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# Hypercerts: on-chain primitives for impact markets

David A. Dalrymple @davidad

FundingTheCommons

2022-06-24

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**1 What:** The idea of hypercerts

**2** Why: Benefits of a hypercert market

**3 How:** Steps to building one

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What: The idea of hypercerts

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Why "certs" at all? Closing the impact-signal-flow loop

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# Why "certs" at all? Closing the impact-signal-flow loop



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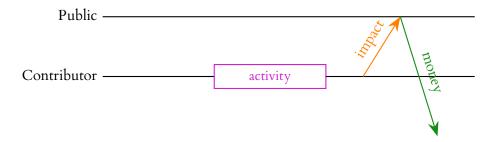
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# Why "certs" at all? Closing the impact-signal-flow loop



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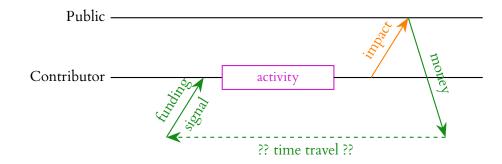
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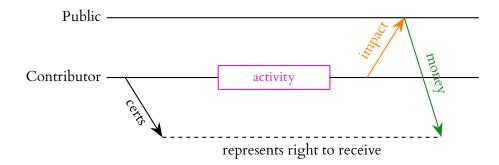
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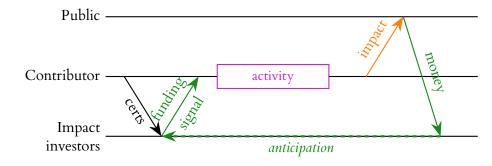
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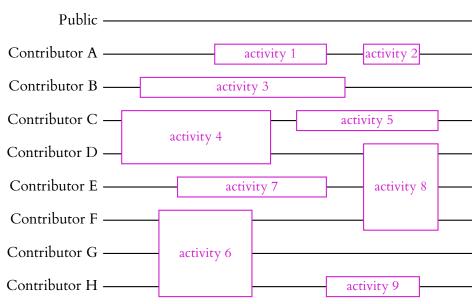
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# Why "certs" aren't quite enough





# Why "certs" aren't quite enough

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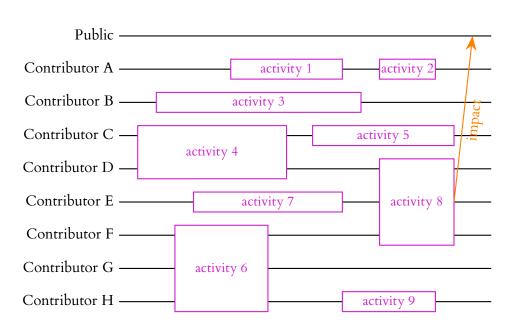
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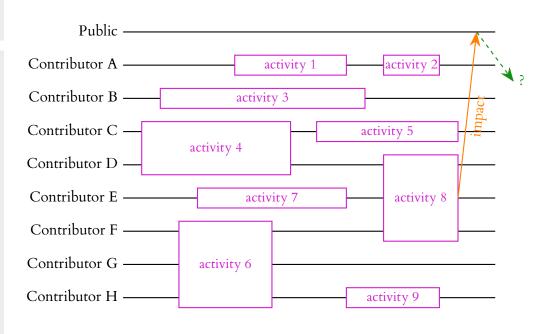
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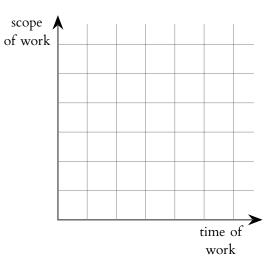
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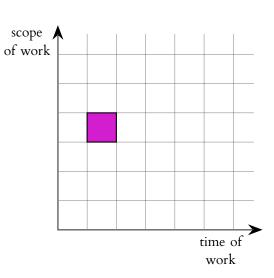
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# Public-good-space



• Hypercert = territorial claim in public-good-space

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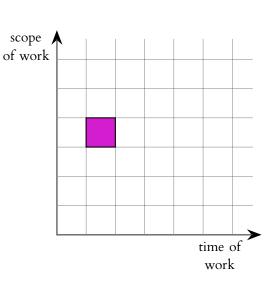
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- Hypercert = territorial claim in public-good-space
- Pictured is a 2-dimensional slice of the space, which also has other axes

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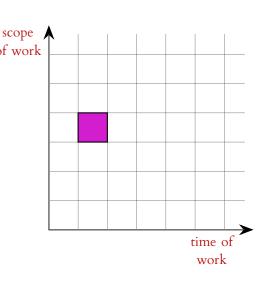
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- Hypercert = territorial claim in public-good-space
- Pictured is a 2-dimensional slice of the space, which also has other axes
- Axes of the full space include:
  - time interval of work
  - scope of work

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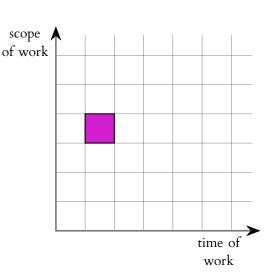
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- Hypercert = territorial claim in public-good-space
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  - time interval of work
  - scope of work
  - time interval of impact

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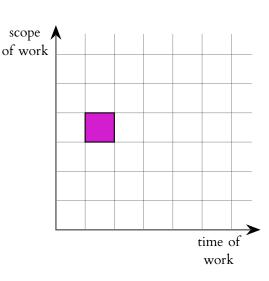
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- Hypercert = territorial claim in public-good-space
- Pictured is a 2-dimensional slice of the space, which also has other axes
- Axes of the full space include:
  - time interval of work
  - scope of work
  - time interval of impact
  - scope of impact

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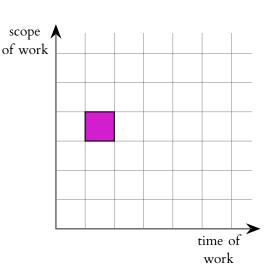
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- Pictured is a 2-dimensional slice of the space, which also has other axes
- Axes of the full space include:
  - time interval of work
  - scope of work
  - time interval of impact
  - scope of impact
  - set of contributors

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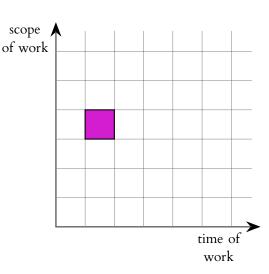
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- Hypercert = territorial claim in public-good-space
- Pictured is a 2-dimensional slice of the space, which also has other axes
- Axes of the full space include:
  - time interval of work
  - scope of work
  - time interval of impact
  - scope of impact
  - set of contributors
  - type(s) of rights (e.g. IP)

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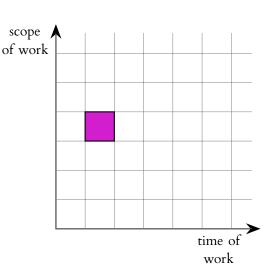
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- Hypercert = territorial claim in public-good-space
- Pictured is a 2-dimensional slice of the space, which also has other axes
- Axes of the full space include:
  - time interval of work
  - scope of work
  - time interval of impact
  - scope of impact
  - set of contributors
  - type(s) of rights (e.g. IP)
- Thus the name *hyper*certs: that square is really a hypercube

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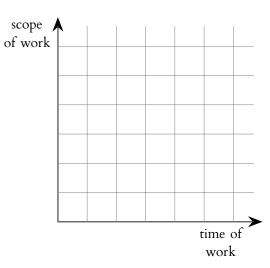
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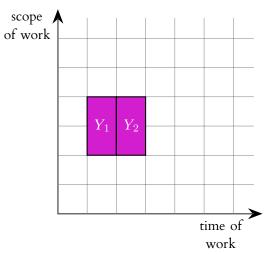
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# Atomic merge-and-split



• Initial state:  $Y_i$  are existing hypercerts

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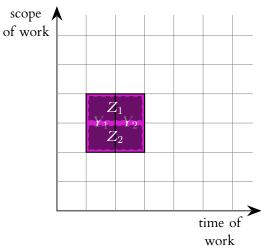
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- Initial state: Y<sub>i</sub> are existing hypercerts
- Owners propose alternative split  $Z_i$  of the same region

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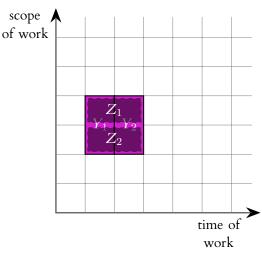
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region
- Required:  $\sum Y_i = \sum Z_i$

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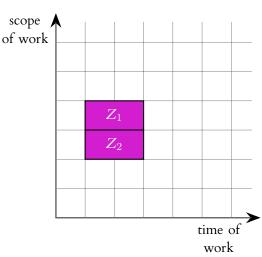
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region
- Required:  $\sum Y_i = \sum Z_i$
- New state:  $Z_i$  exist instead

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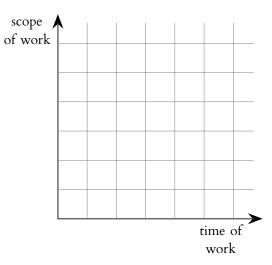
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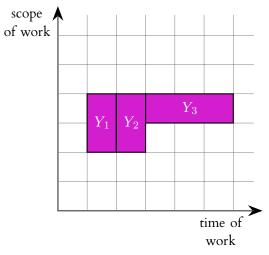
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# Atomic merge-and-split (example 2)



Initial state: Y<sub>i</sub> are existing hypercerts

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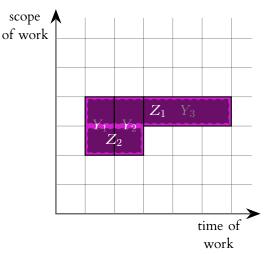
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region
- $\sum Y_i = \sum Z_i$

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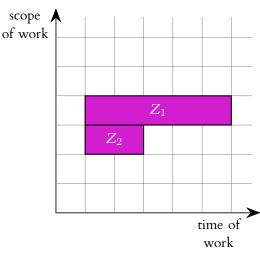
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- Initial state:  $Y_i$  are existing hypercerts
- ullet Owners propose alternative split  $Z_i$ of the same region
- $\sum Y_i = \sum Z_i$
- New state:  $Z_i$  exist instead

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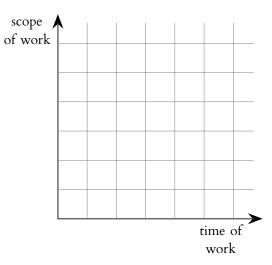
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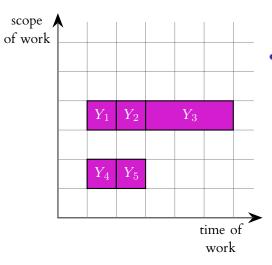
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# Atomic merge-and-split (example 3)



Initial state: Y<sub>i</sub> are existing hypercerts

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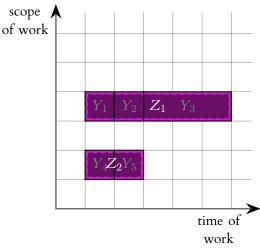
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region (not necessarily contiguous)

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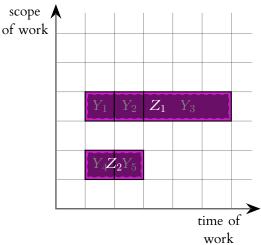
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region (not necessarily contiguous)
- $\sum Y_i = \sum Z_i$

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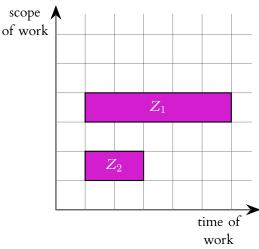
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- Initial state:  $Y_i$  are existing hypercerts
- Owners propose alternative split  $Z_i$ of the same region (not necessarily contiguous)
- $\sum Y_i = \sum Z_i$
- New state:  $Z_i$  exist instead

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# Section 2

Why: Benefits of a hypercert system vs. impact certs

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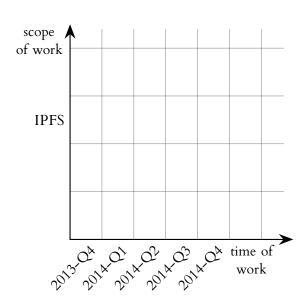
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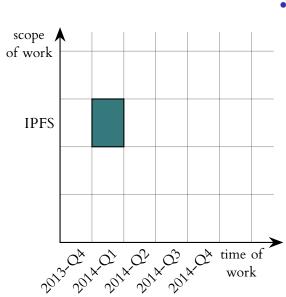
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# A (fictional) user story



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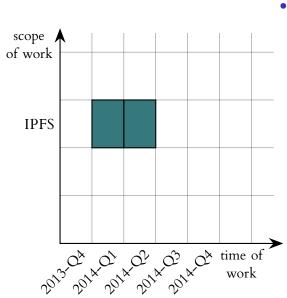
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# A (fictional) user story



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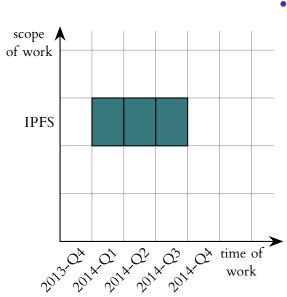
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# A (fictional) user story



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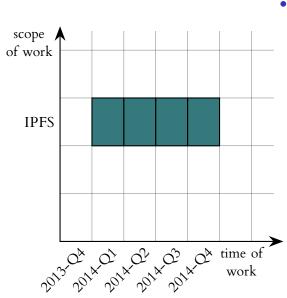
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# A (fictional) user story



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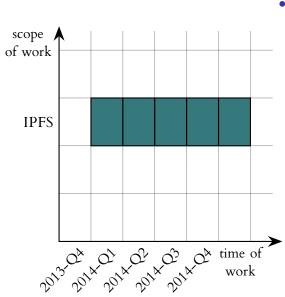
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# A (fictional) user story



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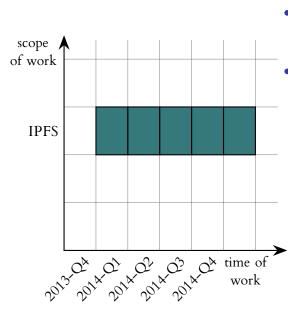
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- Contributor mints a cert every quarter, & offers to a funder
- To make a more appealing NFT, the funder merges them

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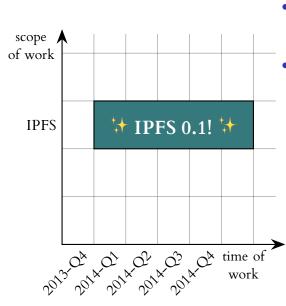
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- Contributor mints a cert every quarter, & offers to a funder
- To make a more appealing NFT, the funder merges them

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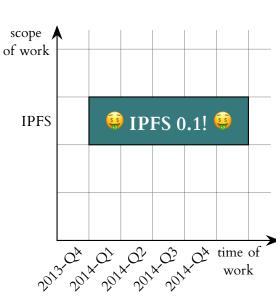
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Thanks



- Contributor mints a cert every quarter, & offers to a funder
- To make a more appealing NFT, the funder merges them
- The "IPFS 0.1!" NFT is successfully auctioned to a trader

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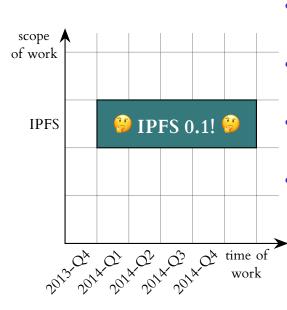
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- Contributor mints a cert every quarter, & offers to a funder
- To make a more appealing NFT, the funder merges them
- The "IPFS 0.1!" NFT is successfully auctioned to a trader
- The trader realizes a higher total value by unbundling conceptual development from implementation

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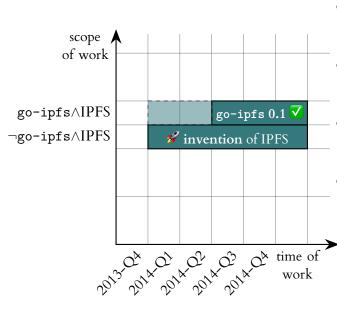
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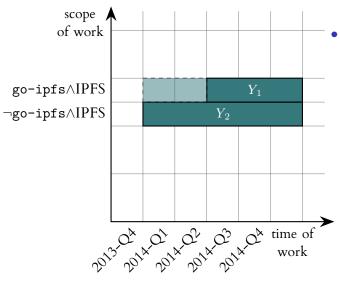
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# A (fictional) user story



Rotating now to a different axis...



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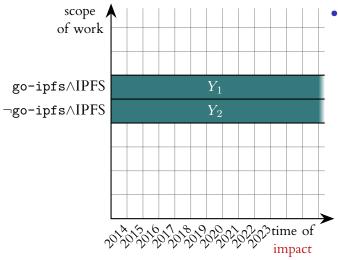
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• Rotating now to a different axis, time of impact (instead of time of work)...



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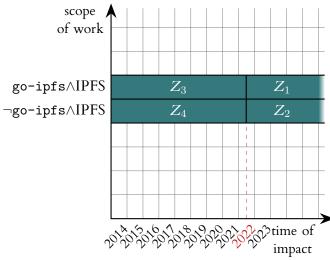
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- Rotating now to a different axis, time of impact (instead of time of work)...
- Assessing past impact is very different from assessing future impact, so whenever assessment happens, it may often be useful to split along this axis

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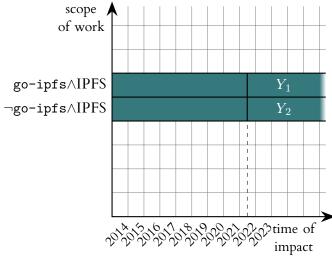
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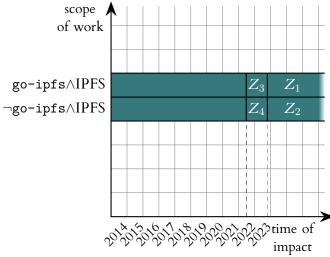
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# Making impact assessments better-defined

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If you were hired to verify an impact NFT, some of your first questions would probably be:

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 Are we talking about impact that's already happened, or future impact that we're trying to predict, or both? If both, can we maybe split those up? @davidad

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Hypercerts answer most of these questions right away

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Hypercerts answer most of these questions right away, & ease contributor verification

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- Donors want to send money to a project
  - without obtaining any tradeable asset in return ...

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- but with obtaining on-chain bragging rights

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- Donors want to send money to a project
  - without obtaining any tradeable asset in return ...
  - but with obtaining on-chain bragging rights
- In a hypercert market, donors can do this by proposing a transaction which:
  - transfers some ETH to the project team
  - adds the donor to the contributor list for the relevant hypercert(s)
  - allocates the donor 0% of those hypercert(s)

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- This is great for experimentation and interoperability

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# Integrates with other mechanisms

Hypercerts facilitate smooth integration with other mechanisms I'm designing for the provision of public goods:

- on-chain intellectual property management with open auction-based licensing
- formal R&D roadmapping for causal modeling of impact through a network of activities
- tools for helping contributors collectively allocate attention

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# Section 3

How: Steps to building a hypercert market

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# Background on ERC1155

 ERC1155 is an interface specification for EVM smart contracts which are mini-ledgers that track ownership of various types of non-fungible and/or semi-fungible tokens.

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    - This means our contract can track extra structured data about each token\_id, namely its corresponding region of public-good-space.

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     Token types don't *have* to just be URIs: The uri(uint256 token\_id)
  - method is an optional extension to ERC1155, and it can be programmatic.
    - This means our contract can track extra structured data about each token\_id, namely its corresponding region of public-good-space.
  - ERC1155 doesn't mandate too-strict invariants: The standard permits tokens to be transferred, minted, or burned, more-or-less arbitrarily.

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 Hypercerts should support functions like safeTransferFrom and balanceOf, in addition to hypercert-specific operations like atomicMergeAndSplit

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- Hypercerts should support functions like safeTransferFrom and balanceOf, in addition to hypercert-specific operations like atomicMergeAndSplit
- So, the hypercert ledger *should* be ERC1155-compliant, *in addition to* supporting a hypercert-specific interface extension.

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- So, the hypercert ledger *should* be ERC1155-compliant, *in addition to* supporting a hypercert-specific interface extension.
- Data structures and algorithms for Boolean algebra of primitive ranges are not *trivial*, but hardly a grand challenge either.

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- So, the hypercert ledger *should* be ERC1155-compliant, *in addition to* supporting a hypercert-specific interface extension.
- Data structures and algorithms for Boolean algebra of primitive ranges are not *trivial*, but hardly a grand challenge either.
- My current estimate: implementation in the range of 1500–3000 lines of Solidity code
  - for reference, the OpenZeppelin ERC1155 implementation is about 500 lines

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# Platform integrations

 Complying with ERC1155 means easy integration with NFT platforms like OpenSea and Rarible.

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# Platform integrations

- Complying with ERC1155 means easy integration with NFT platforms like OpenSea and Rarible.
- However, easy does not mean trivial.
- There is work to do, especially around how to construct **great images** to represent hypercerts on platforms that mostly trade in visuals.

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# UX/product design for hypercert operations

• We can get started with existing NFT platforms/interfaces via ERC1155, but...

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# UX/product design for hypercert operations

- We can get started with existing NFT platforms/interfaces via ERC1155, but...
- To natively explore the landscape of hypercerts in public-good-space, and to run hypercert-specific operations like atomic-merge-and-splits, the hypercert market would benefit a lot from a hypercert-specific Web platform.

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- This needs thoughtful
  - user-story gathering & brainstorming
    - e.g. thinking about special use-cases for atomic-merge-and-split to make super-easy,

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    - e.g. thinking about special use-cases for atomic-merge-and-split to make super-easy,
  - product management & requirements engineering,
  - UX design,
  - UI development, and
  - backend development (to connect the platform to the Ethereum blockchain).

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- There's also work to do to convince
  - contributors
  - funders
  - innovators in public-good provisioning
  - &c.

that they should use or build upon hypercerts, not just ERC1155 or ERC721.

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- We could call it
  - community management
  - growth hacking
  - business development

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that they should use or build upon hypercerts, not just ERC1155 or ERC721.

- We could call it
  - community management
  - growth hacking
  - business development

... or just marketing.

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Thanks

To sum up, this year I would like some bandwidth for hypercerts from:

- A product manager
- An EVM developer
- A UX designer
- A Web developer
- A backend developer with Ethereum experience
- A community manager

If you might be one (or more) of these people, please reach out to me and Holke Brammer!

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To sum up, this year I would like some bandwidth for hypercerts from:

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# Acknowledgments

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Thanks

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- John Deming
- Eliana Lorch
- Adam Marblestone
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## @davidad

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# Questions?

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FundingTheCommons

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