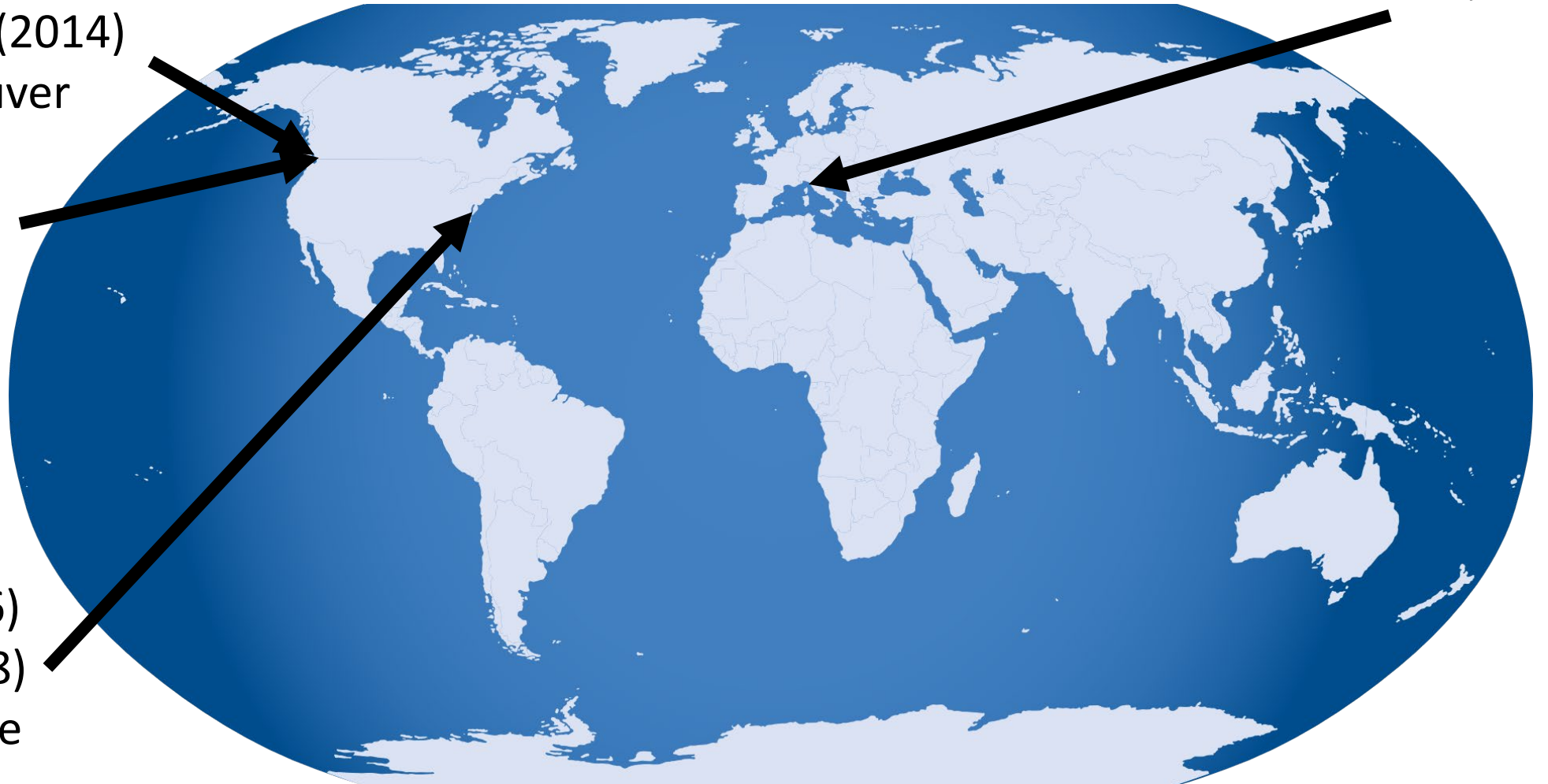
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AIRR IV (2019)
Uni of Genoa, Italy

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How does the AIRR community set standards?

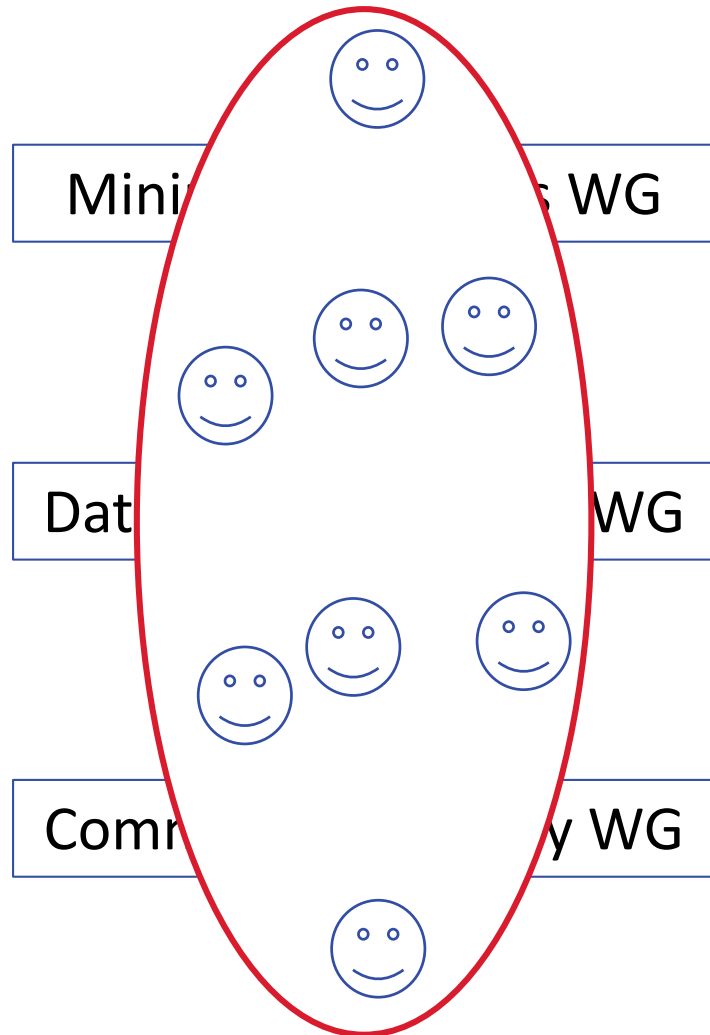
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Data Representation WG

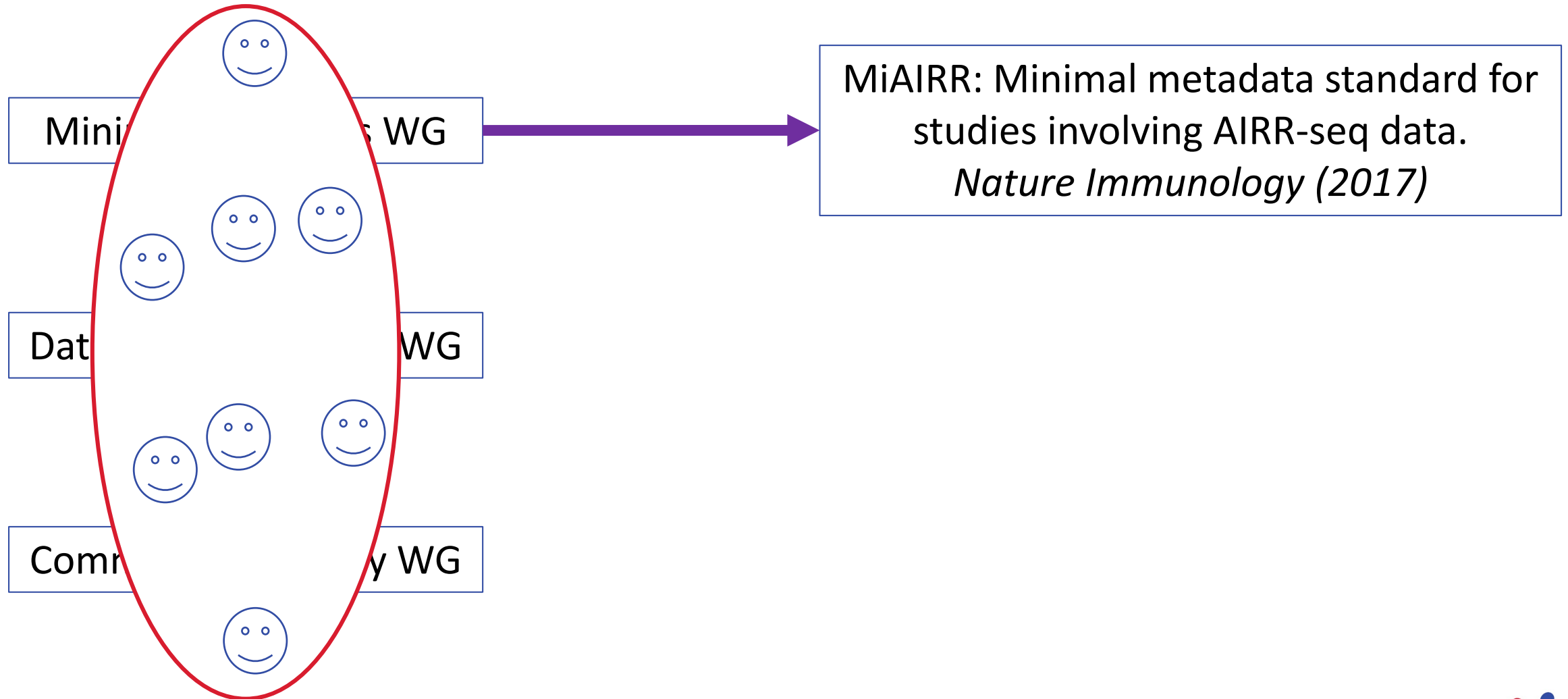
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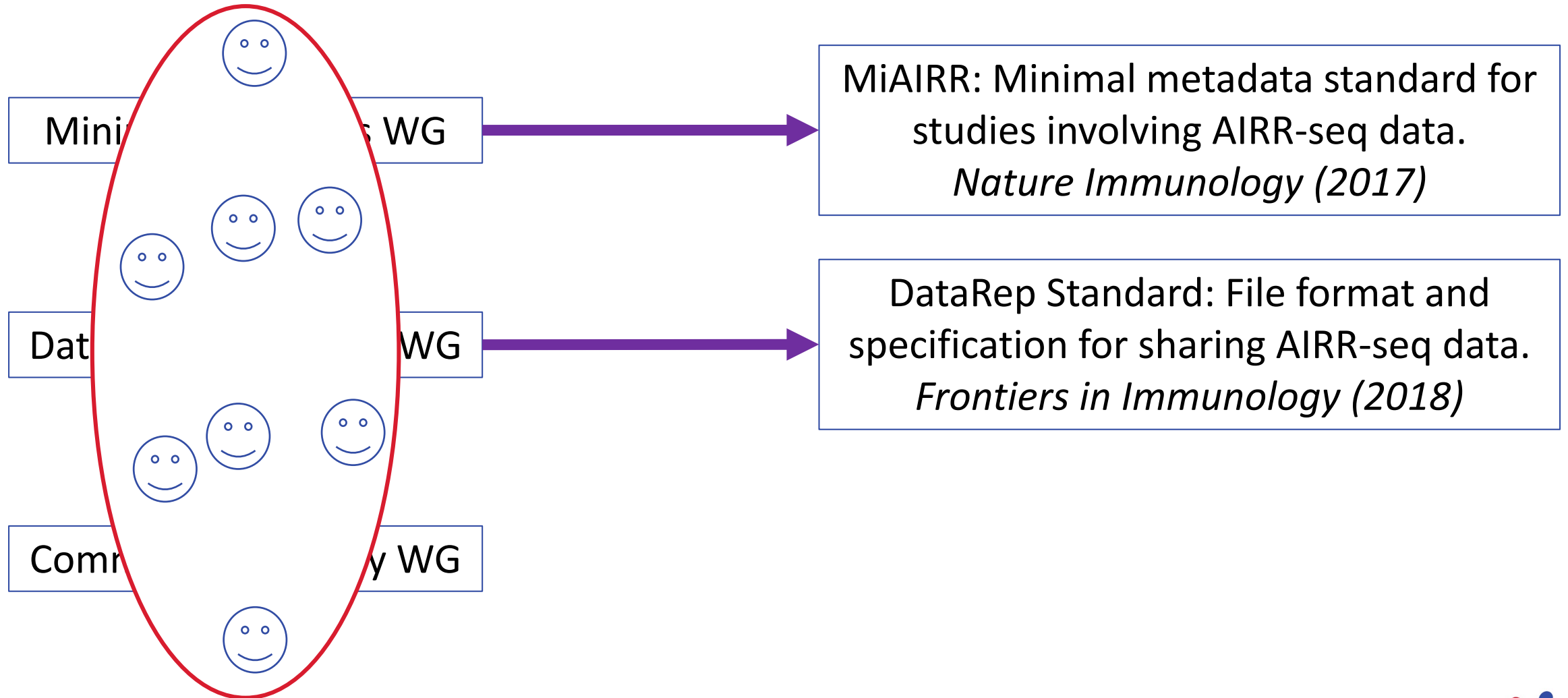
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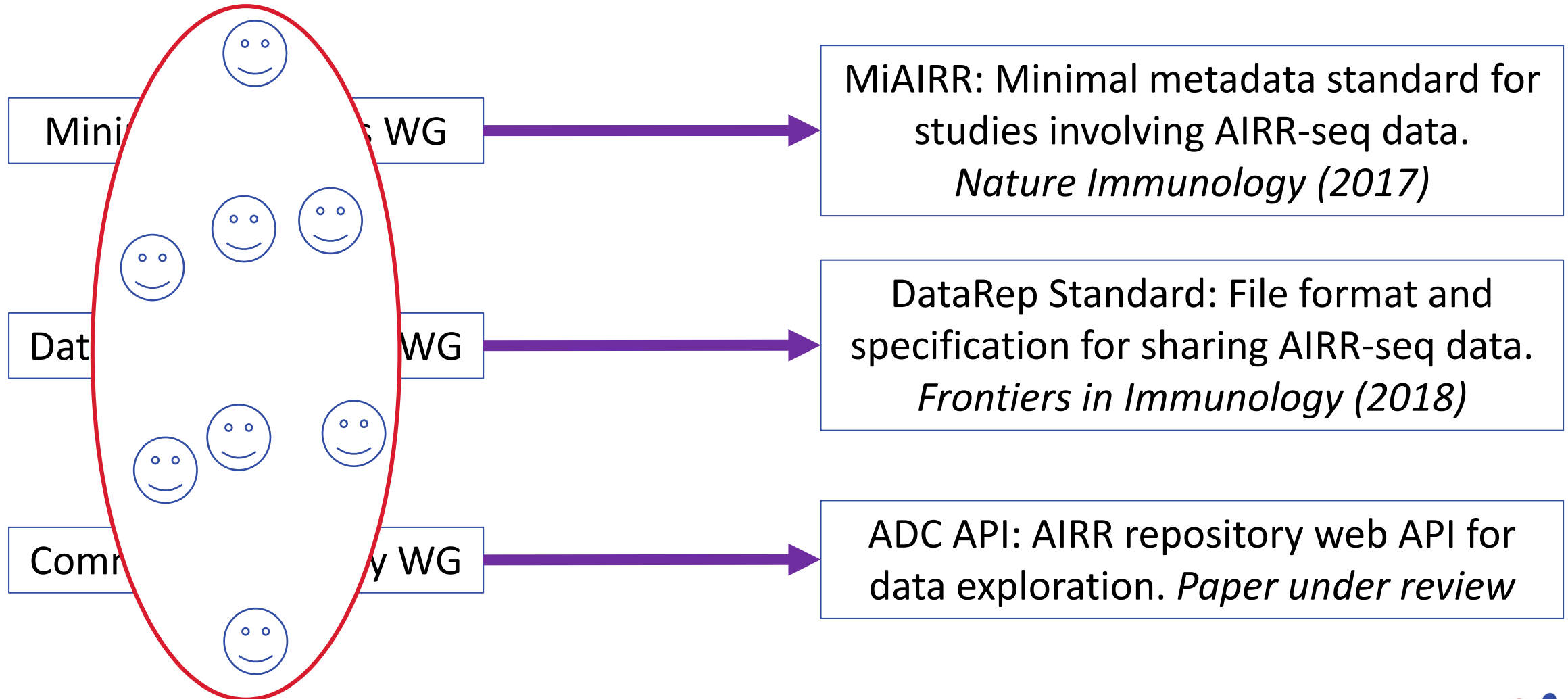
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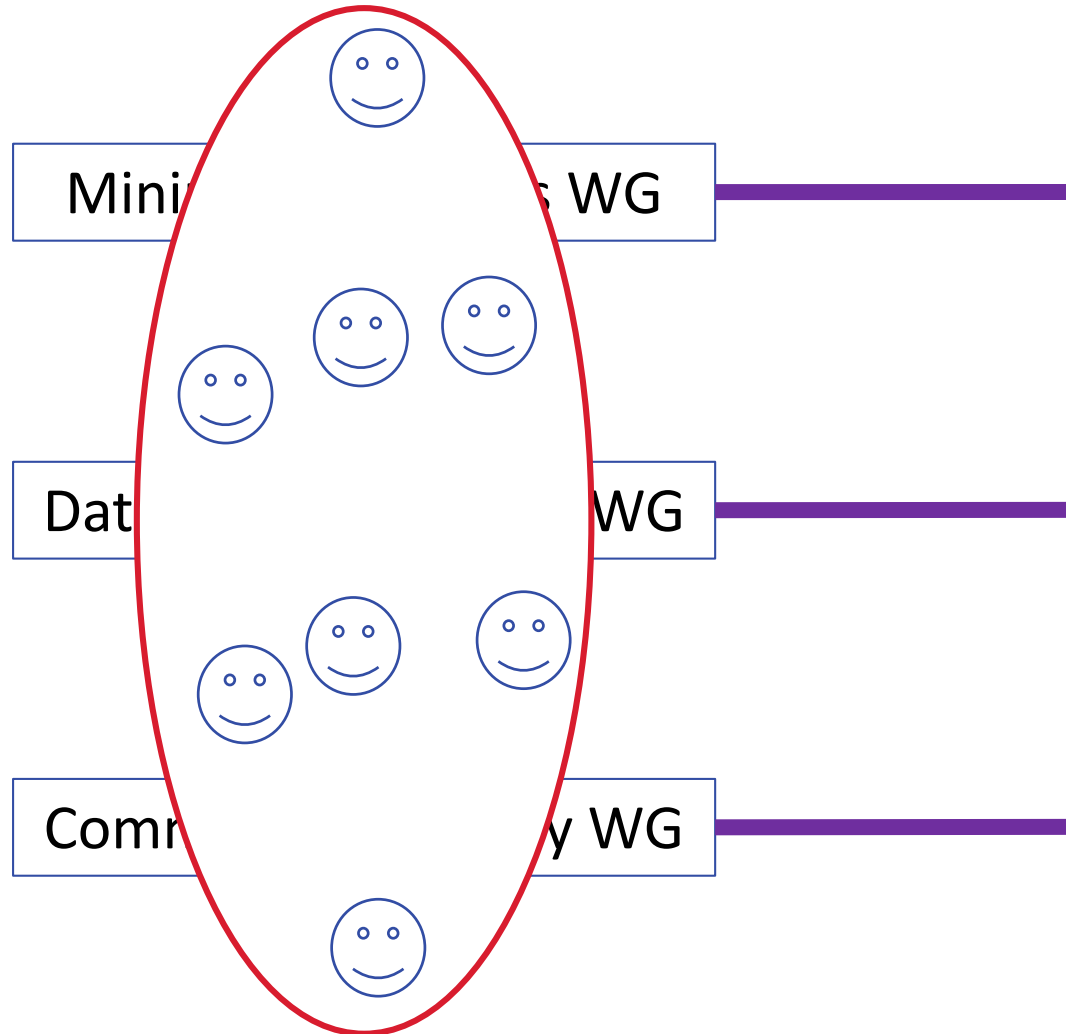
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AIRR Community Manuscript Process

- WG writes standards manuscript
- Distributed to AIRR Exec → AIRR Community
- Community approval: Electronic ballot, 25% of community quorum, 2/3 of voters approve

Ensures broad acceptance of standards

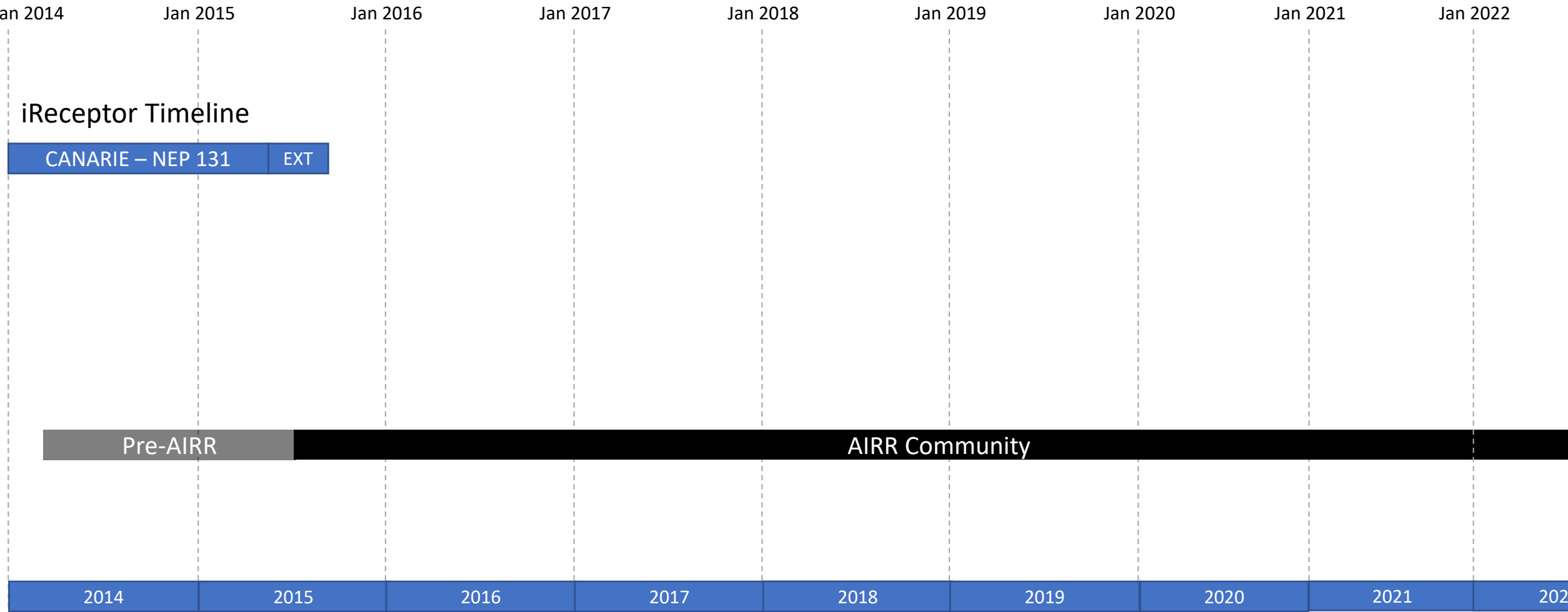
- [84 AIRR Community member endorsements](#) for the MiAIRR standard



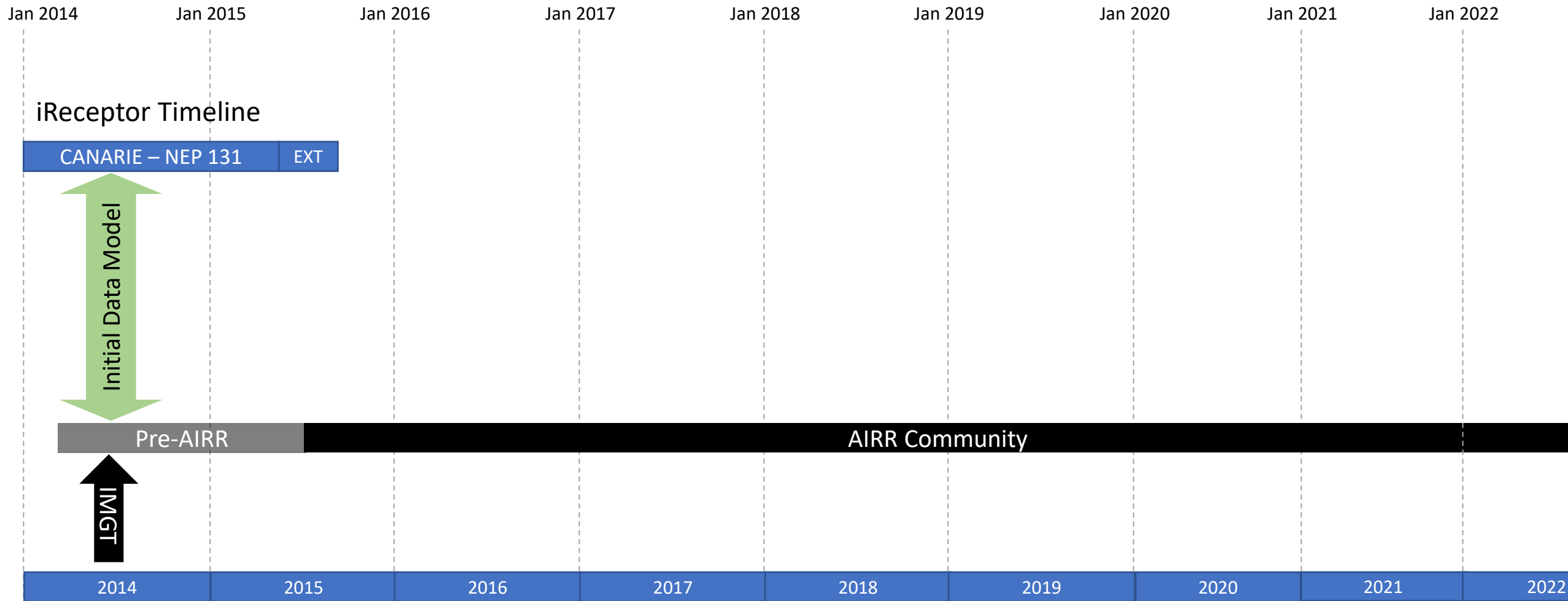
iReceptor and the AIRR Community



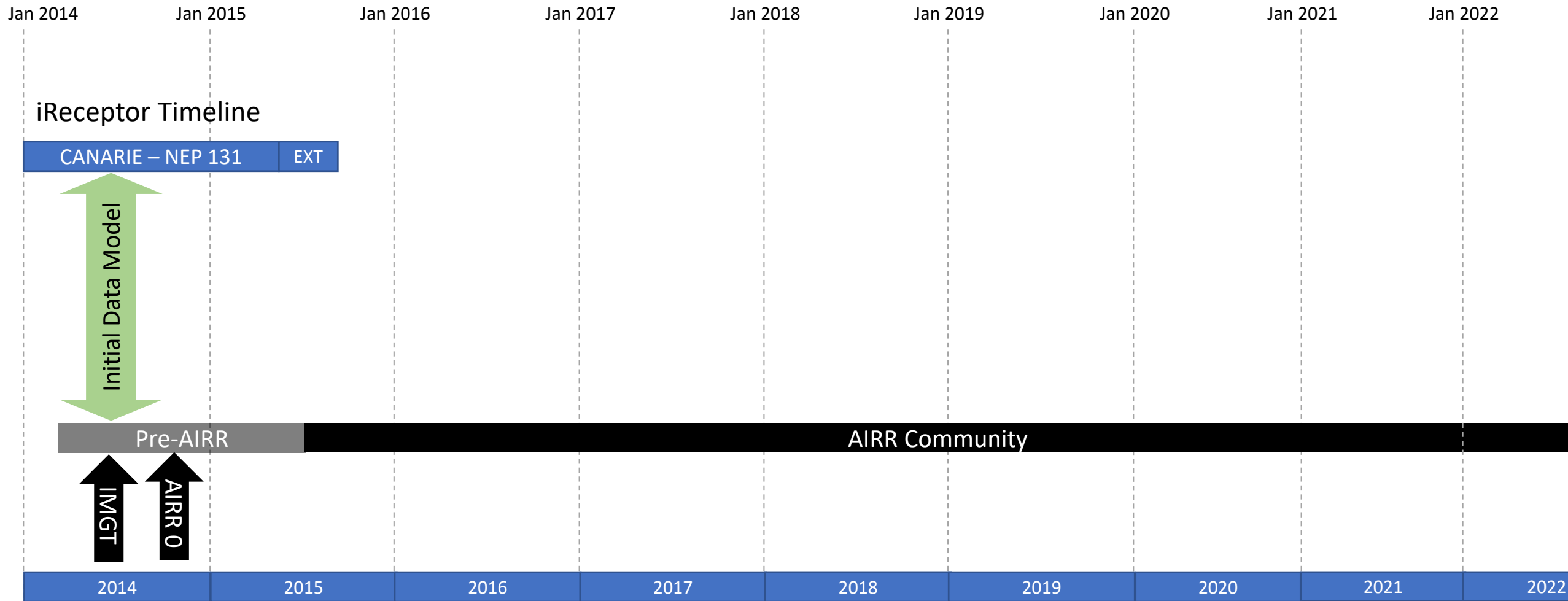
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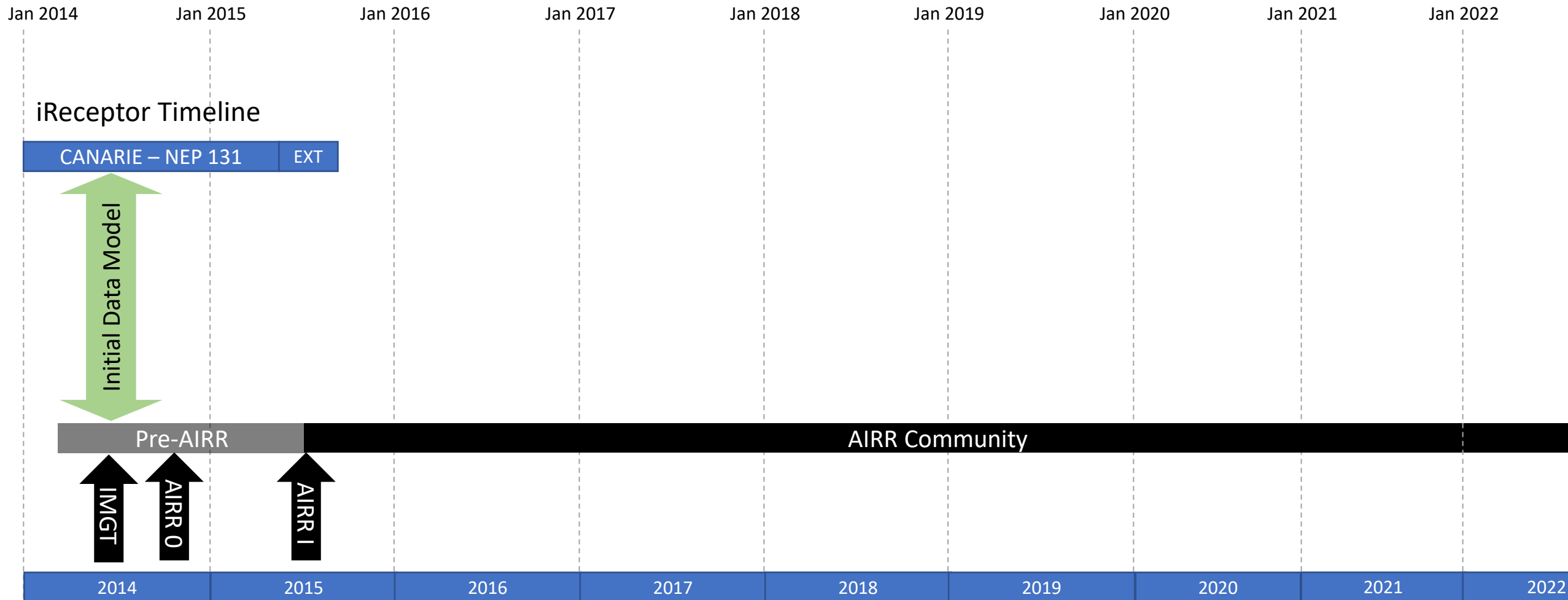
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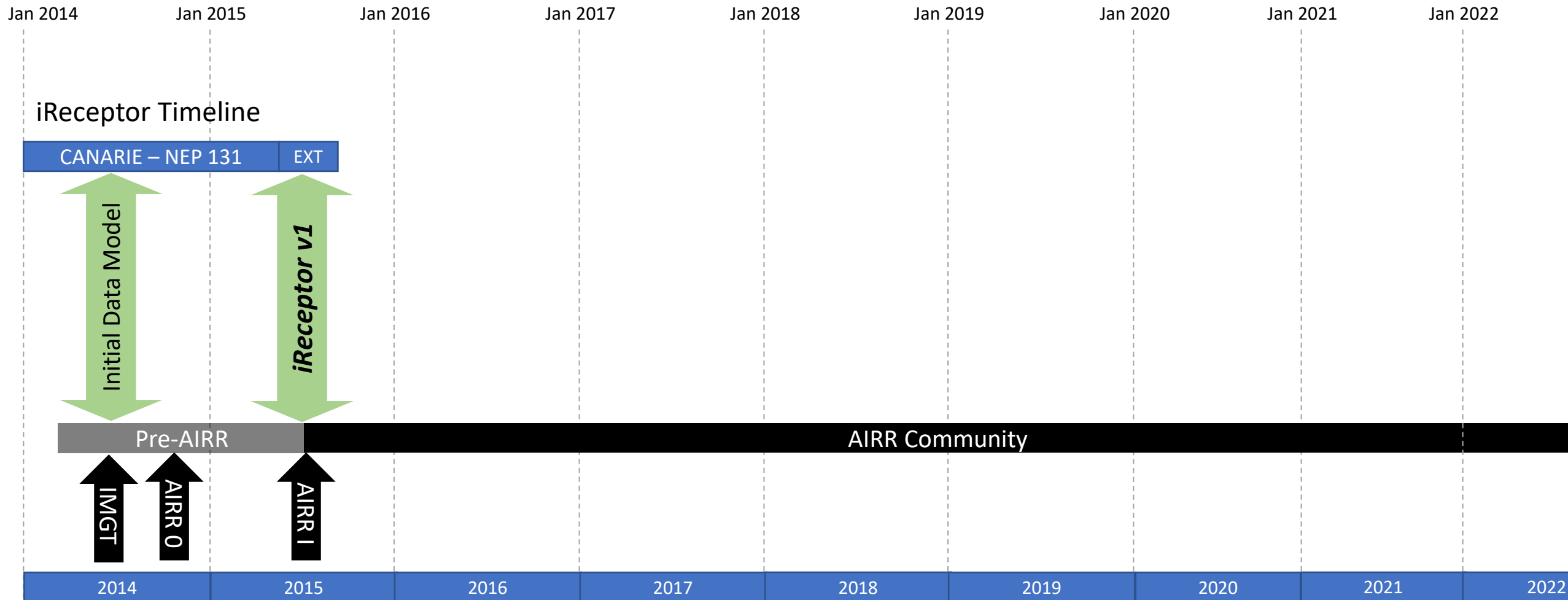
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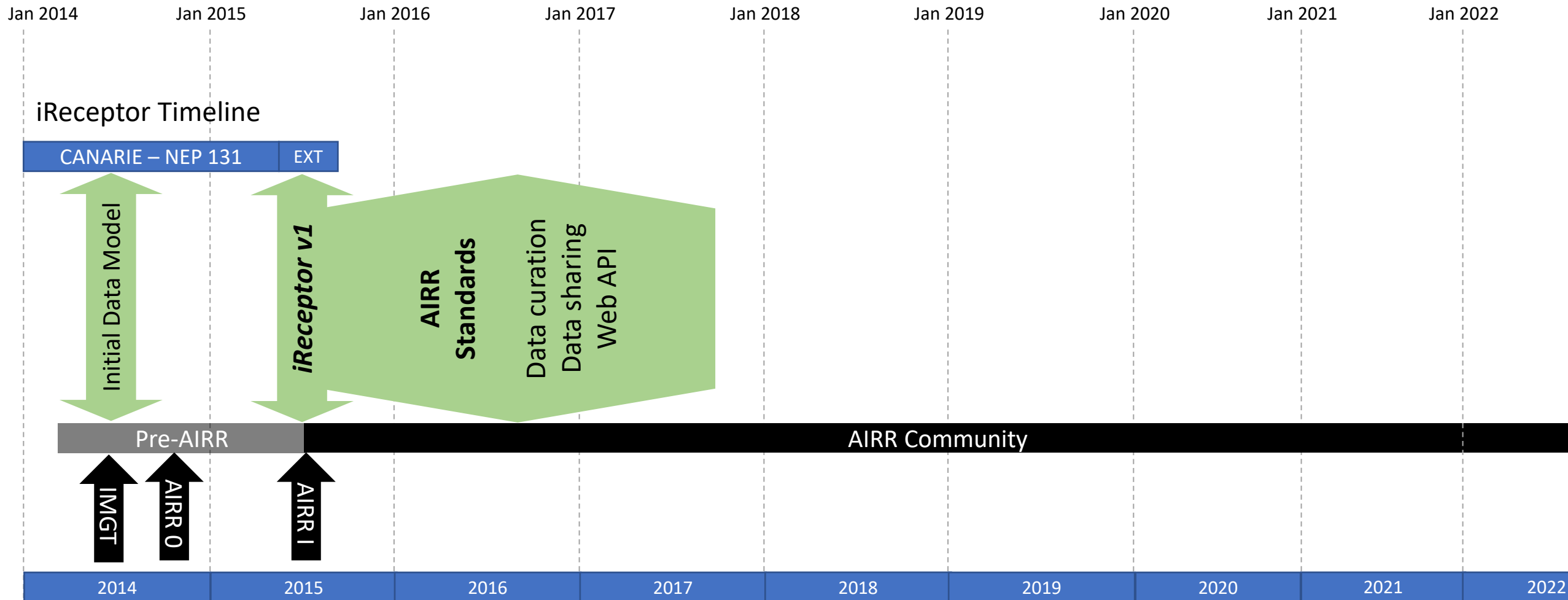
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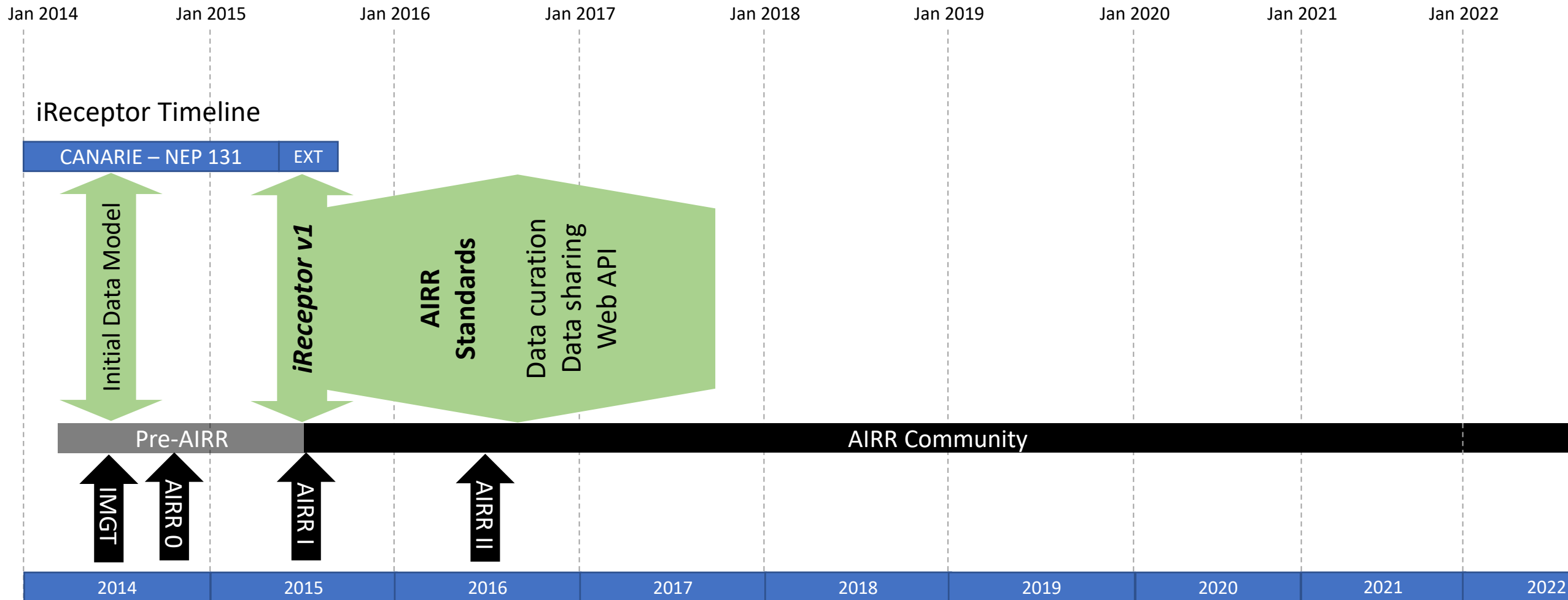
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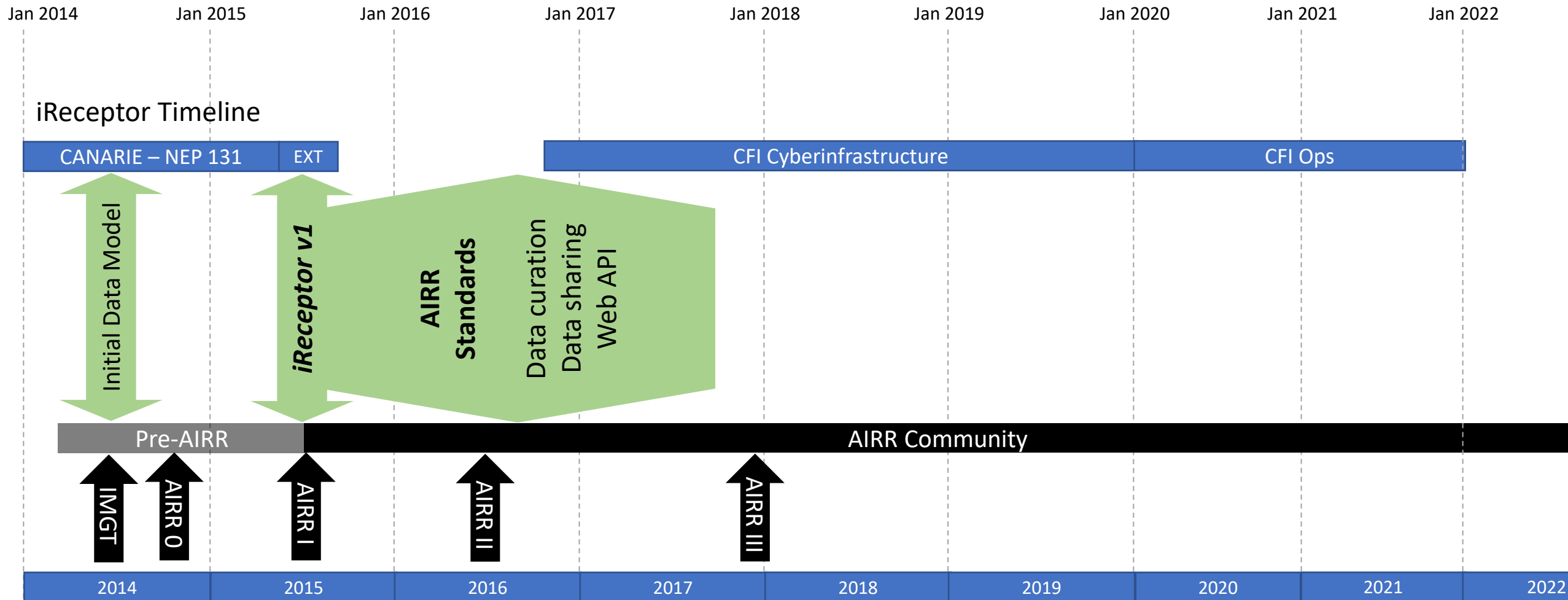
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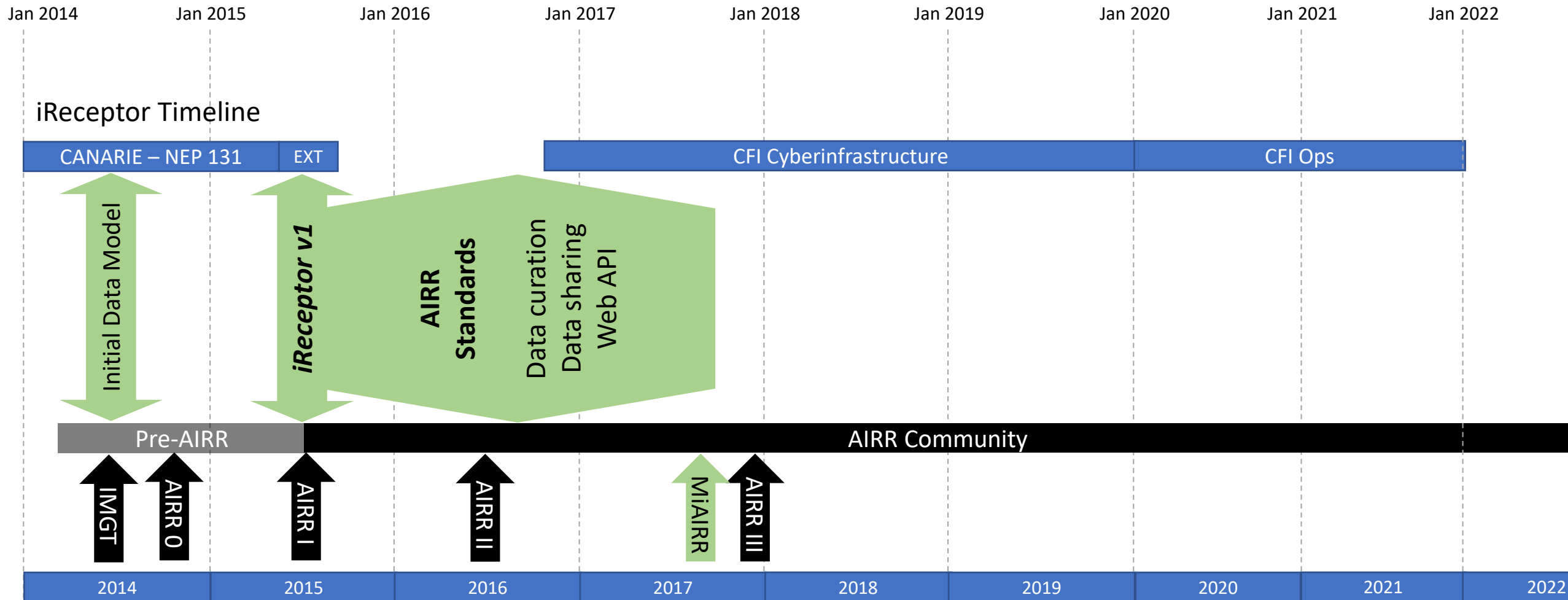
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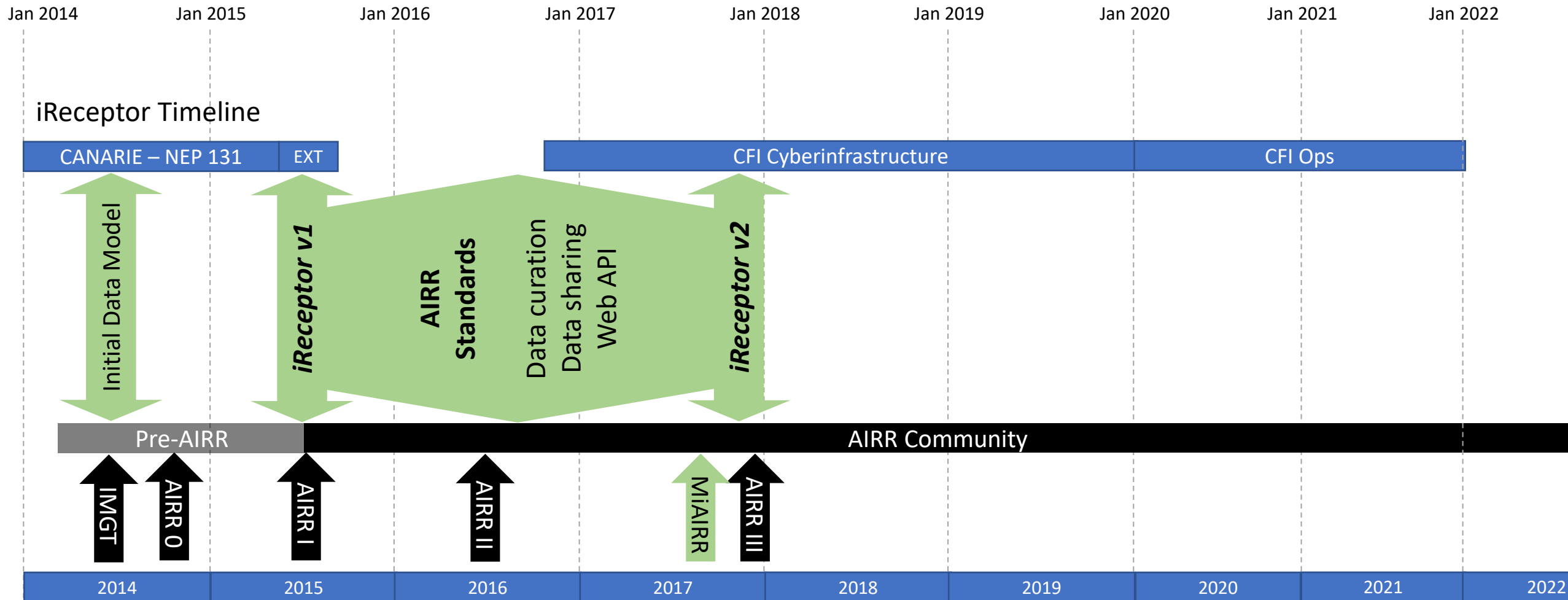
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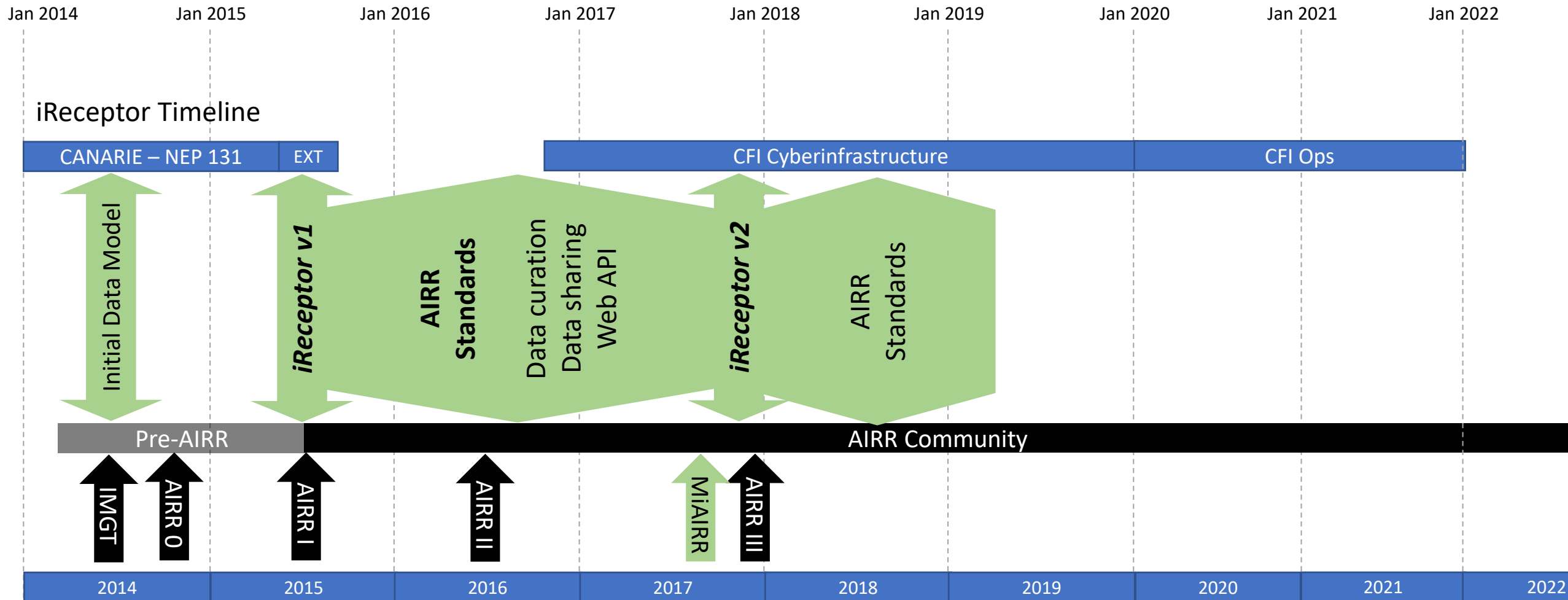
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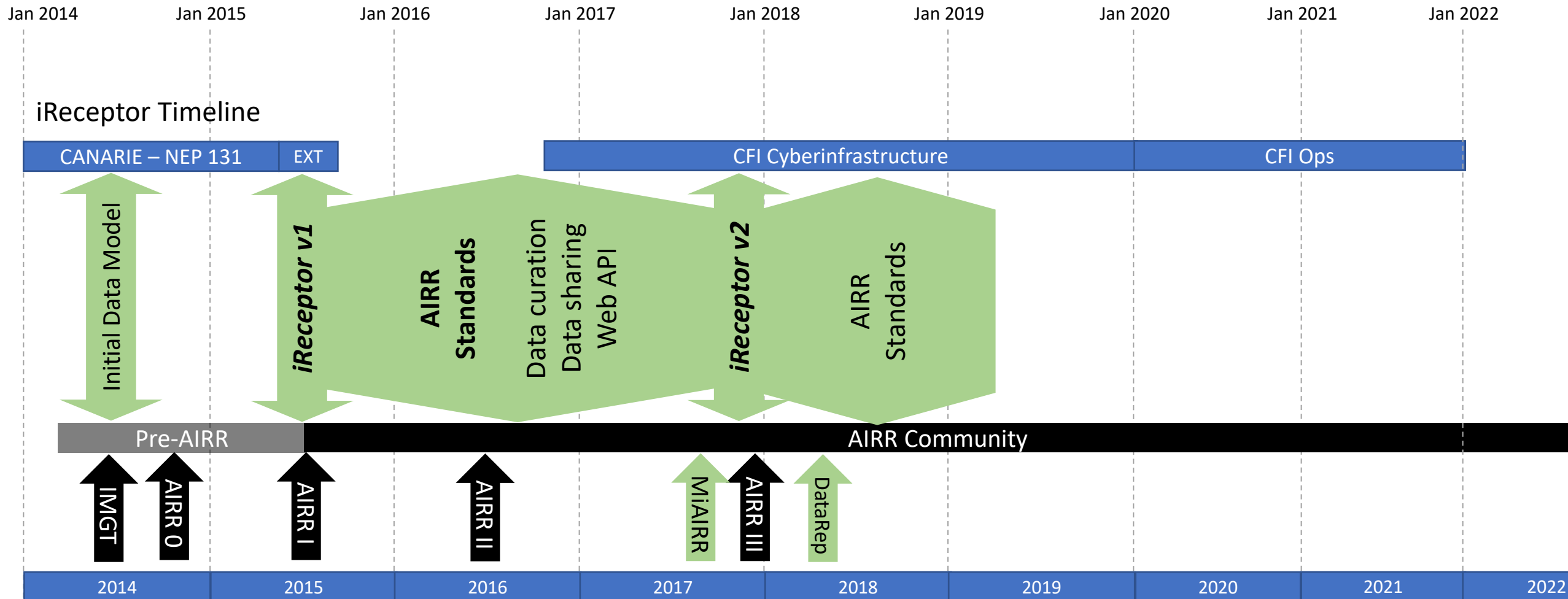
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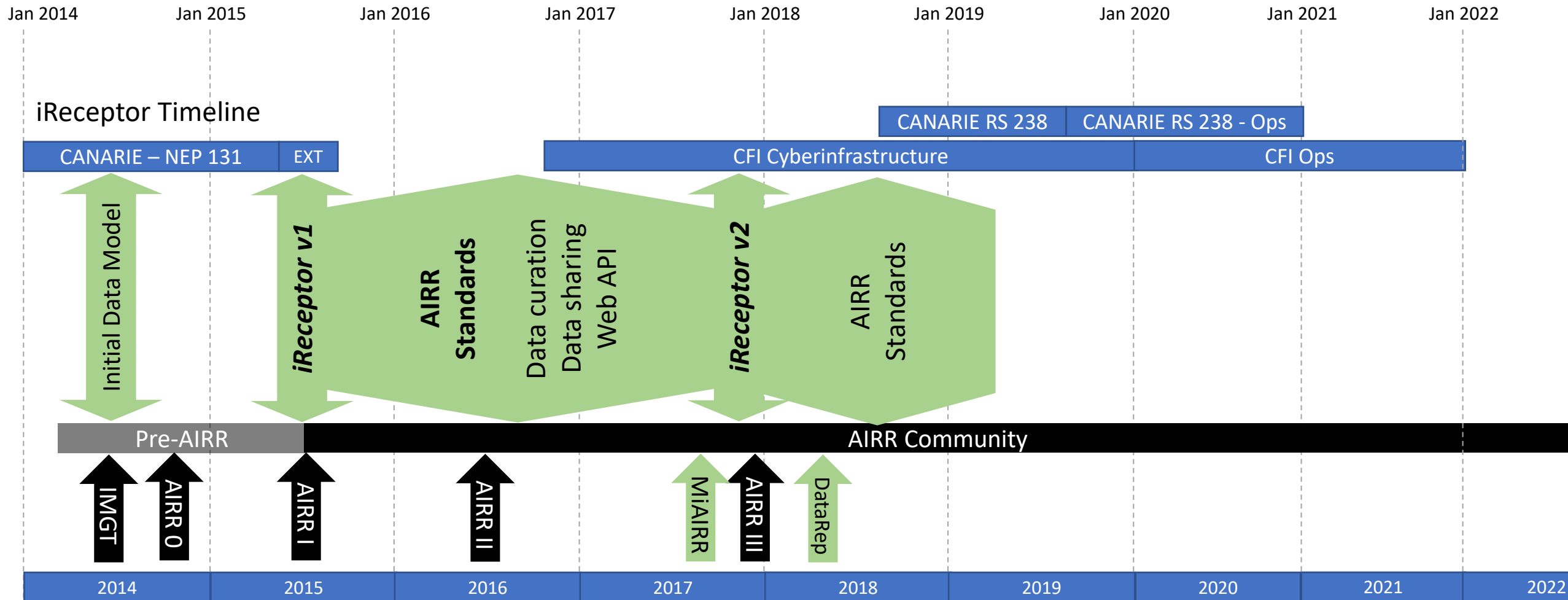
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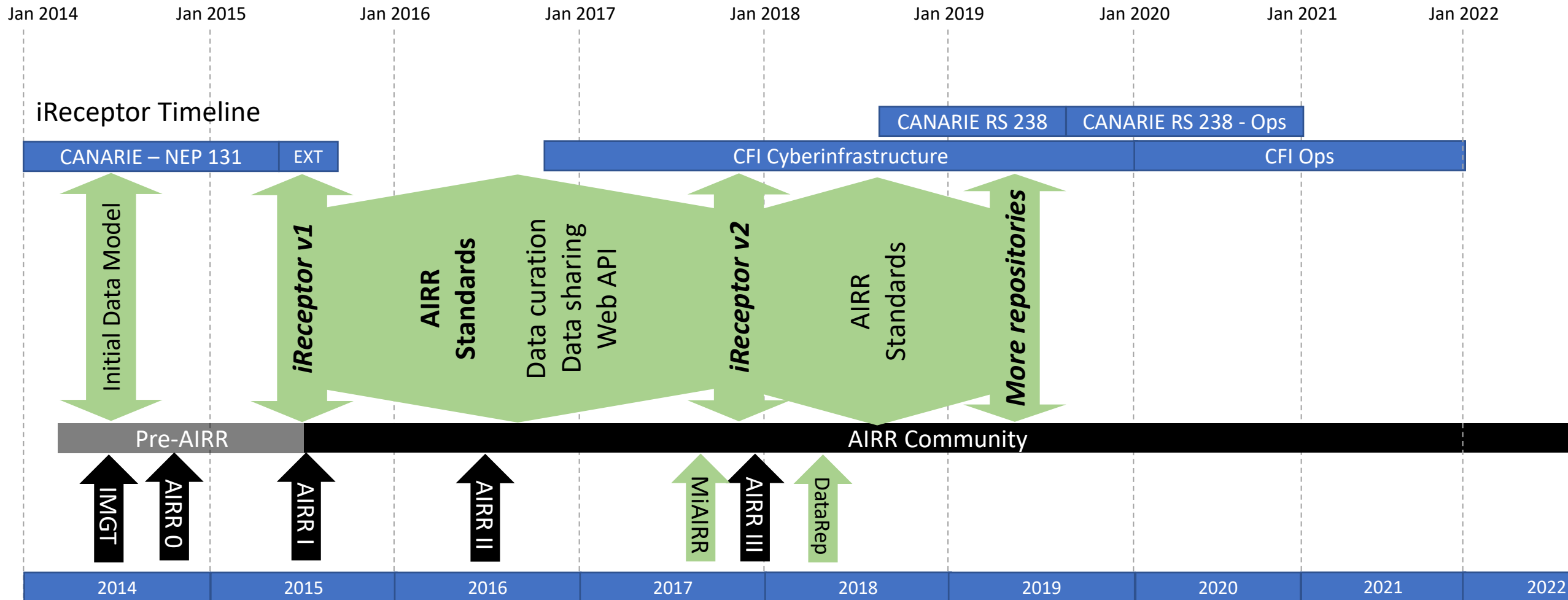
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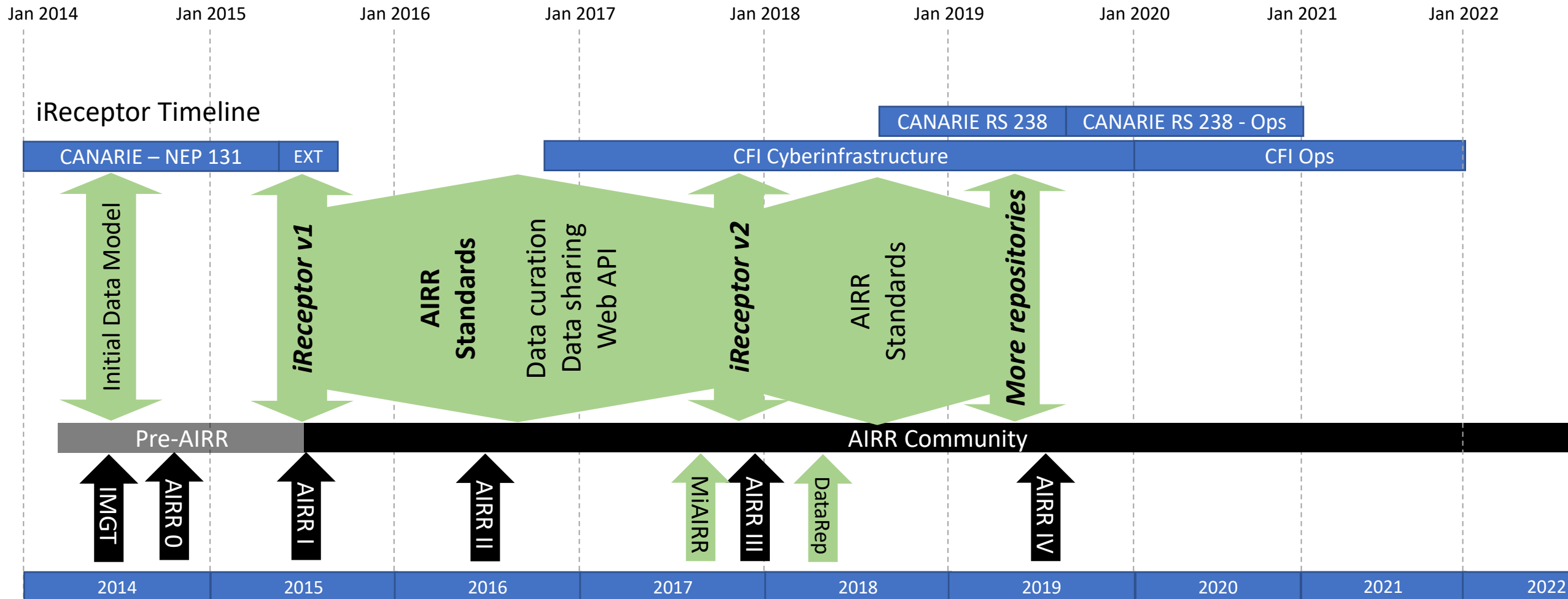
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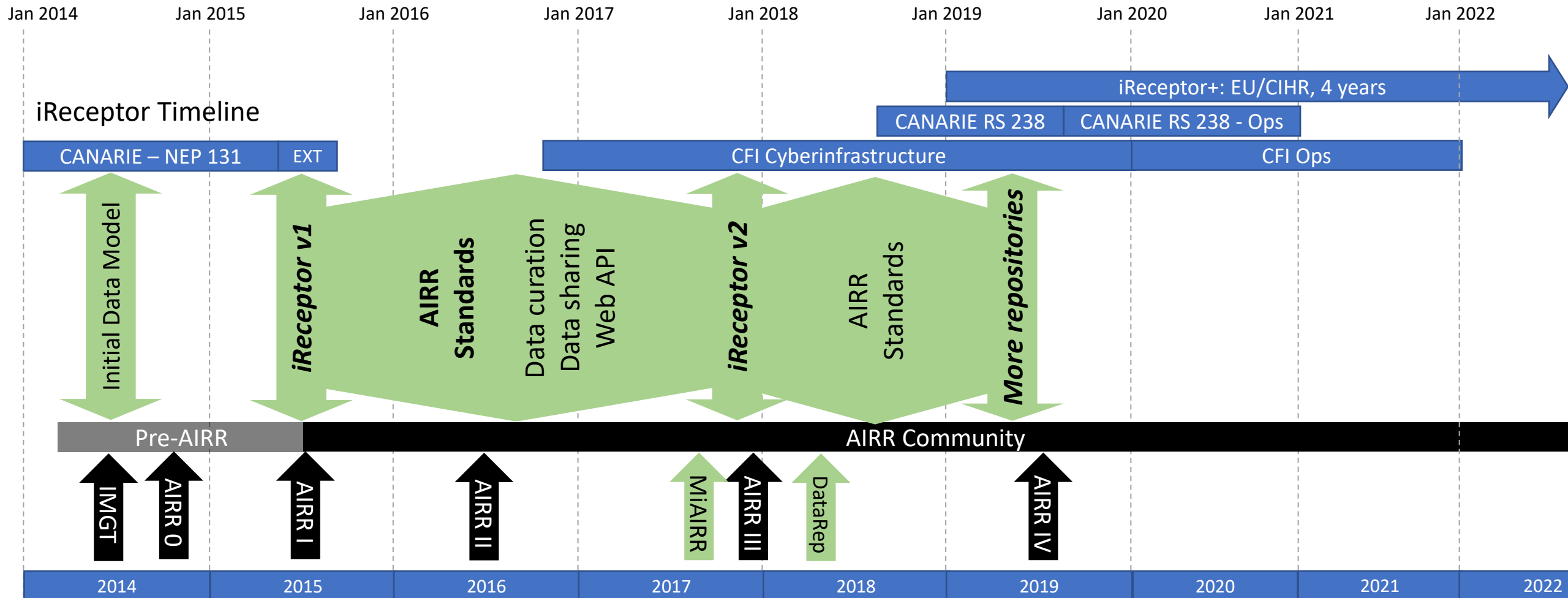
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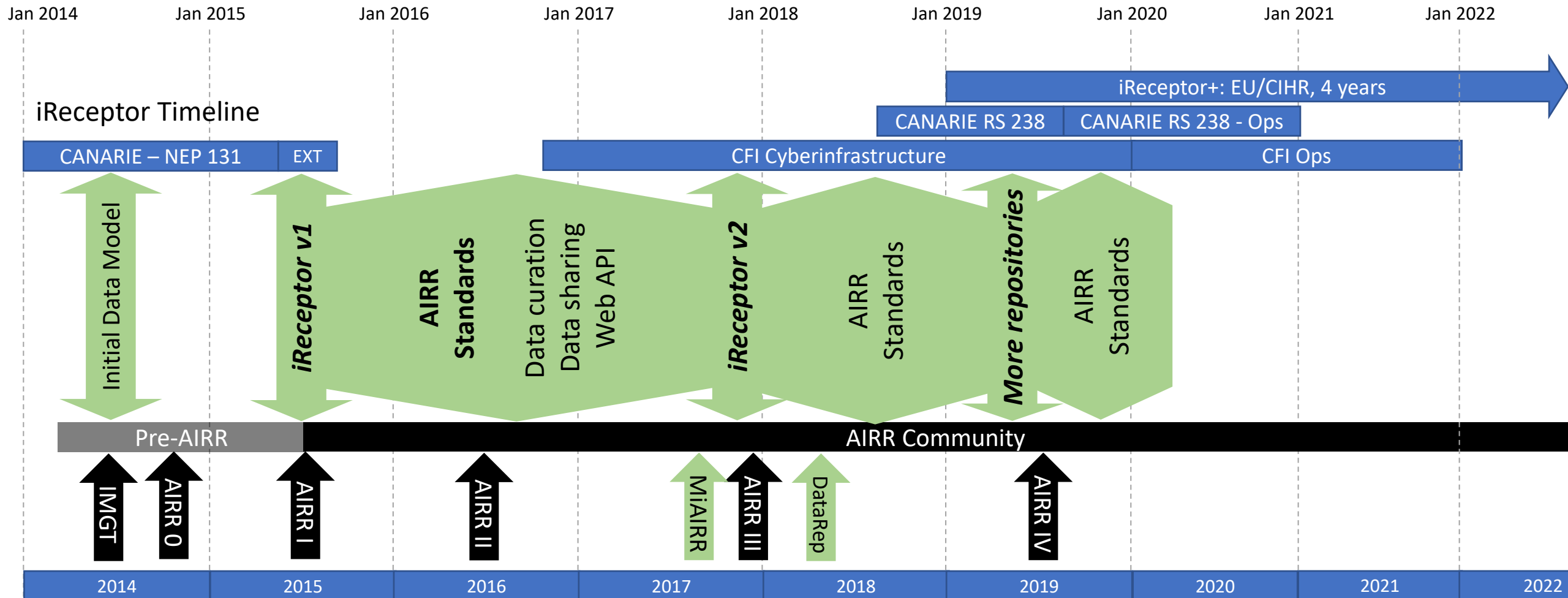
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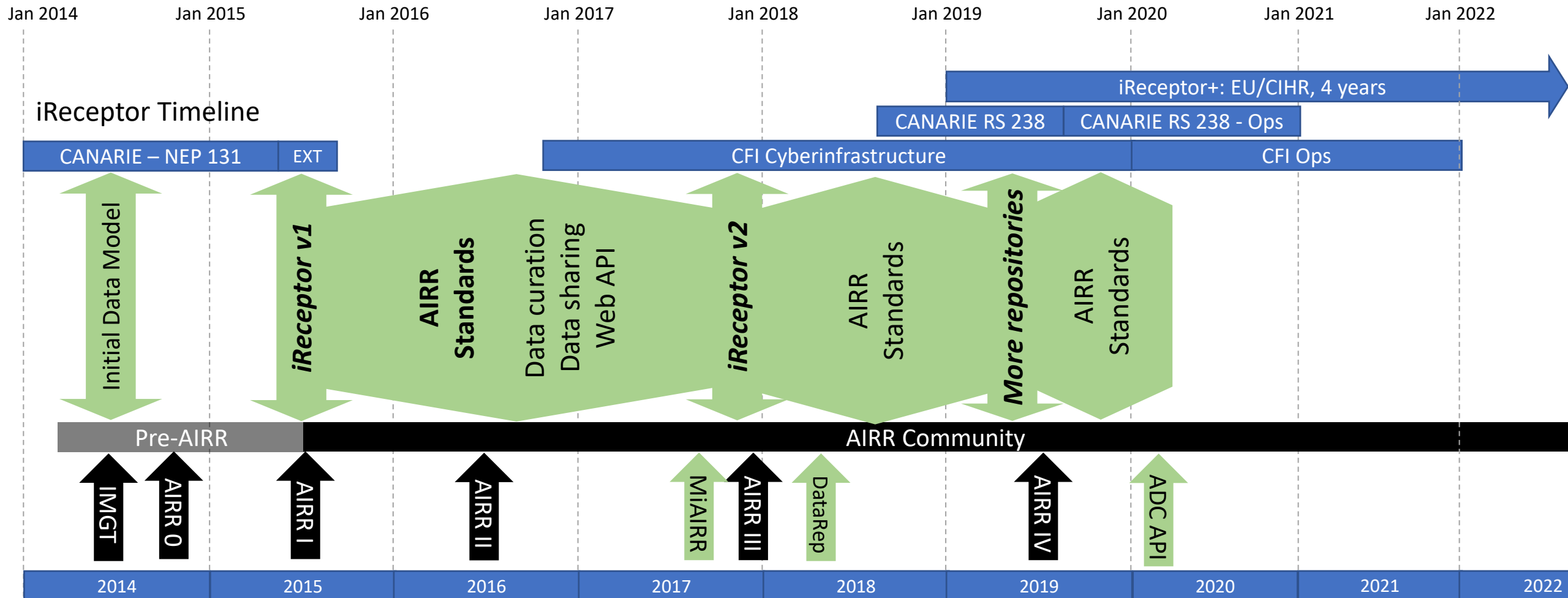
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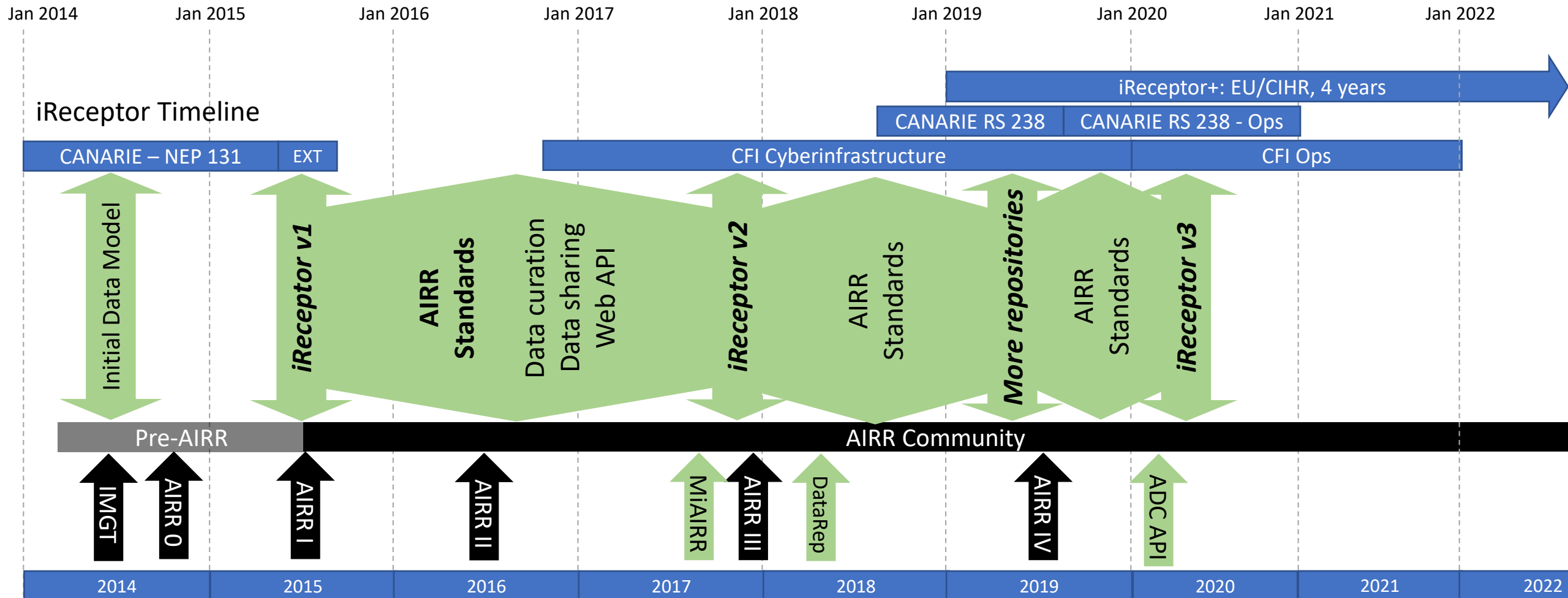
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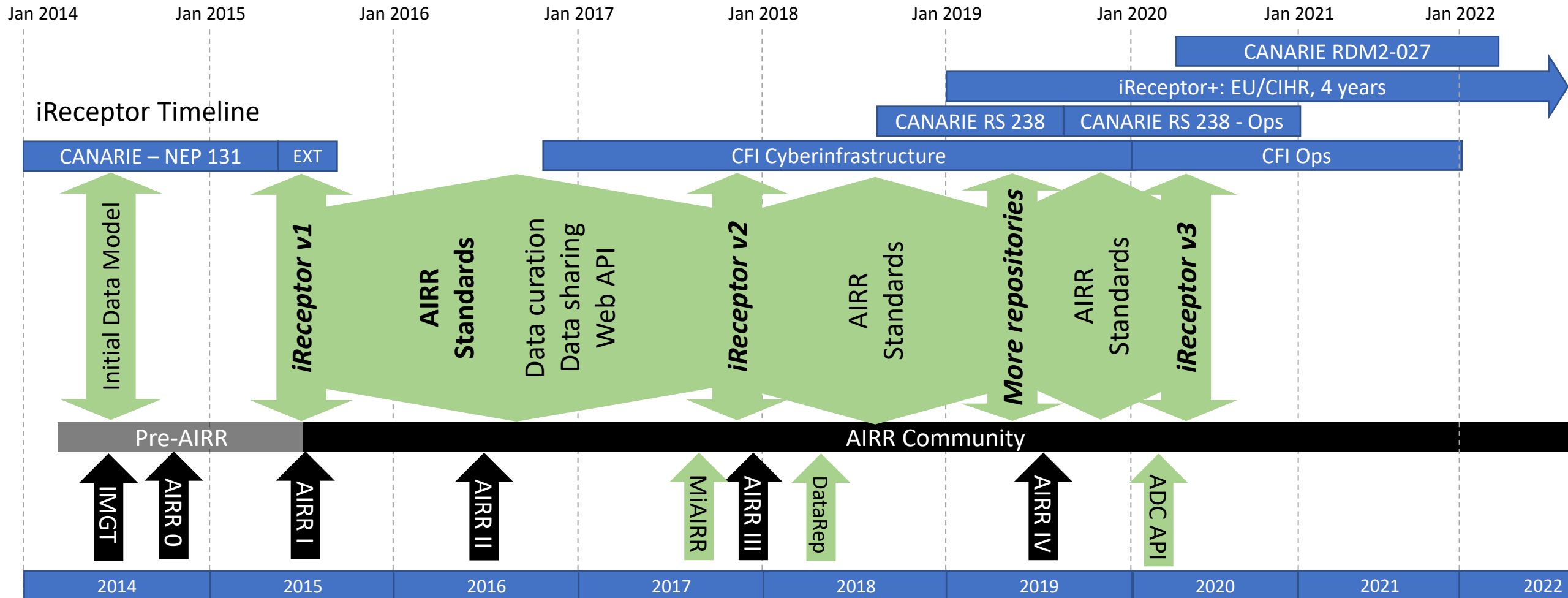
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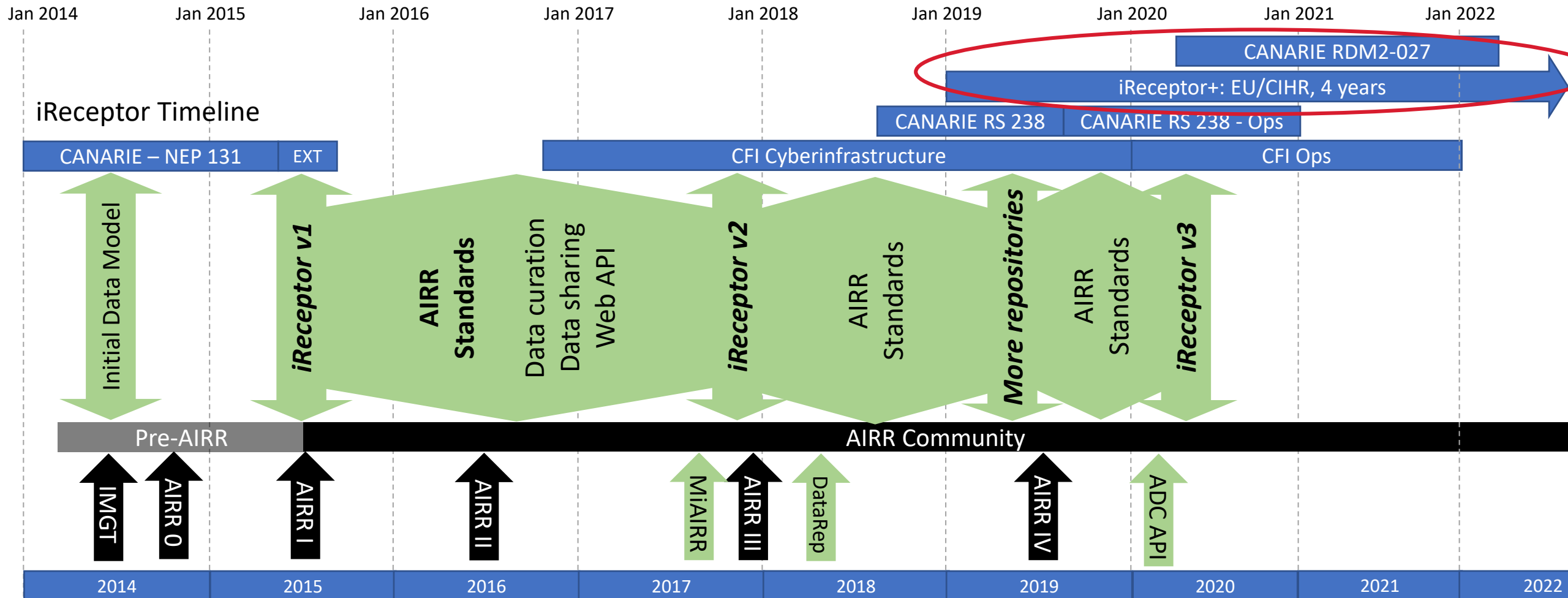
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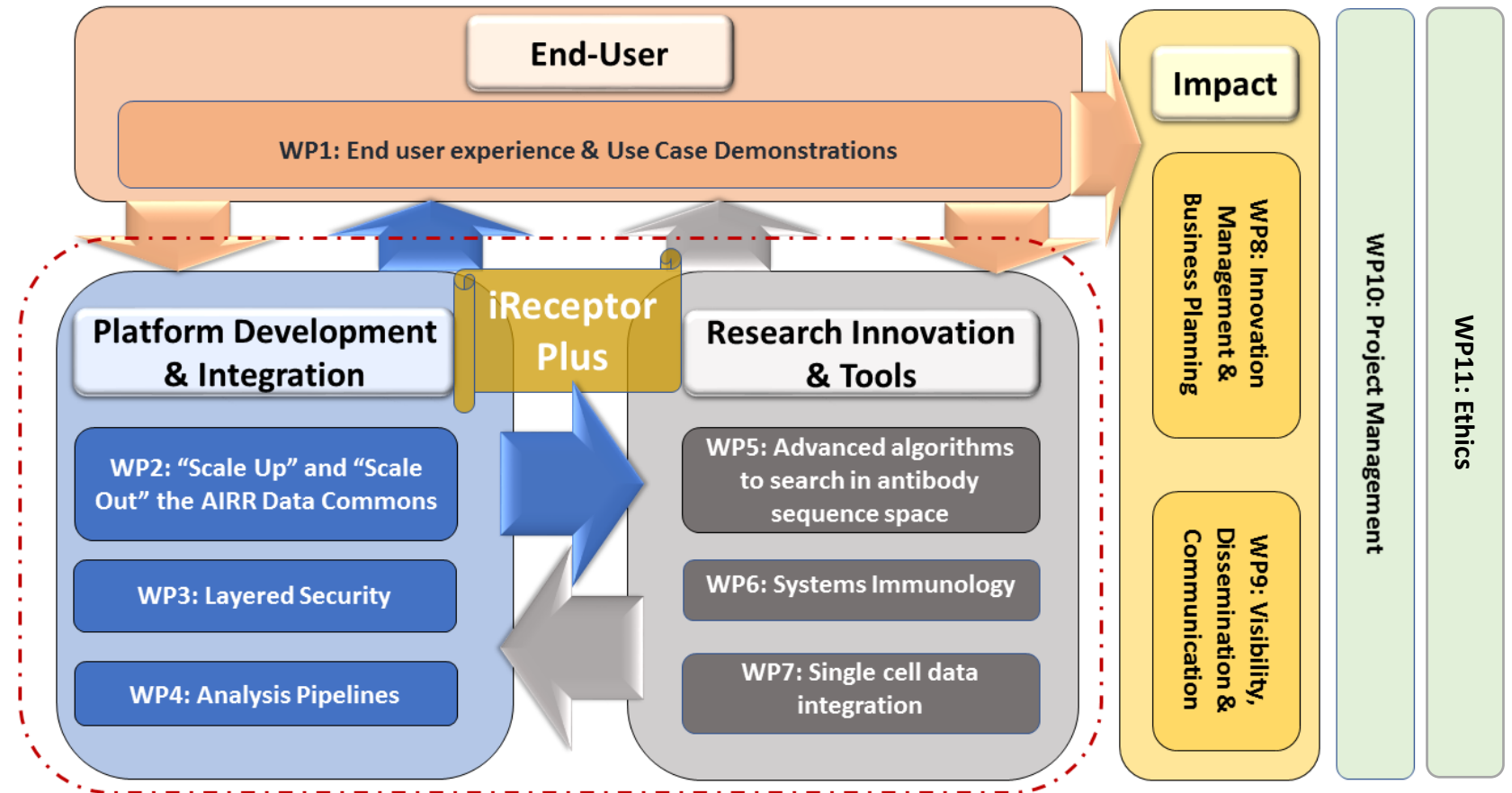
What is iReceptor+

- Joint EU Horizon 2020/CIHR project (4 years, started Jan 2019)
 - Significant expansion of iReceptor scope and scale!
 - € 8.4M over four years, € 7.85M from EC, \$800K CAD from CIHR
 - 20 partners from 9 countries
 - Research (life sciences), research (computing science), clinic/hospital, industry



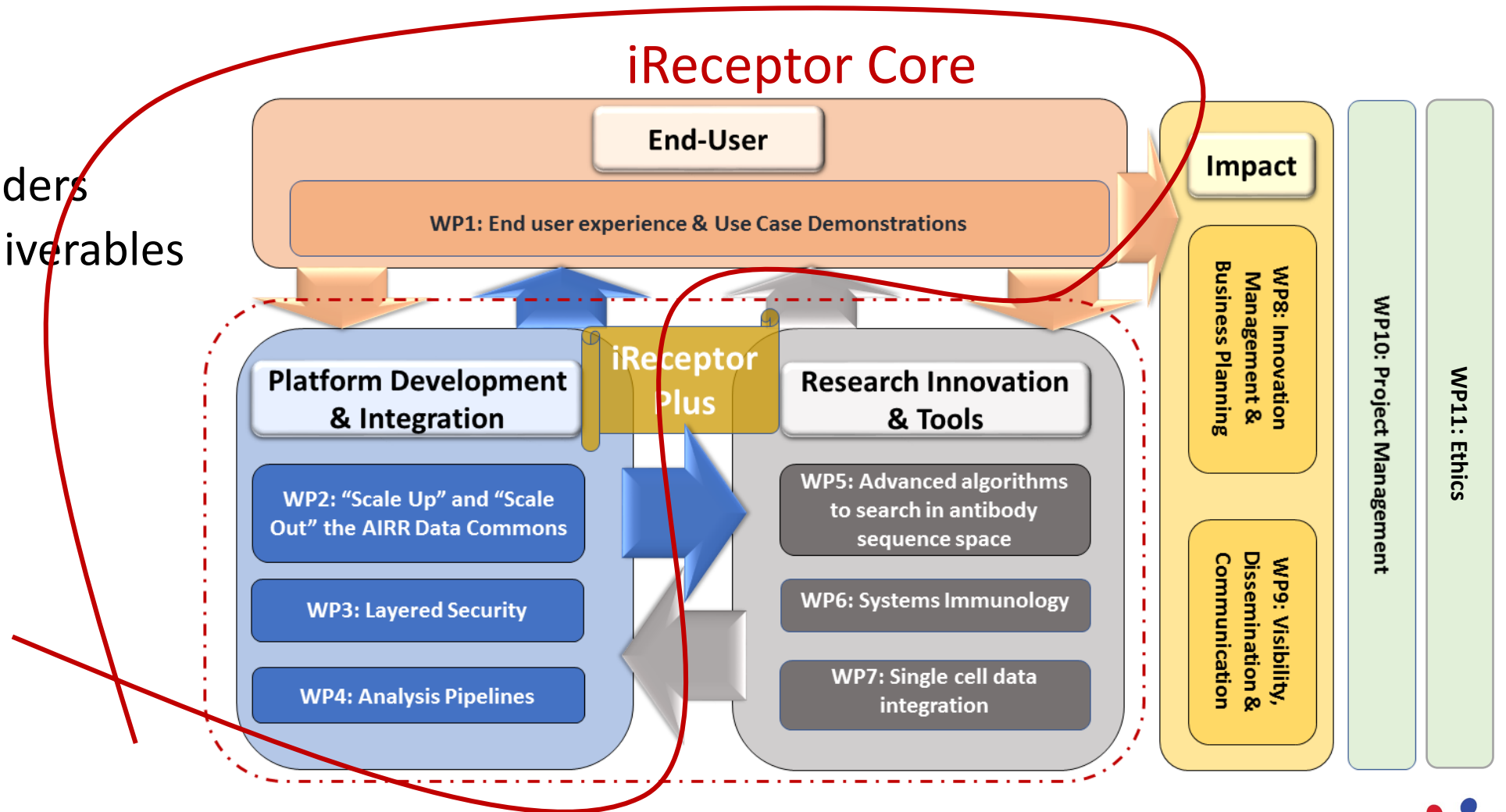
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- WP structure
 - WPs have leaders
 - WPs have deliverables



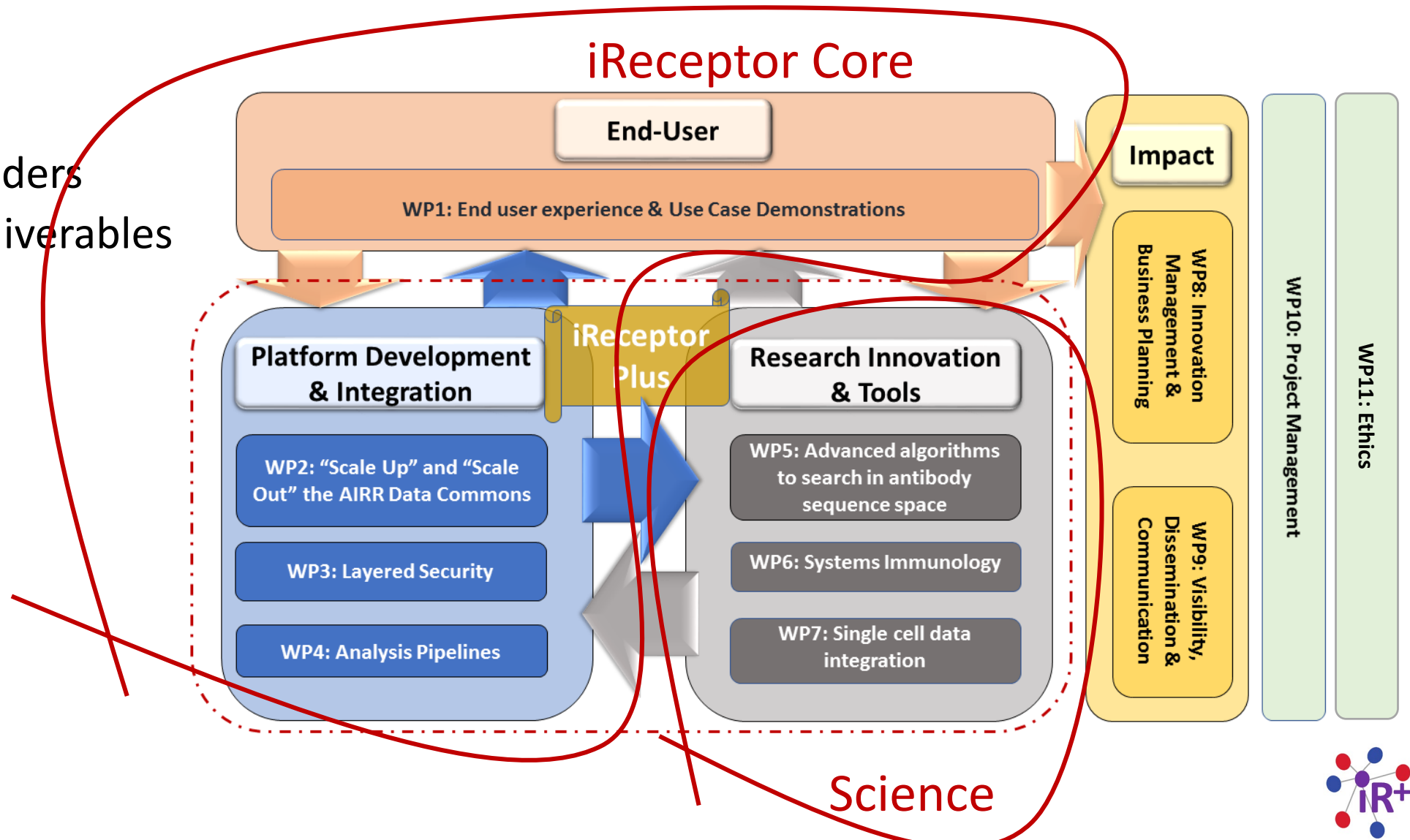
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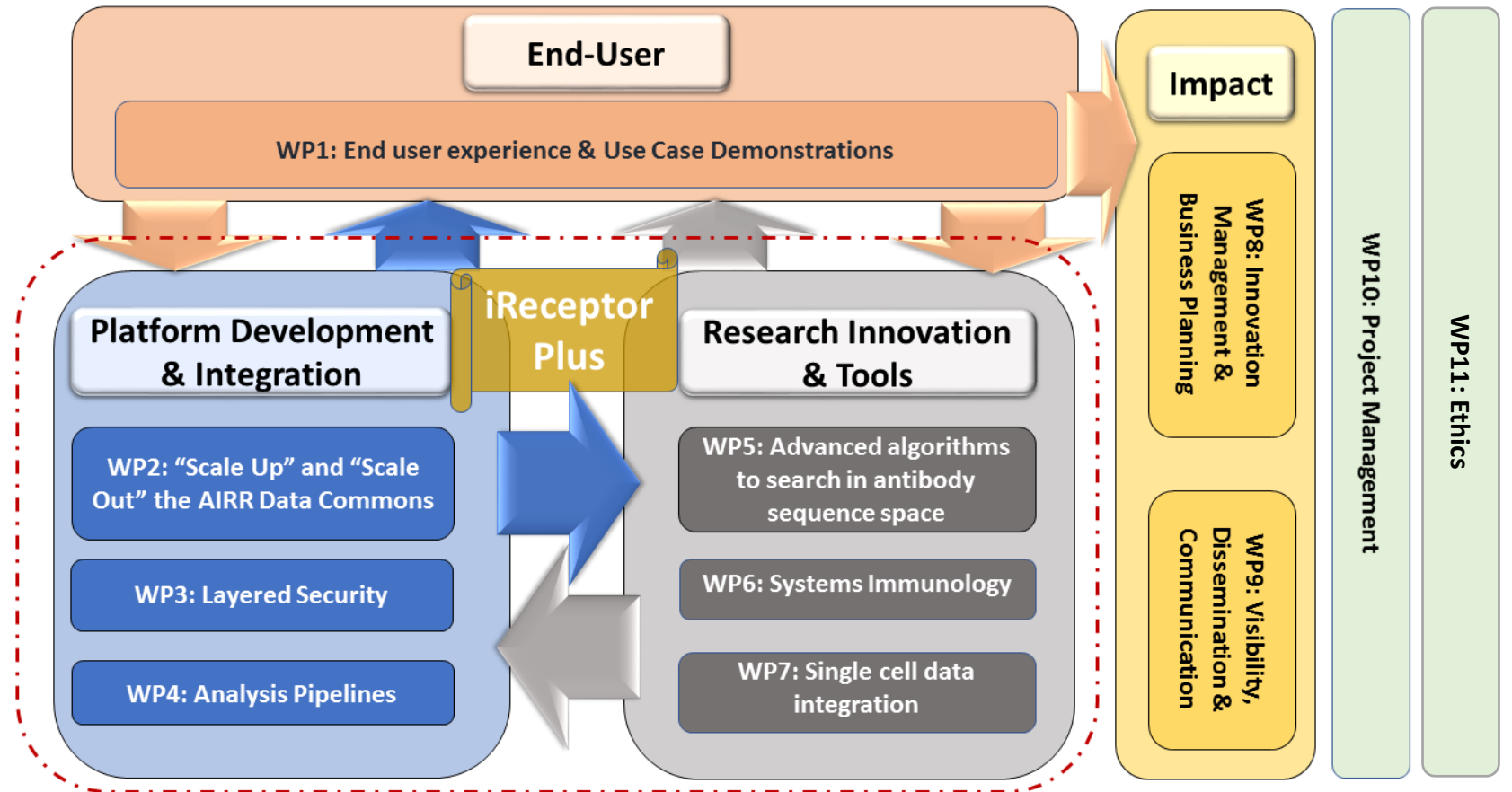
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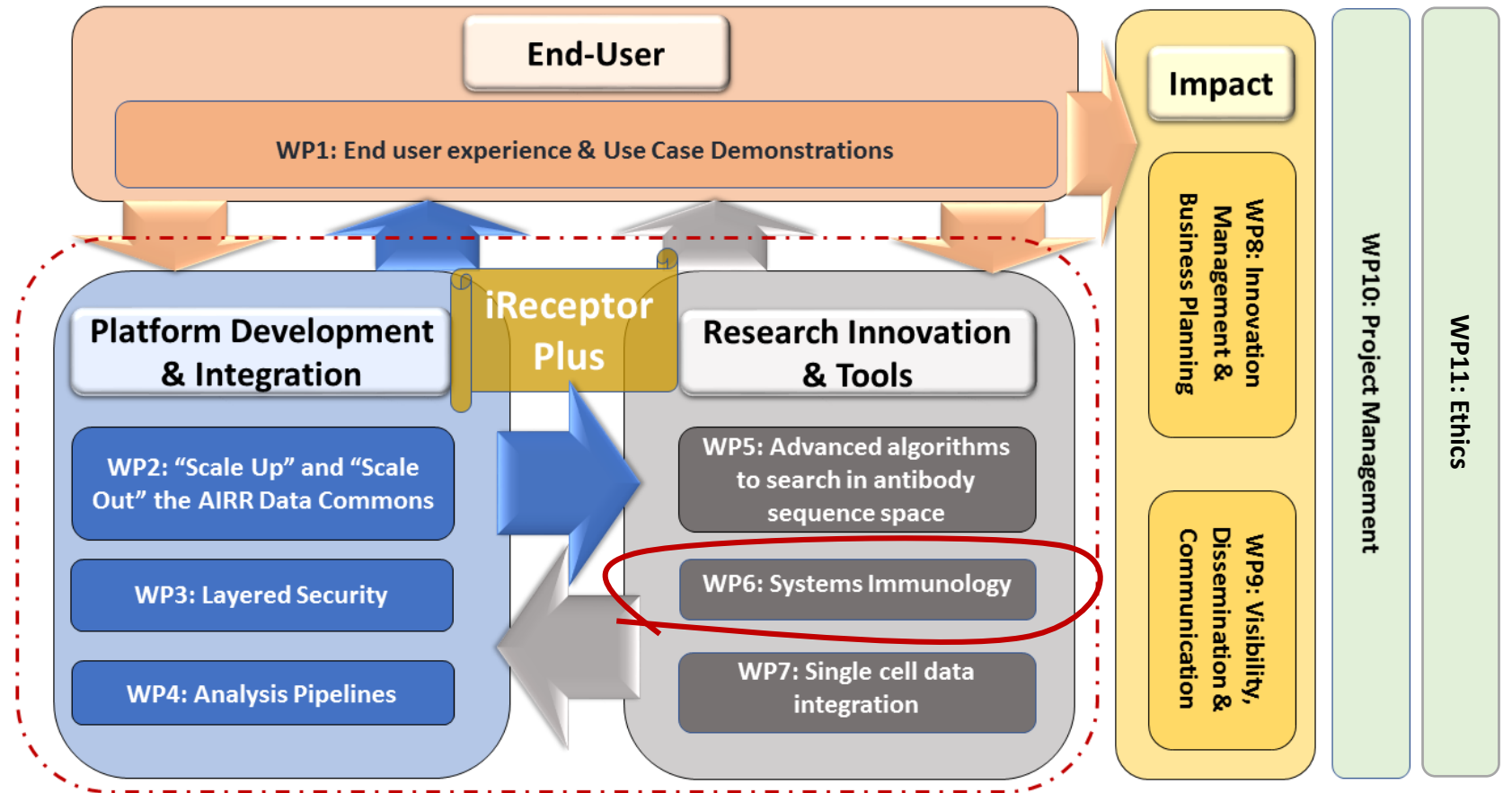
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 - Integrating other FAIR scientific data into the platform
- Systems Immunology
- Single Cell Data
- Ontologies
- Germline



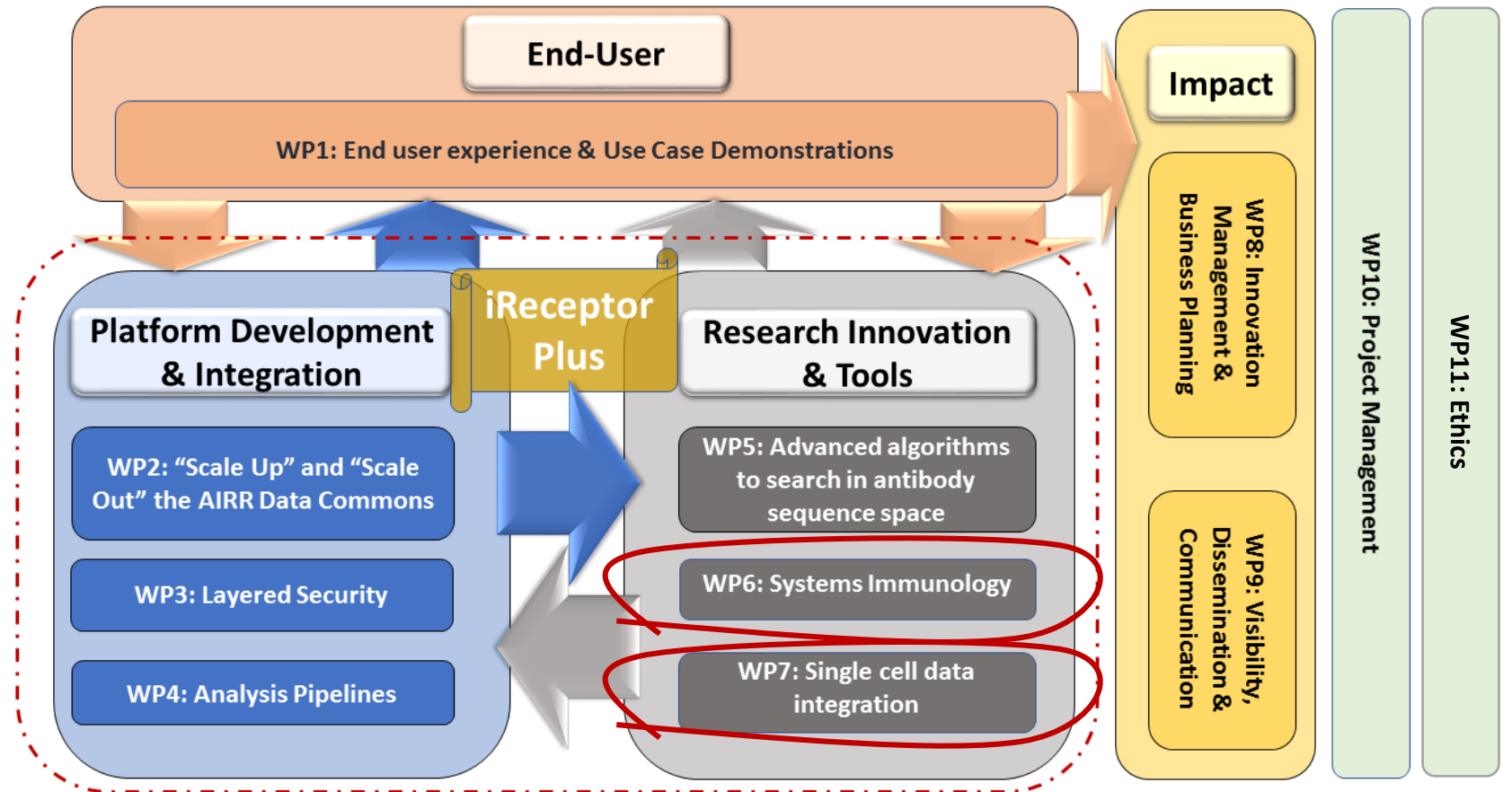
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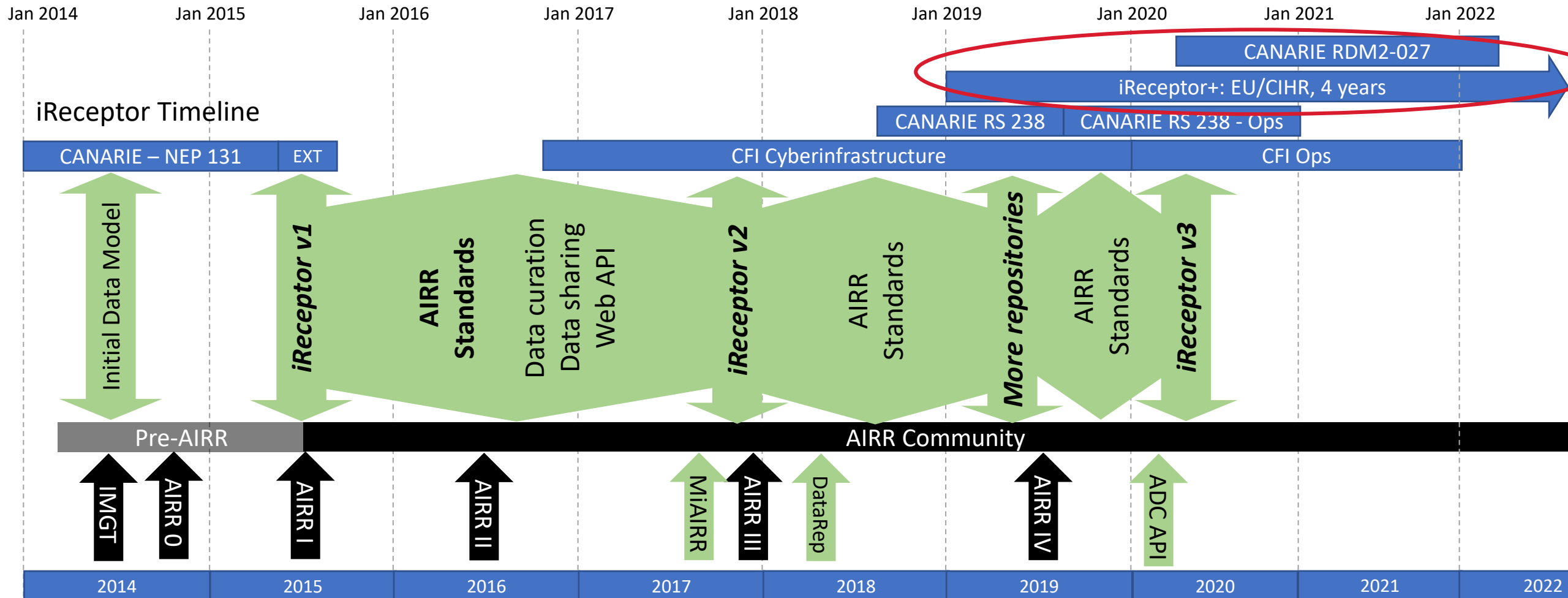


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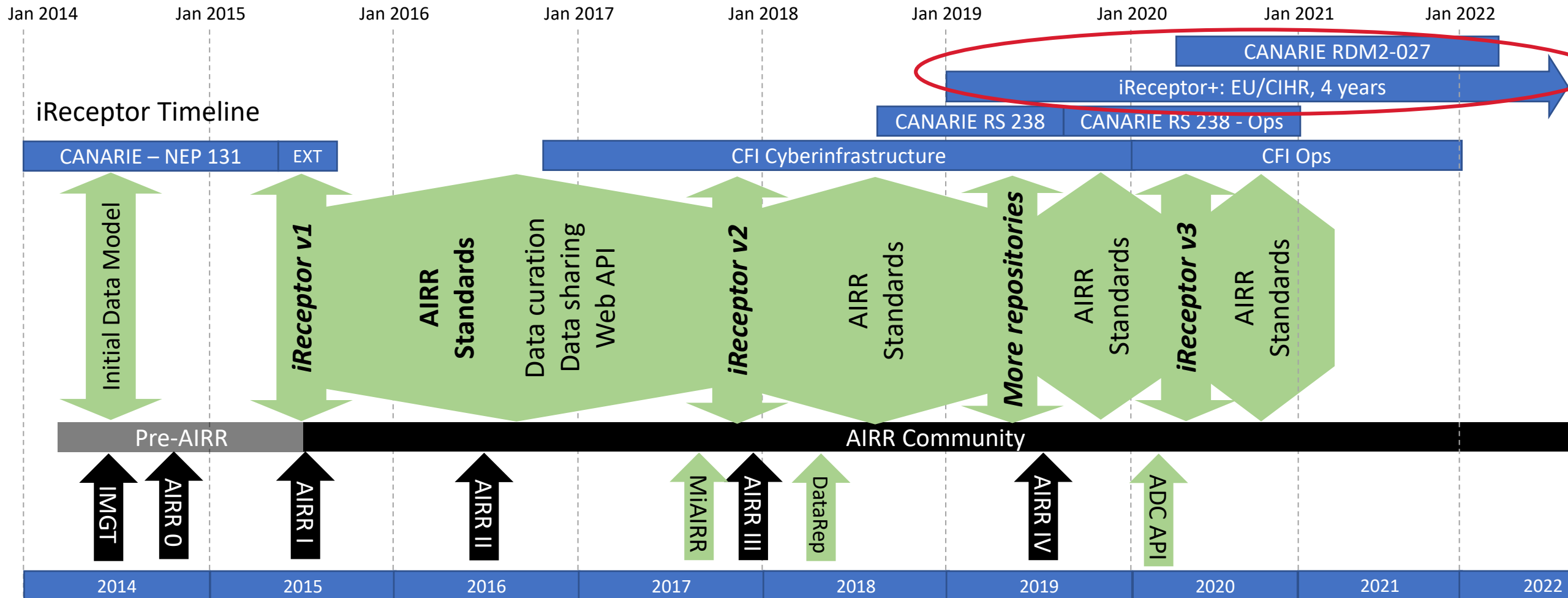
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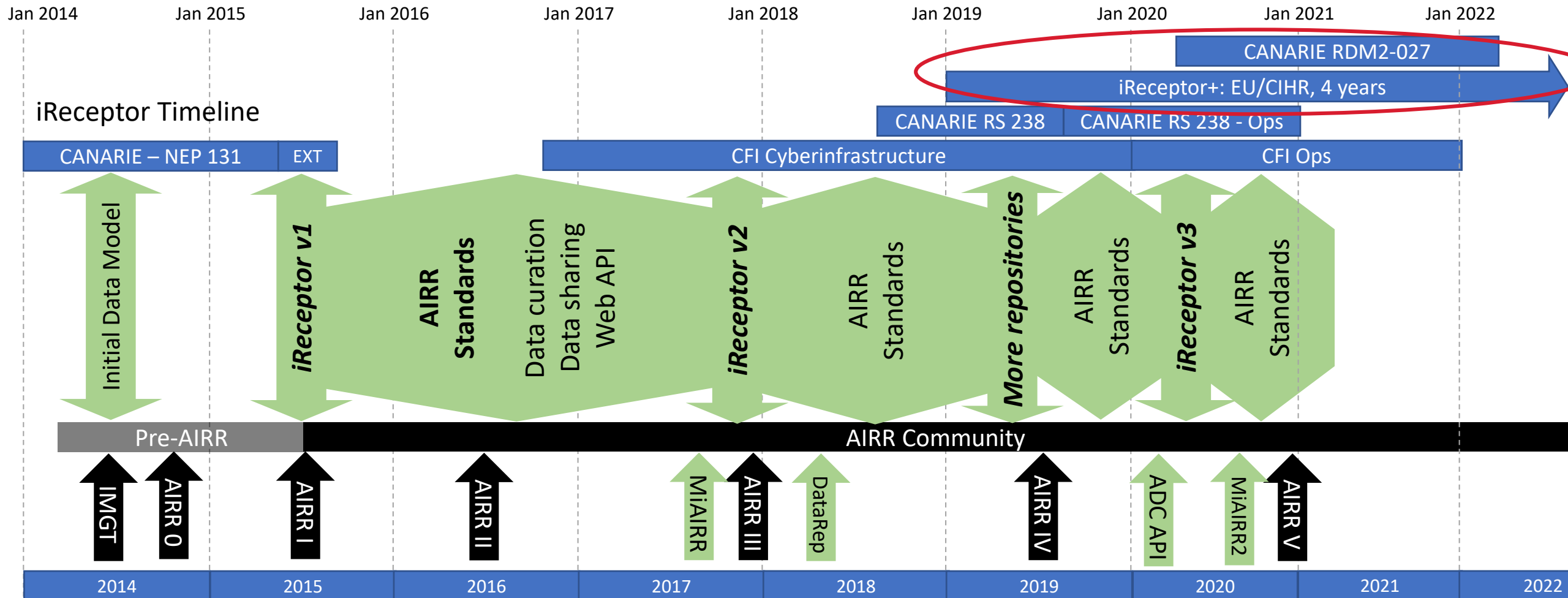
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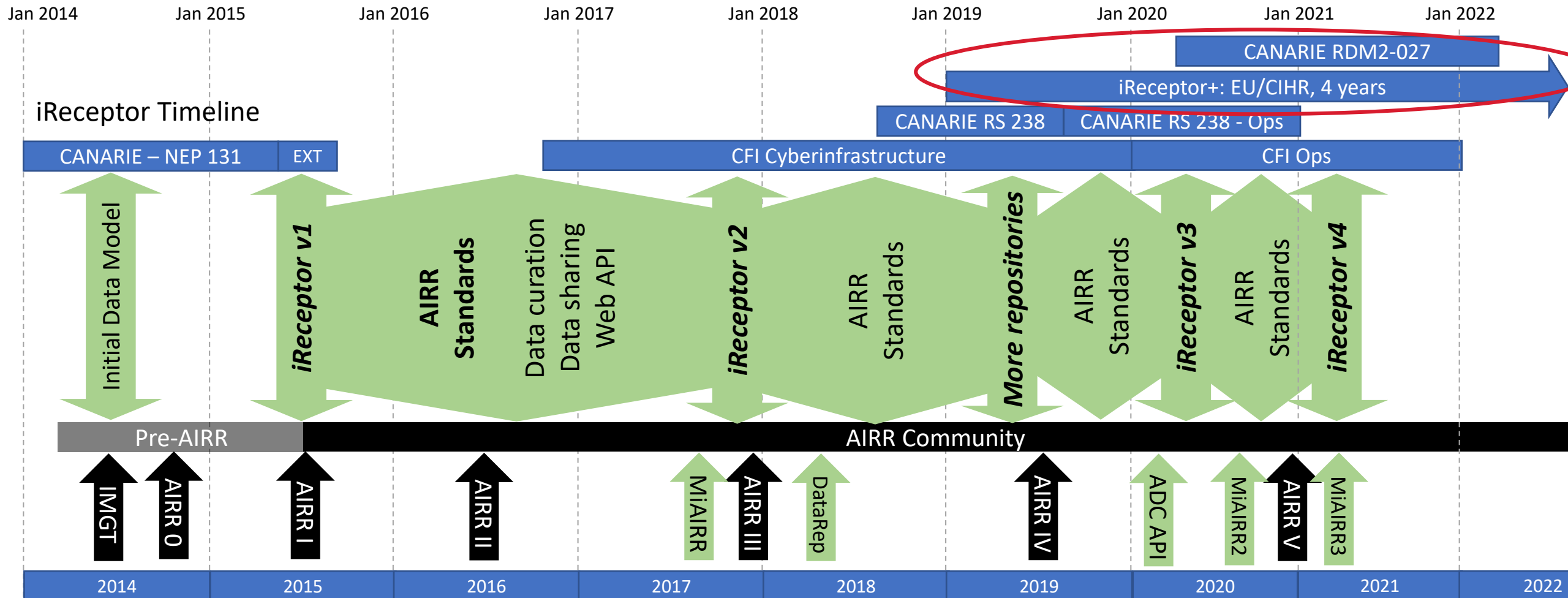
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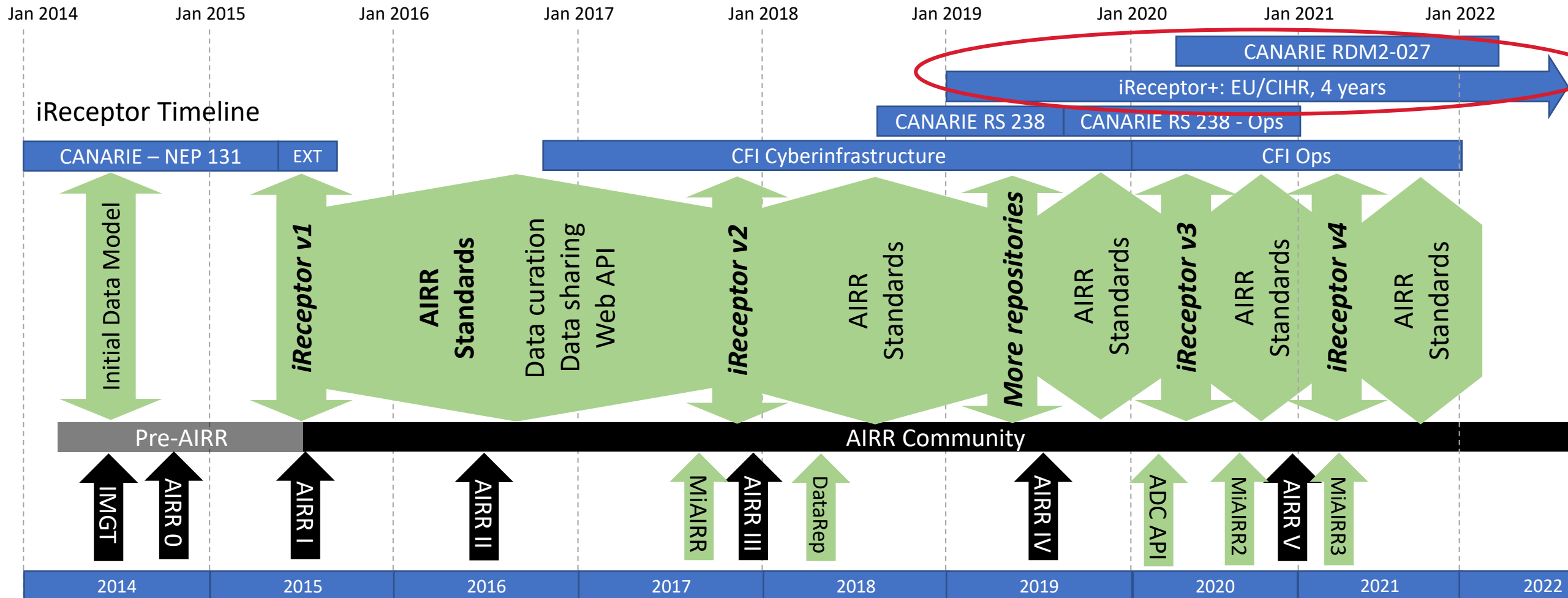
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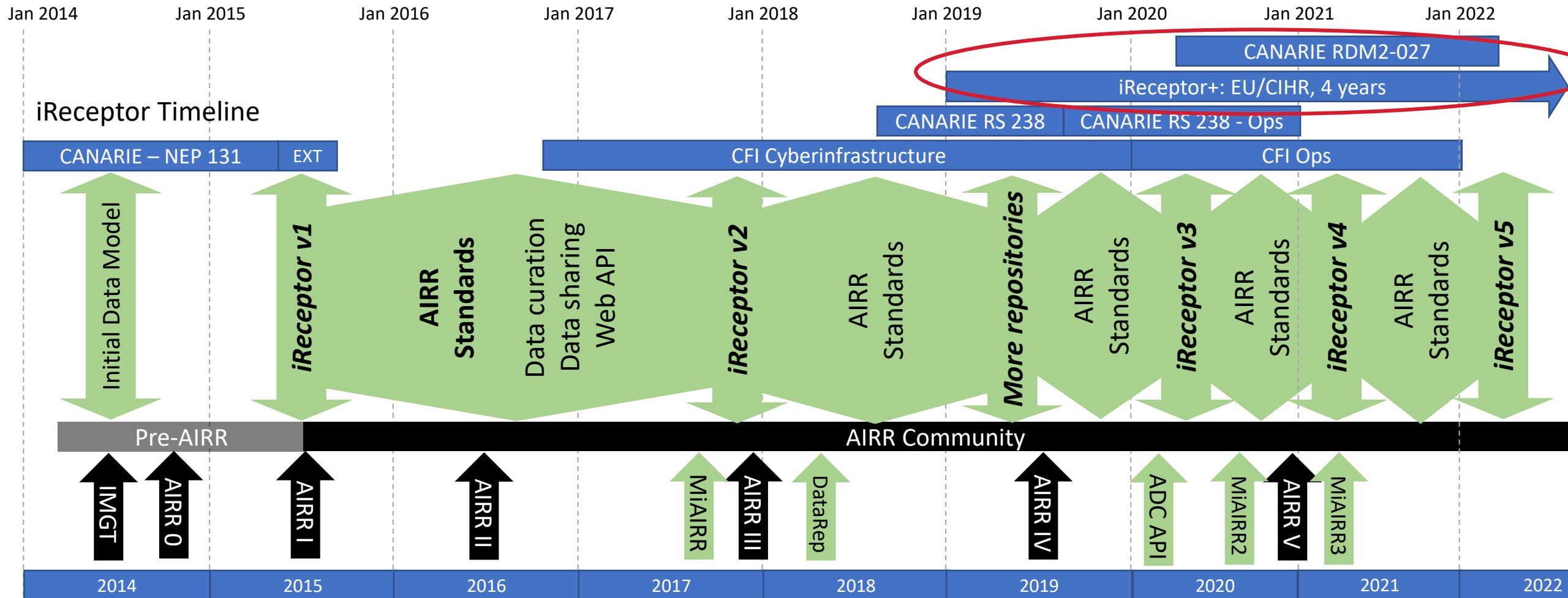
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- Chair Elect: **L. Cowell (UTSW)**
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AIRR Sub-Committees

- Communications: J. Burkert (Dis. Bio), **V. Greiff (Oslo)**
- Inferred Allele: A. Collins (UNSW)
- Meetings: **P. Borghardt, J. Scott (SFU)**

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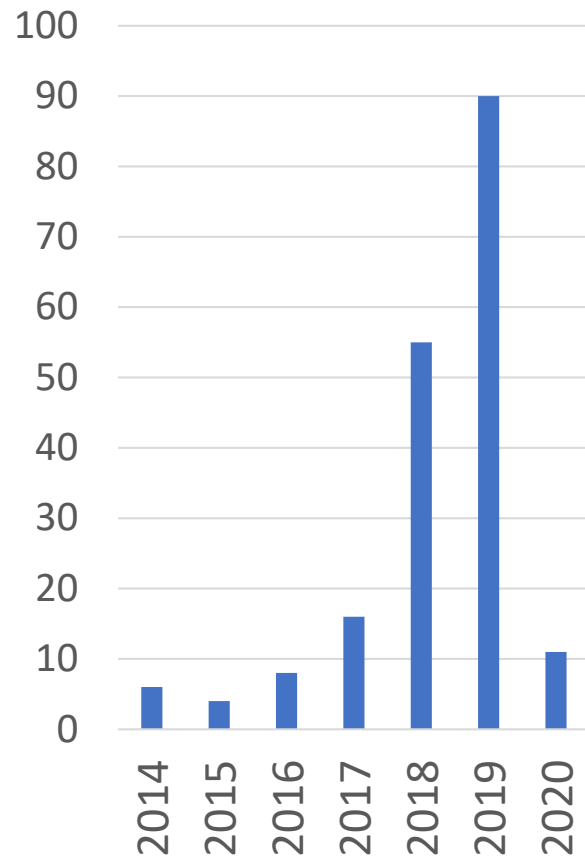
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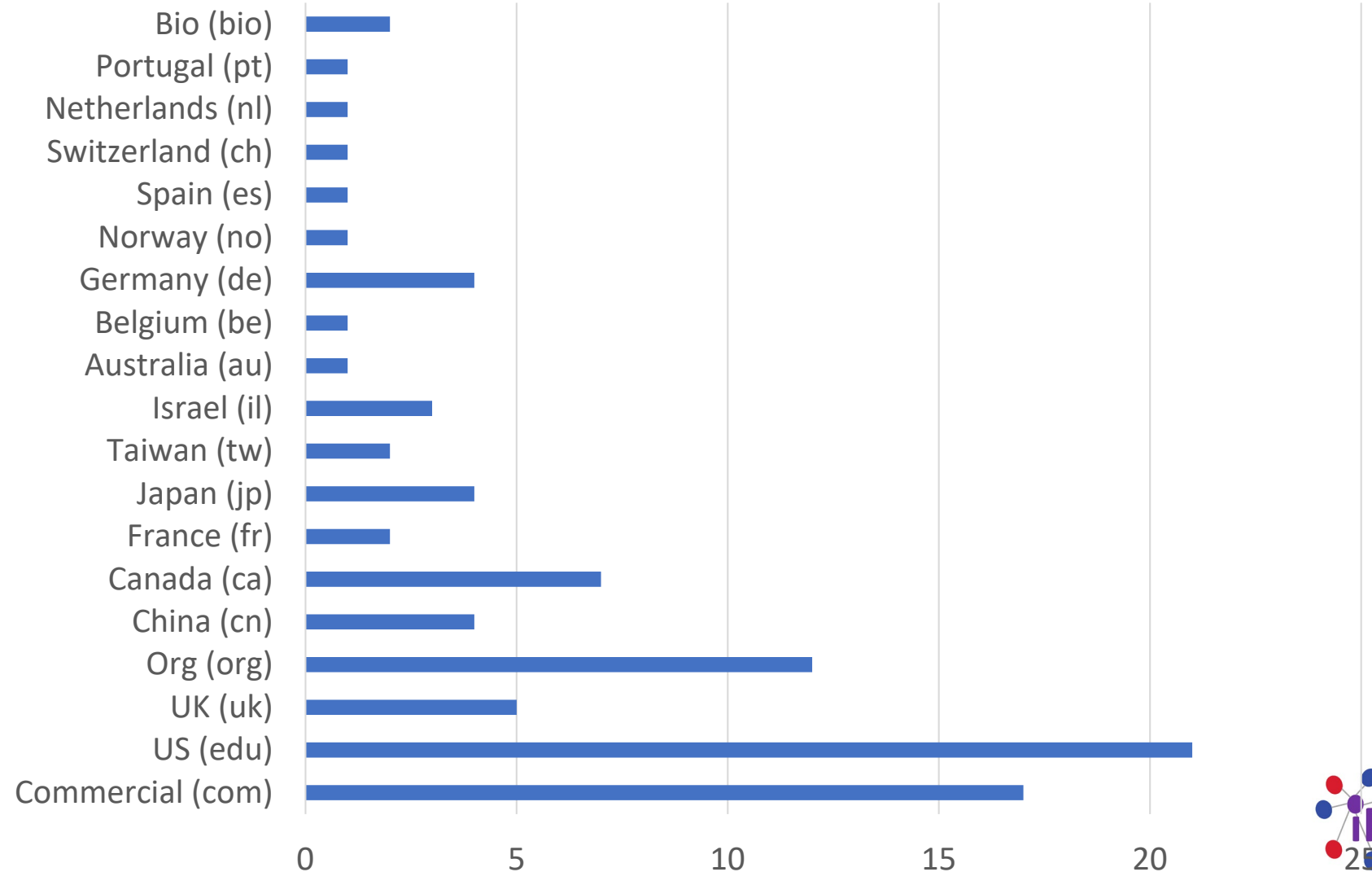


Interactions: iReceptor - an international platform

Users Added by Year



Users Added by Email Domain (2019)



So why are we excited about this?

- Belief that data sharing is critical for personalized immunotherapy
 - Immunotherapy for cancer, autoimmune, and infectious disease
 - E.g. Using the immune response for diagnostics (the future of serology)
- Seeing/anticipating broad, international adoption of the standards
 - Small number of repositories today, but we think this will grow substantially
 - Tool developers are adopting standards
 - Key players are buying (have bought) in



Why is this working in our community?

- In general this is really hard to do – why is it working here?
- We started early with an international community
 - Community recognized that standards were needed
- We have an active AIRR Community setting standards
 - Amazing group of very dedicated people at the core!
 - Many active working groups, meeting bi-weekly or monthly
 - Making AIRR-sea data FAIR
- Broad AIRR Community is buying in



Acknowledgements

- Colleagues in the AIRR Community
- Collaborators on various funded projects below
- Funders
 - Canada Foundation for Innovation
 - CANARIE
 - Canadian Institutes of Health Research
 - BC Knowledge Development Fund
 - EU Horizon 2020 Research and Innovation Programme (Agreement #825821)



Questions?

Useful References

- Websites
 - iReceptor web site: www.ireceptor.org
 - iReceptor Scientific Gateway: gateway.ireceptor.org
 - iReceptor Plus: www.ireceptorplus.org
 - AIRR Community: www.airr-community.org
- GitHub
 - <https://github.com/sfu-ireceptor>
 - <https://github.com/airr-community>
- Publications
 - iReceptor paper: Immunological Reviews – (DOI: 10.1111/imr.12666)
 - AIRR Community paper: Frontiers in Immunology – (DOI: 10.3389/fimmu.2017.01418)
 - AIRR Data Standards paper: Nature Immunology – (DOI: 10.1038/ni.3873)
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