Universal Composition

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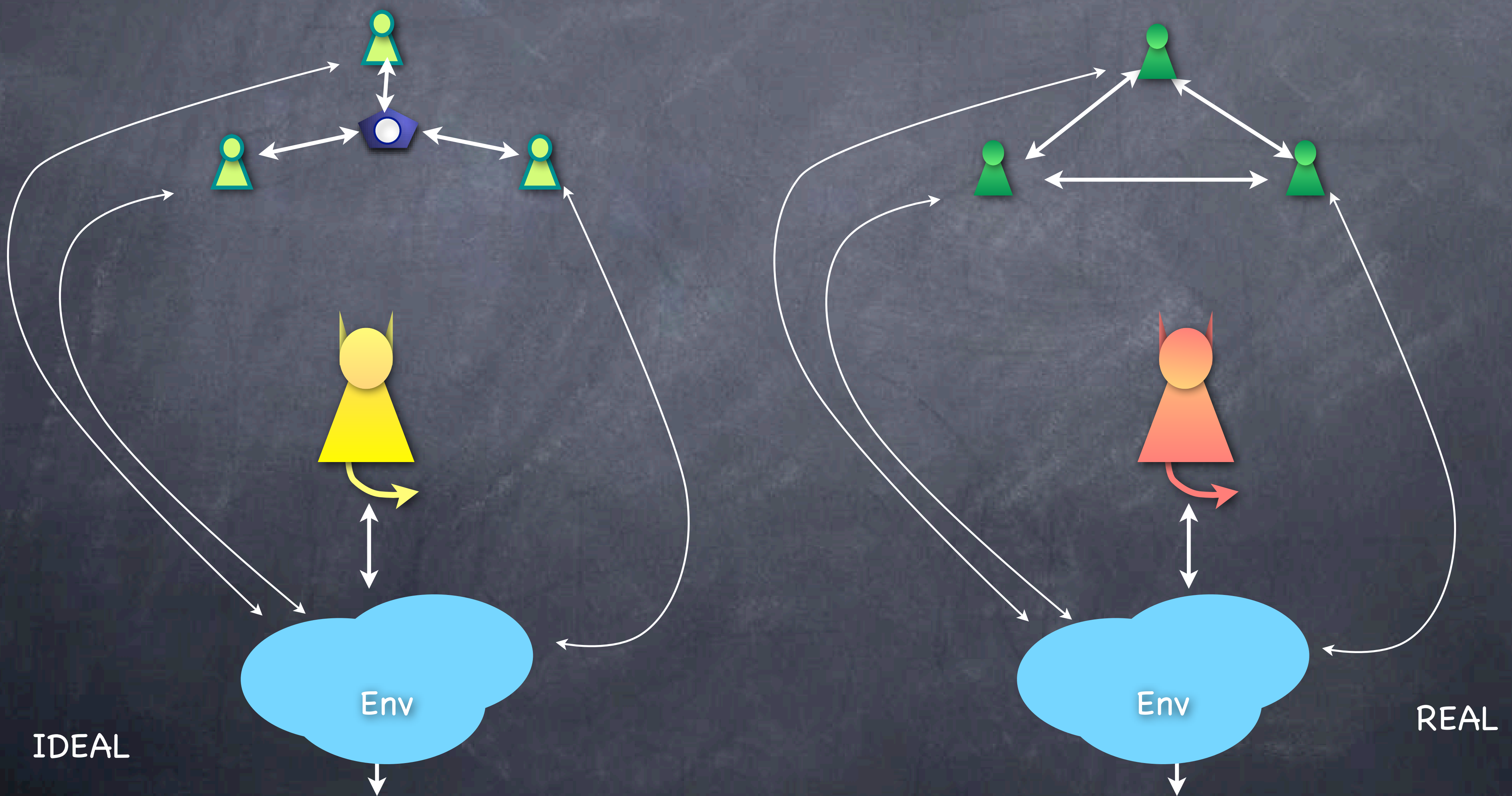
Lecture 17

And the GMW-Paradigm for MPC Protocols

Security

REAL (with protocol) is as secure as IDEAL (with functionality) if:



RECALL

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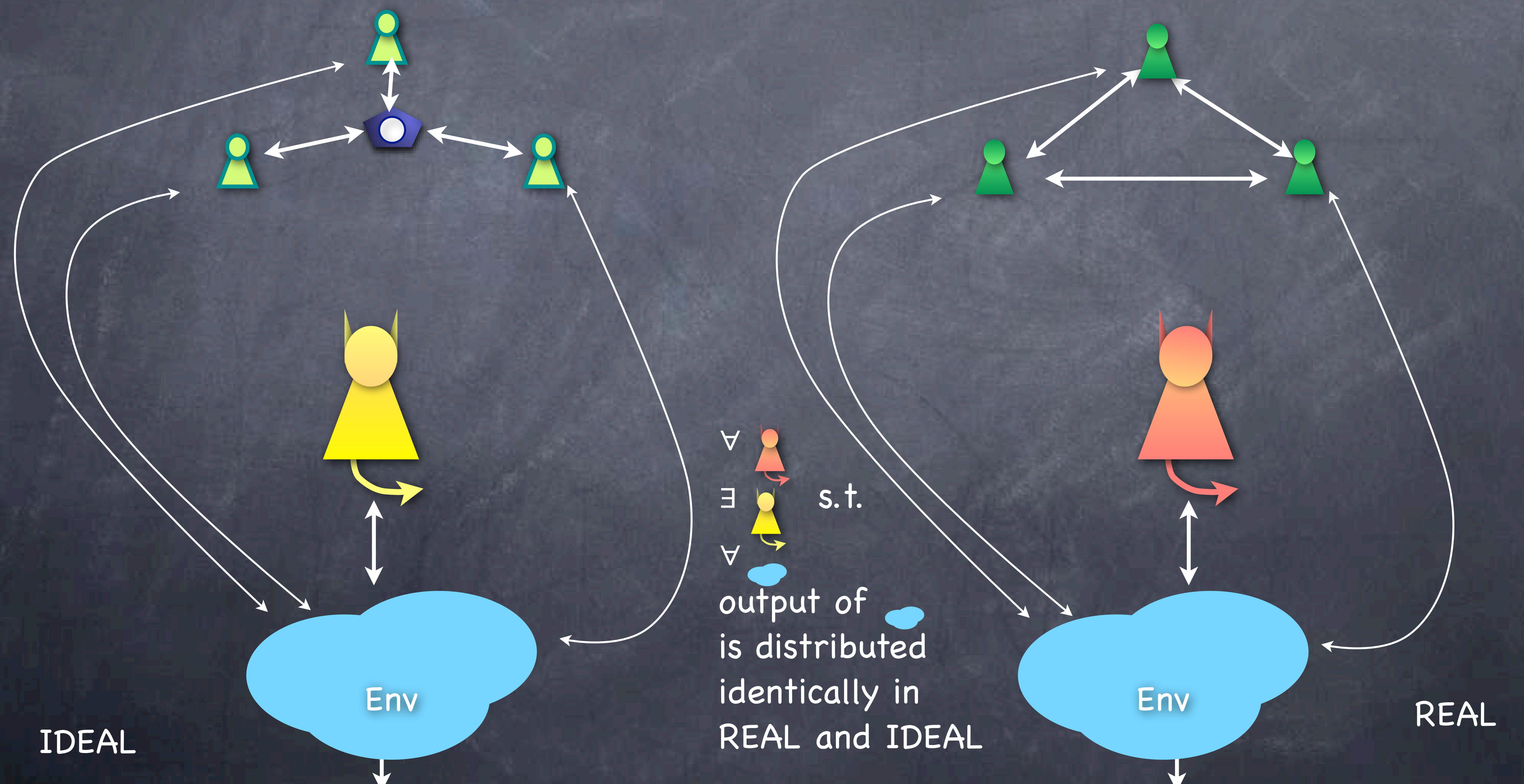
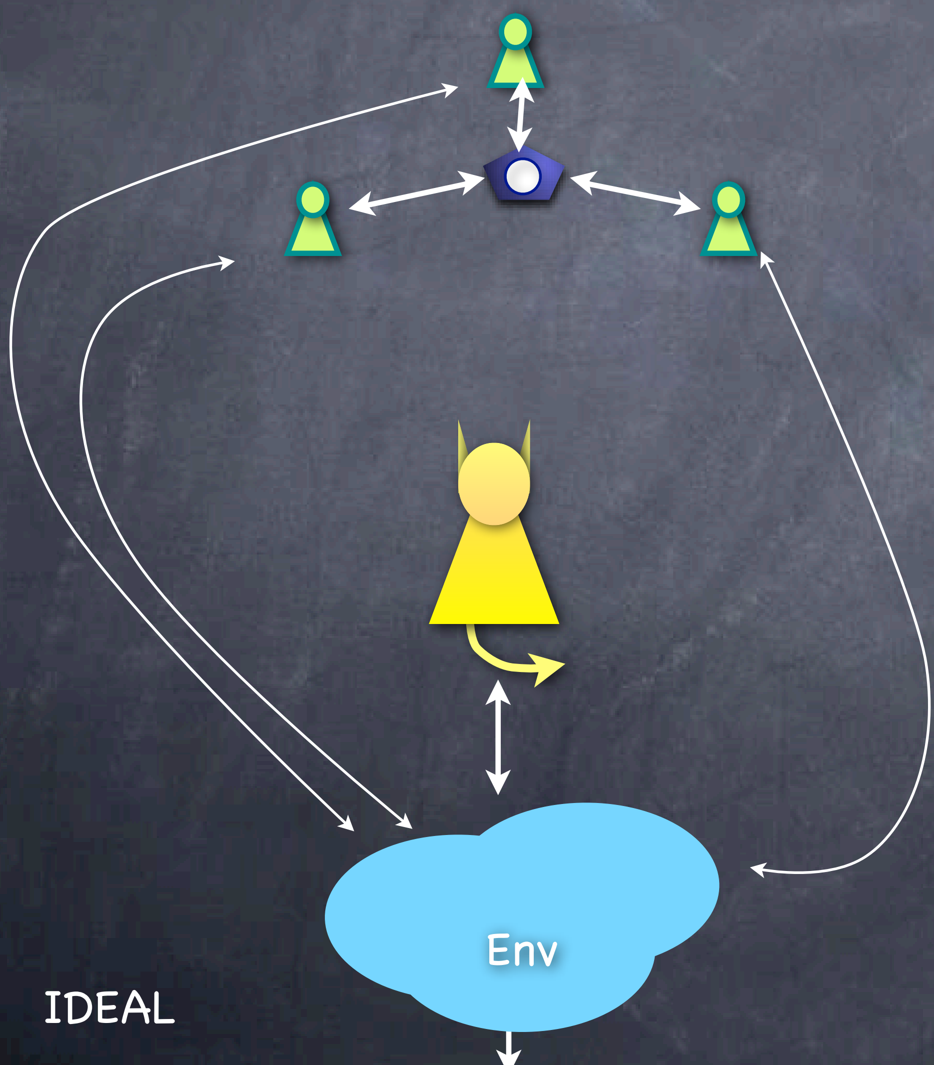
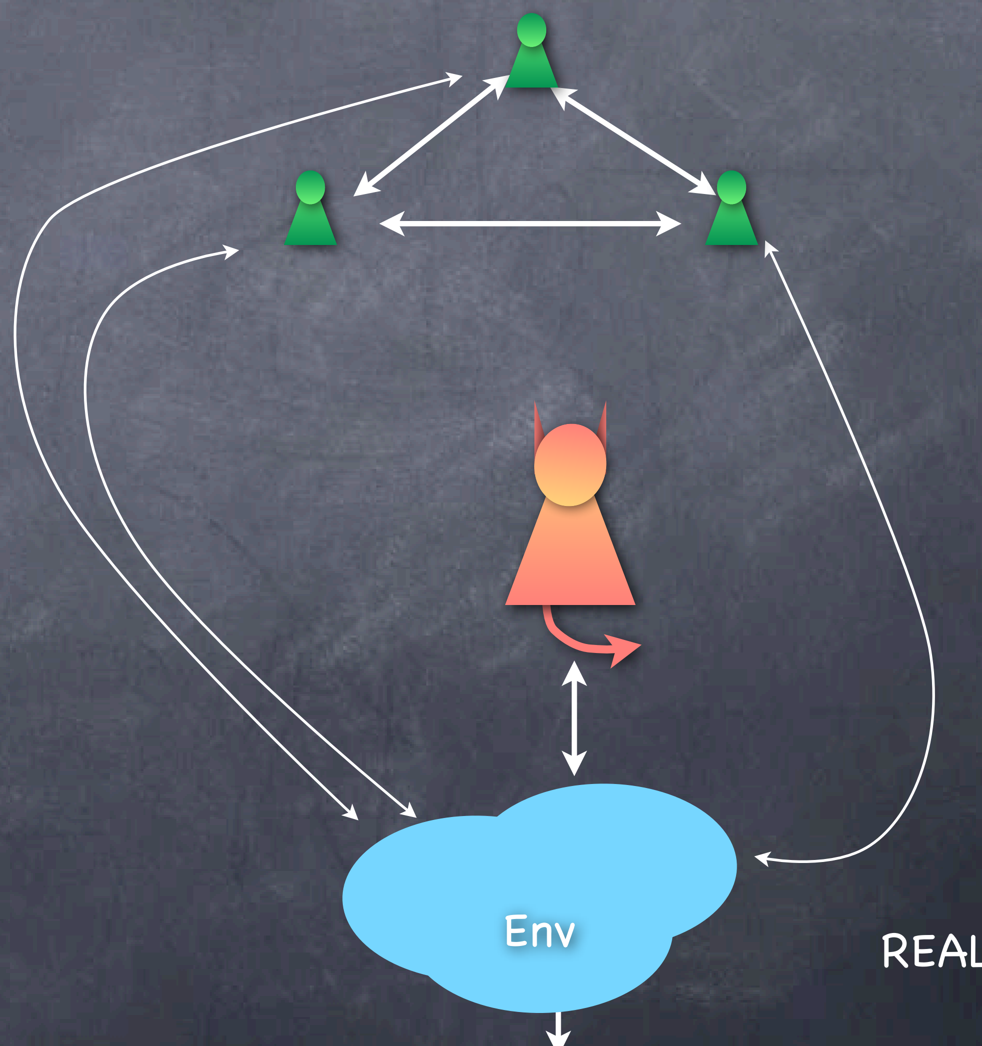


Security of Composed Systems

- Extend to allow a "composed system" with multiple functionalities





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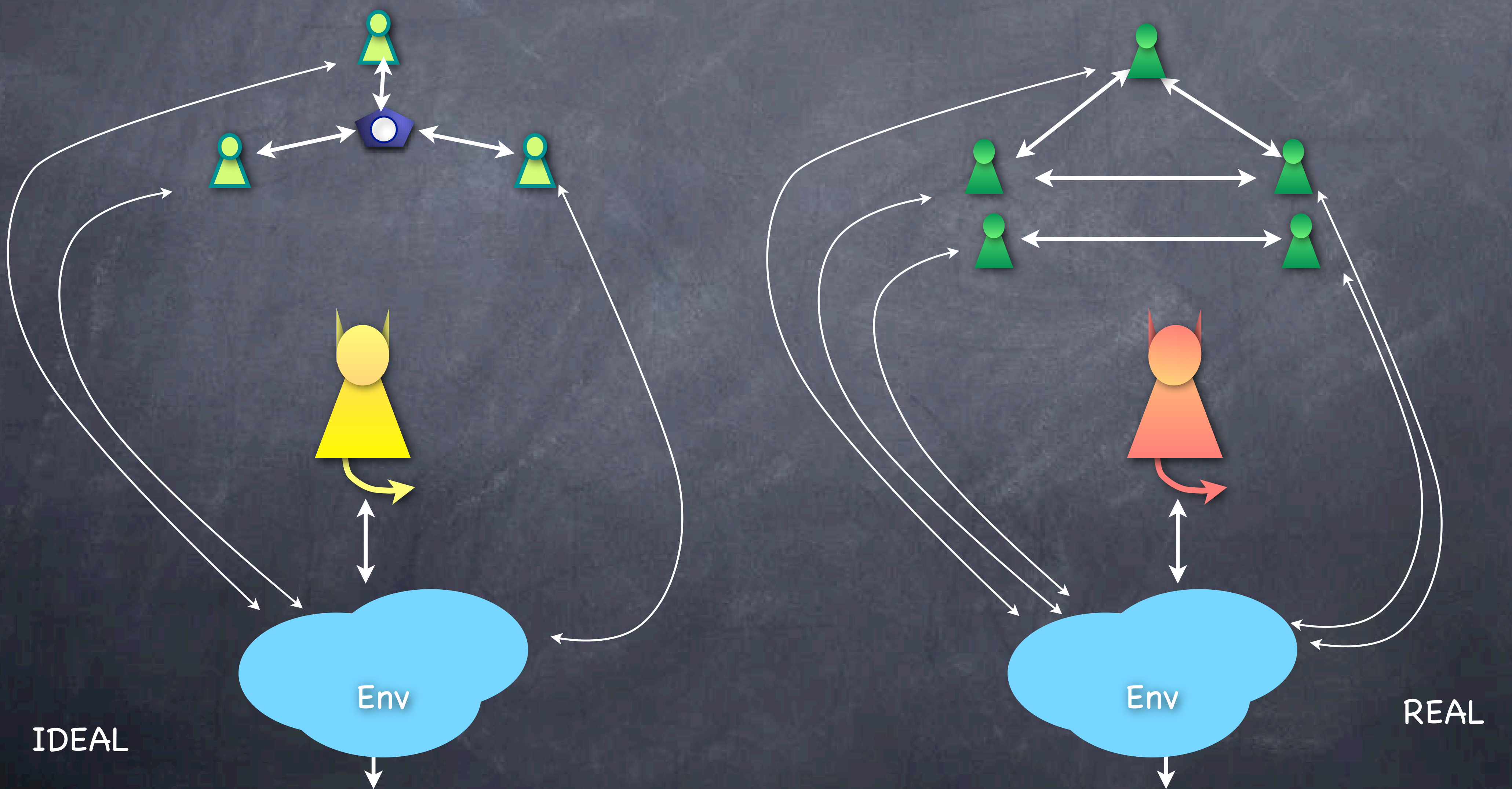

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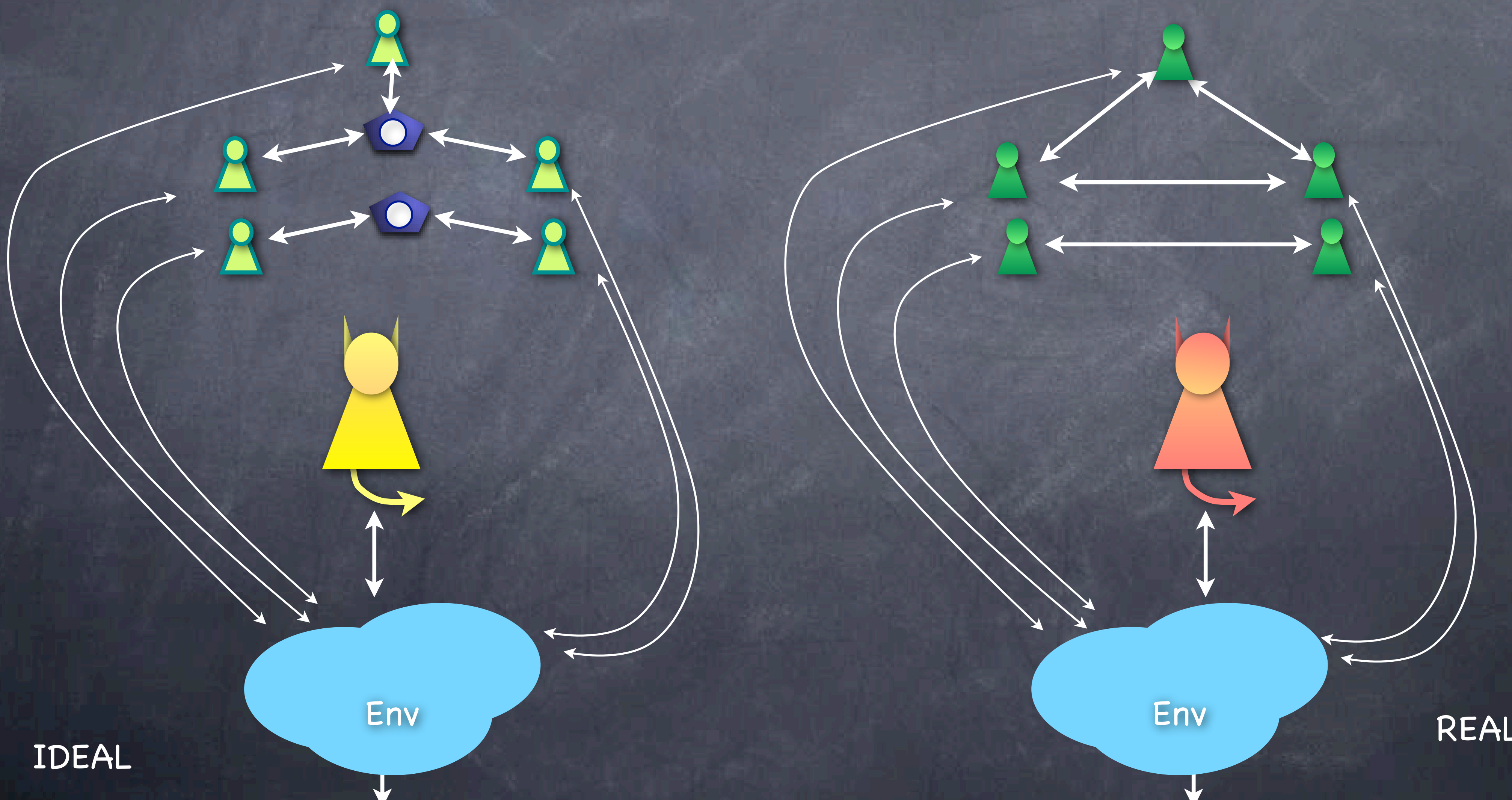

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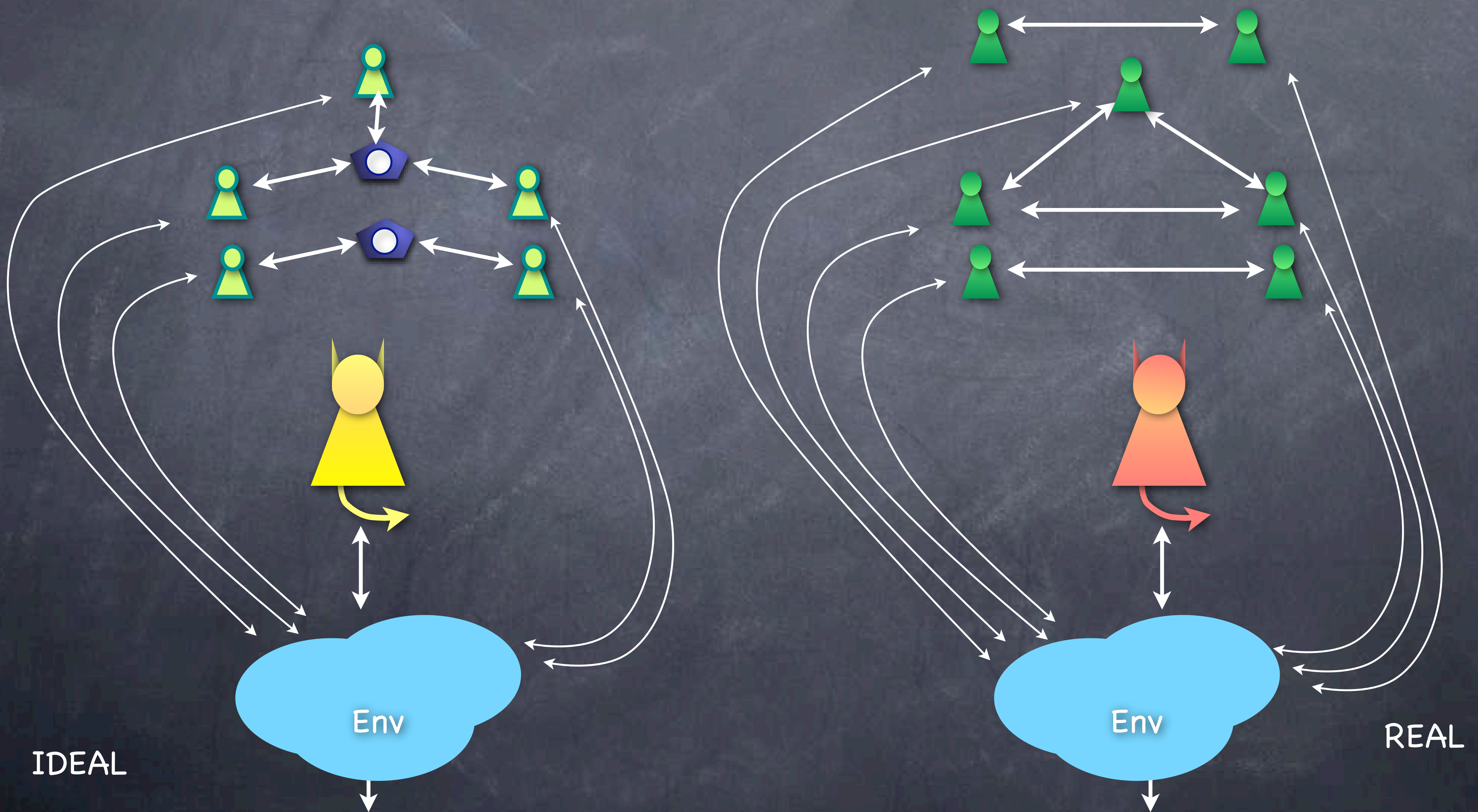

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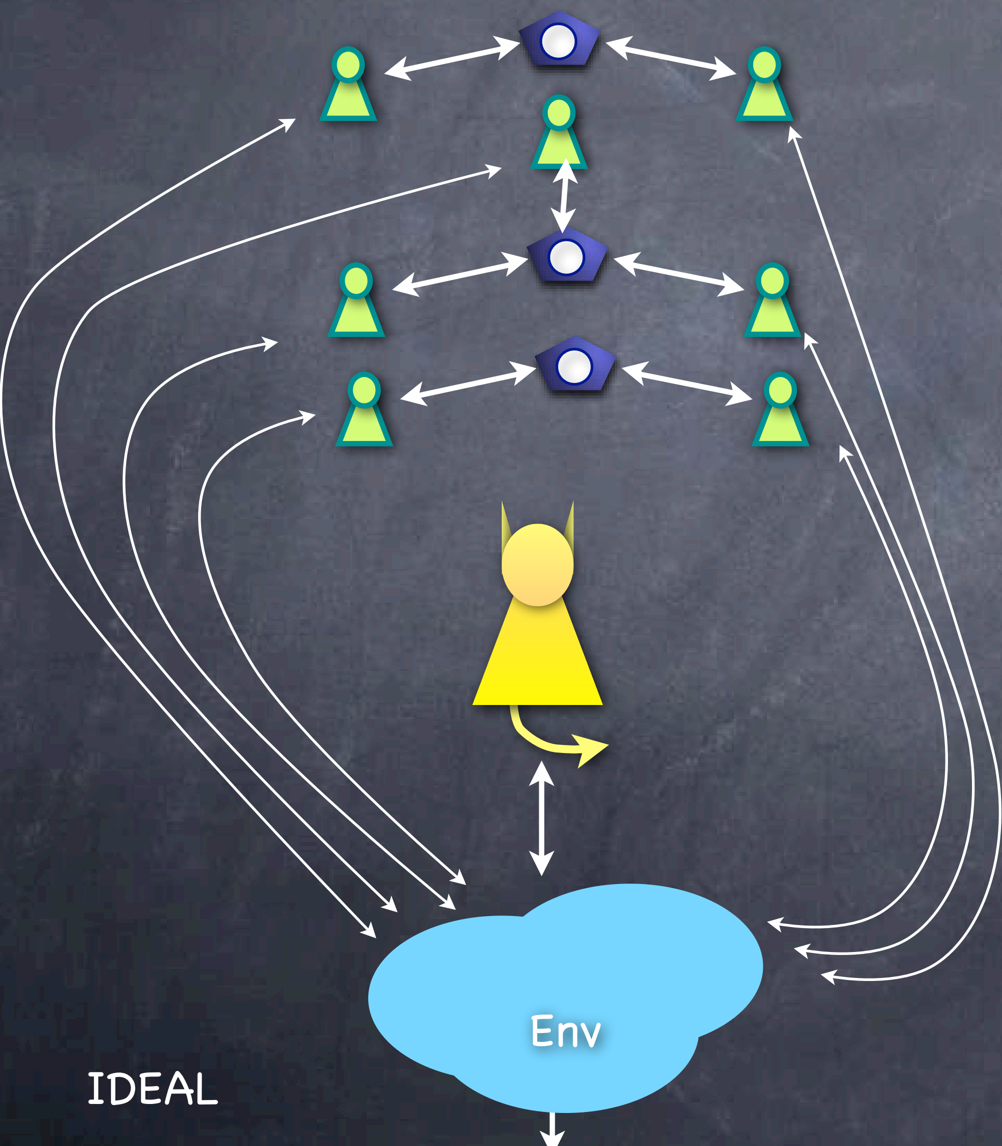
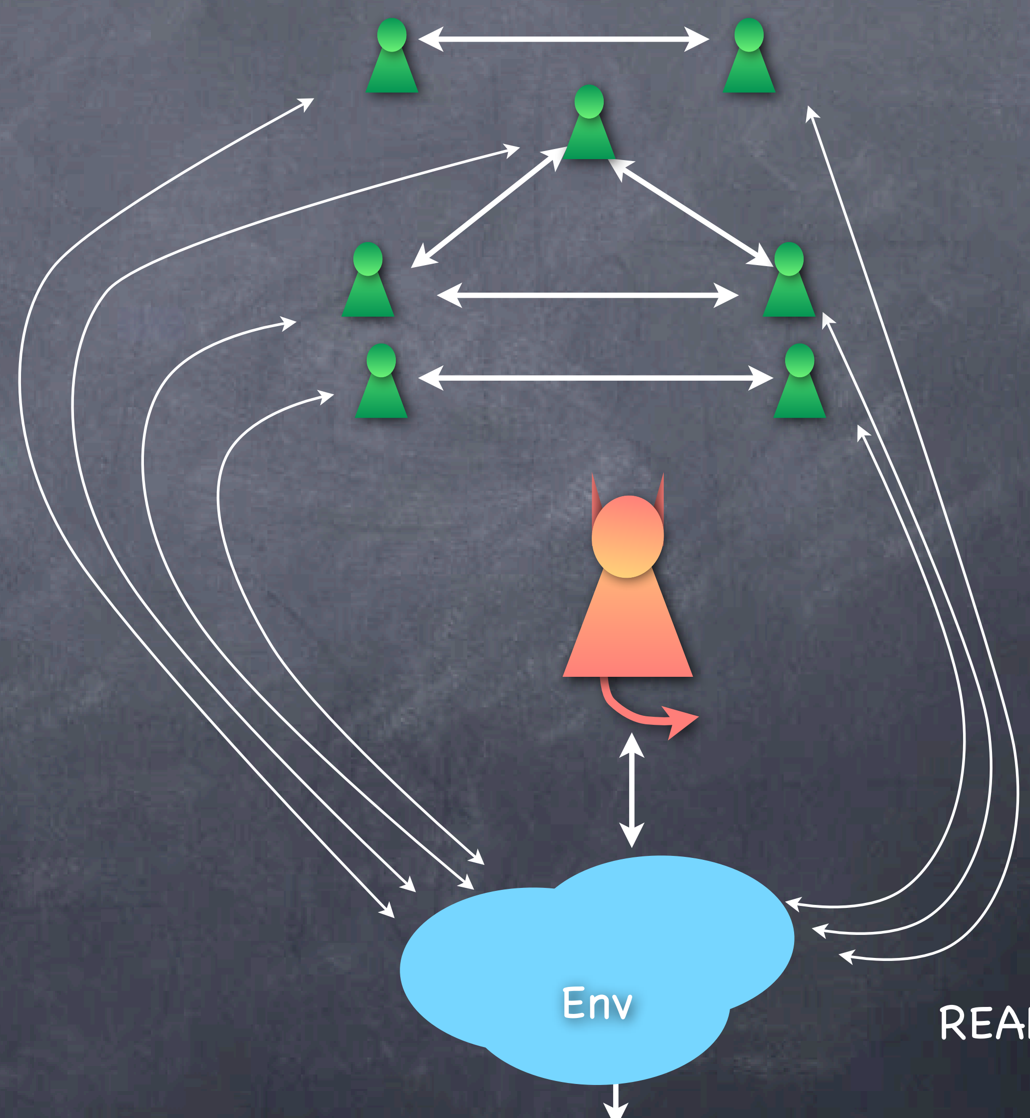


IDEAL



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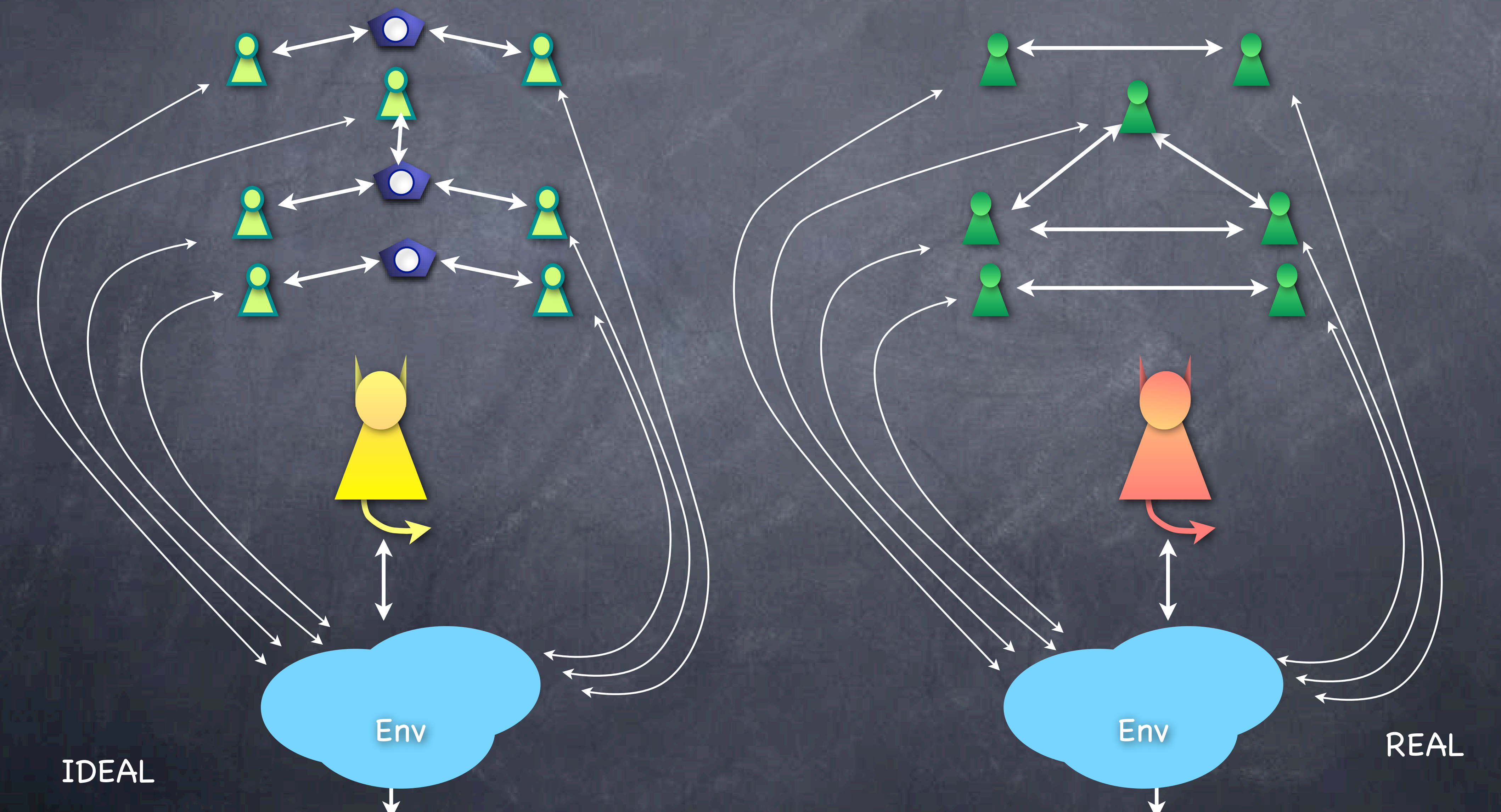

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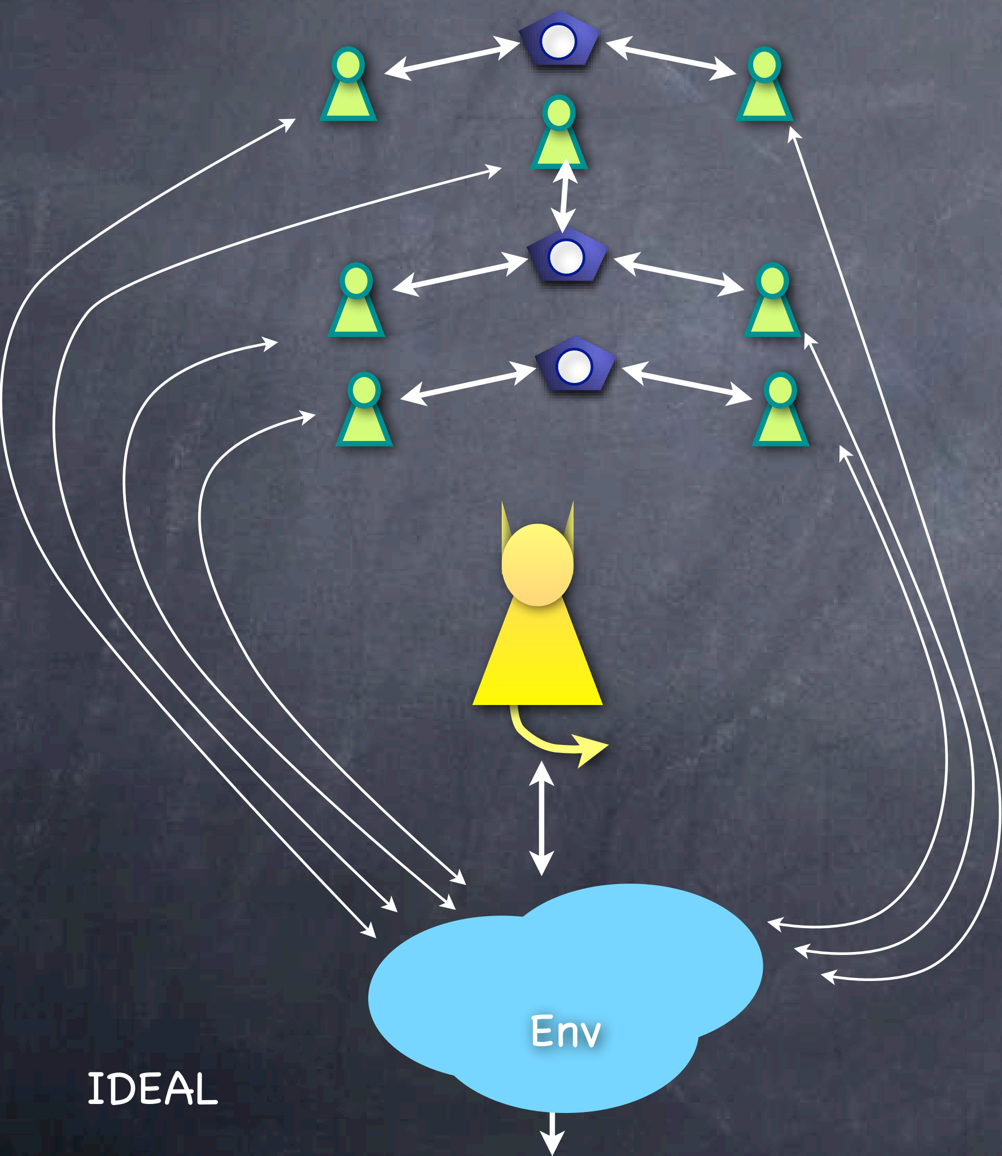

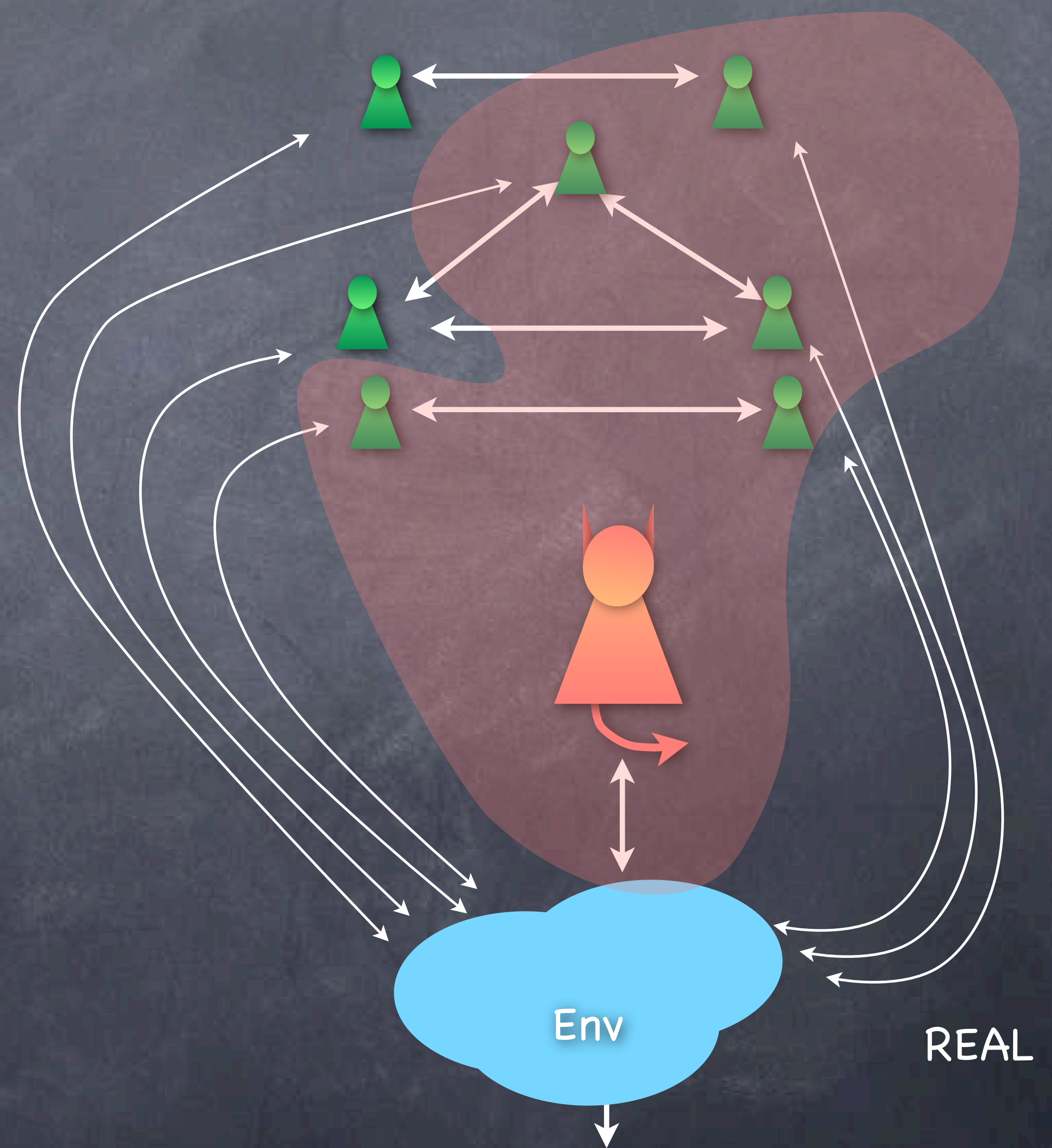

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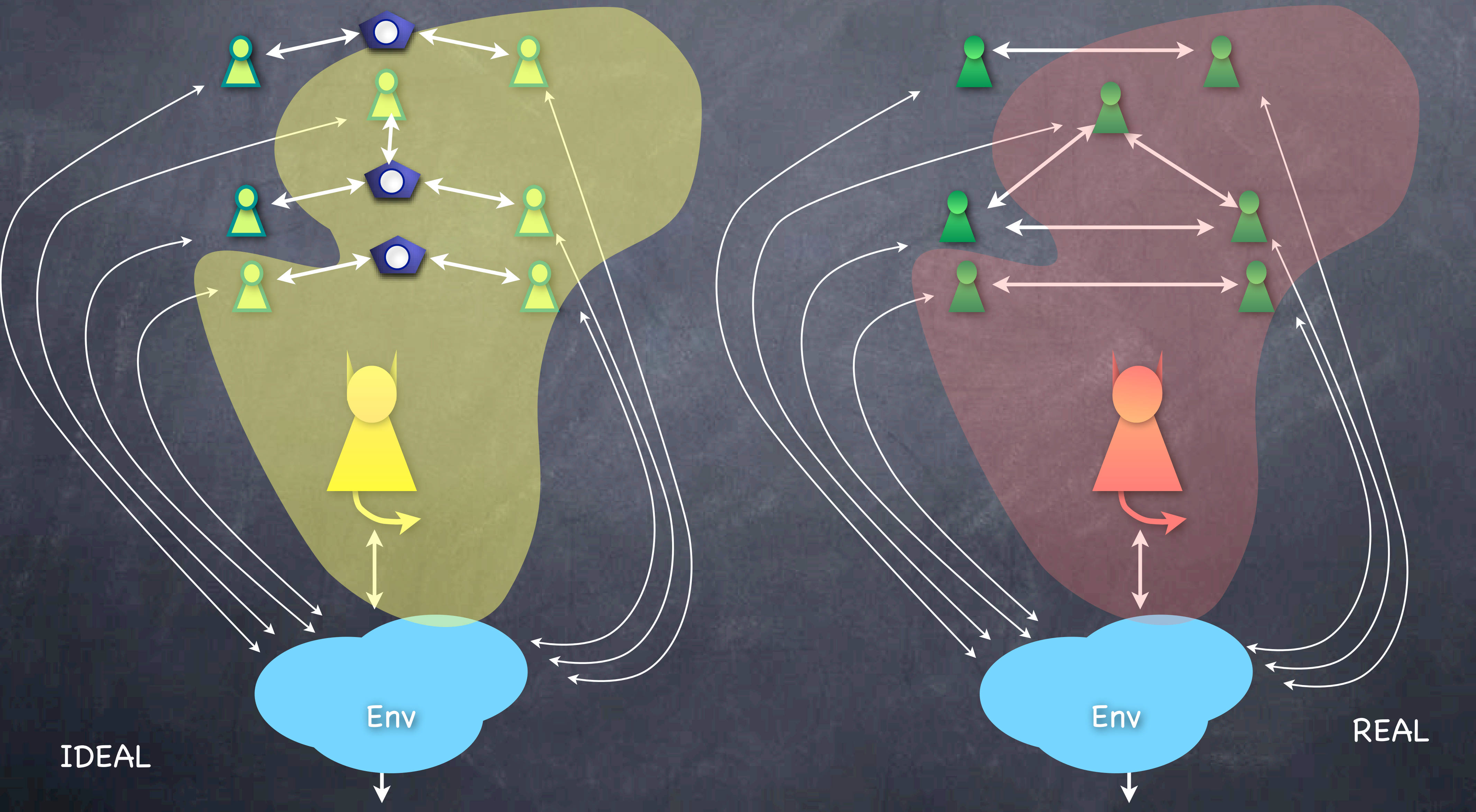

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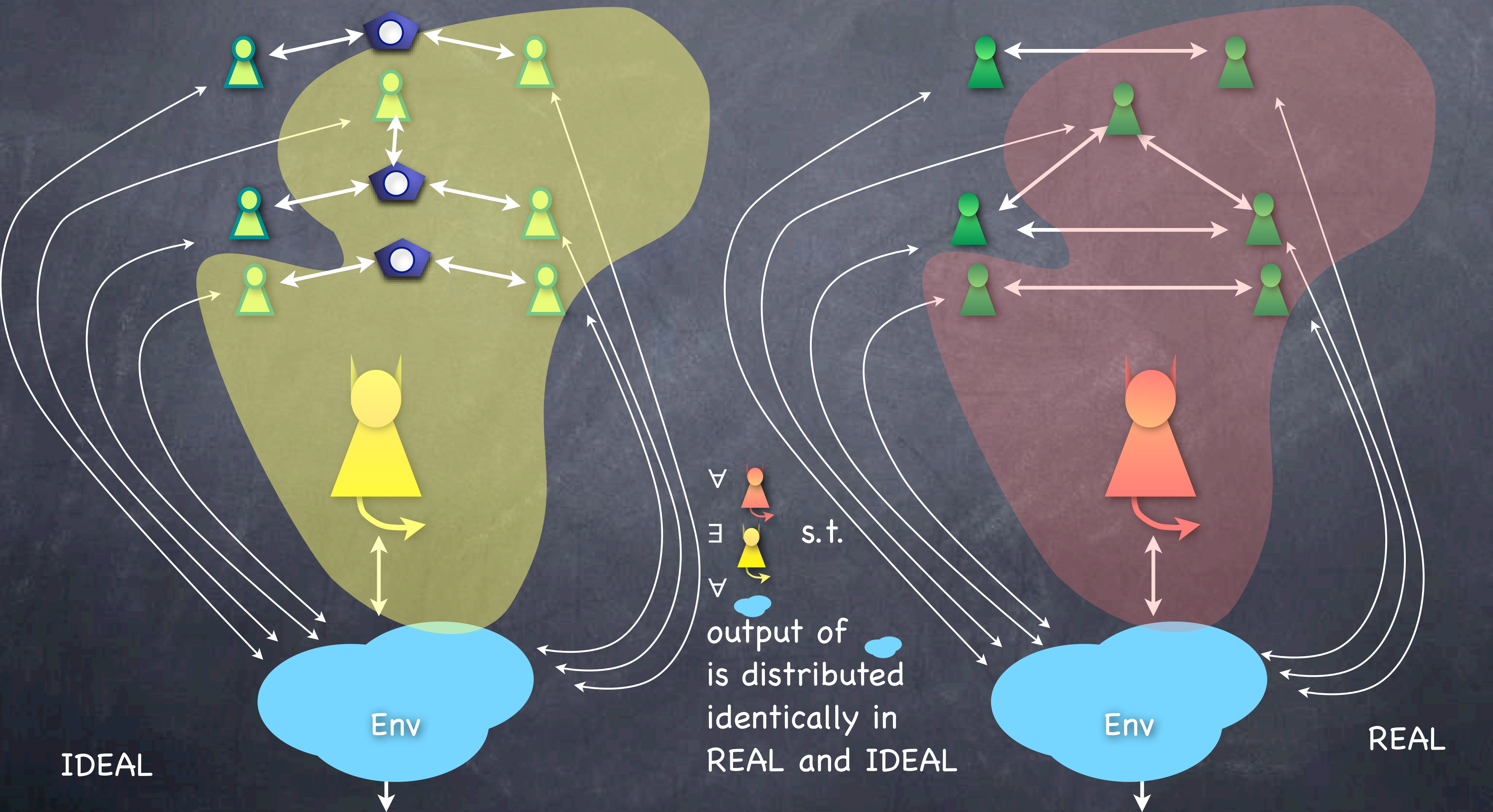

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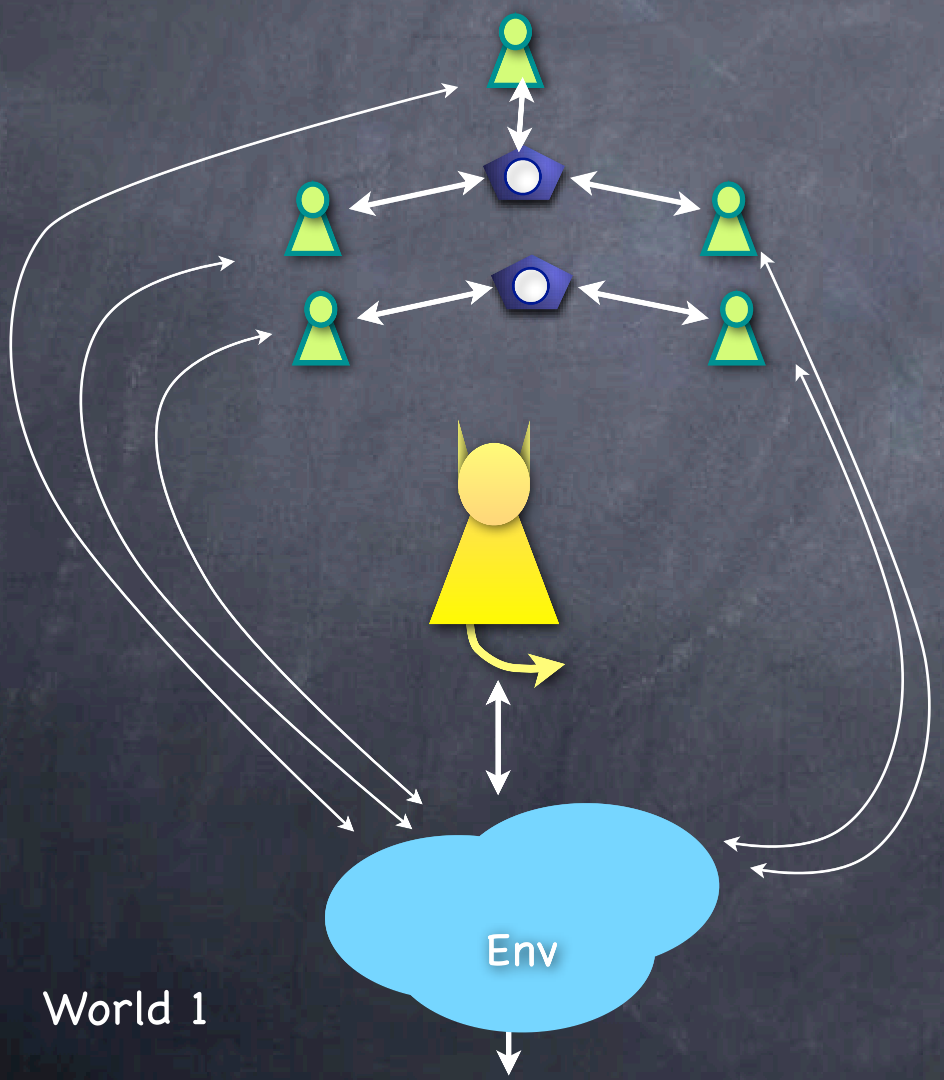

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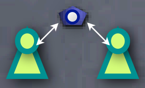
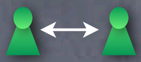
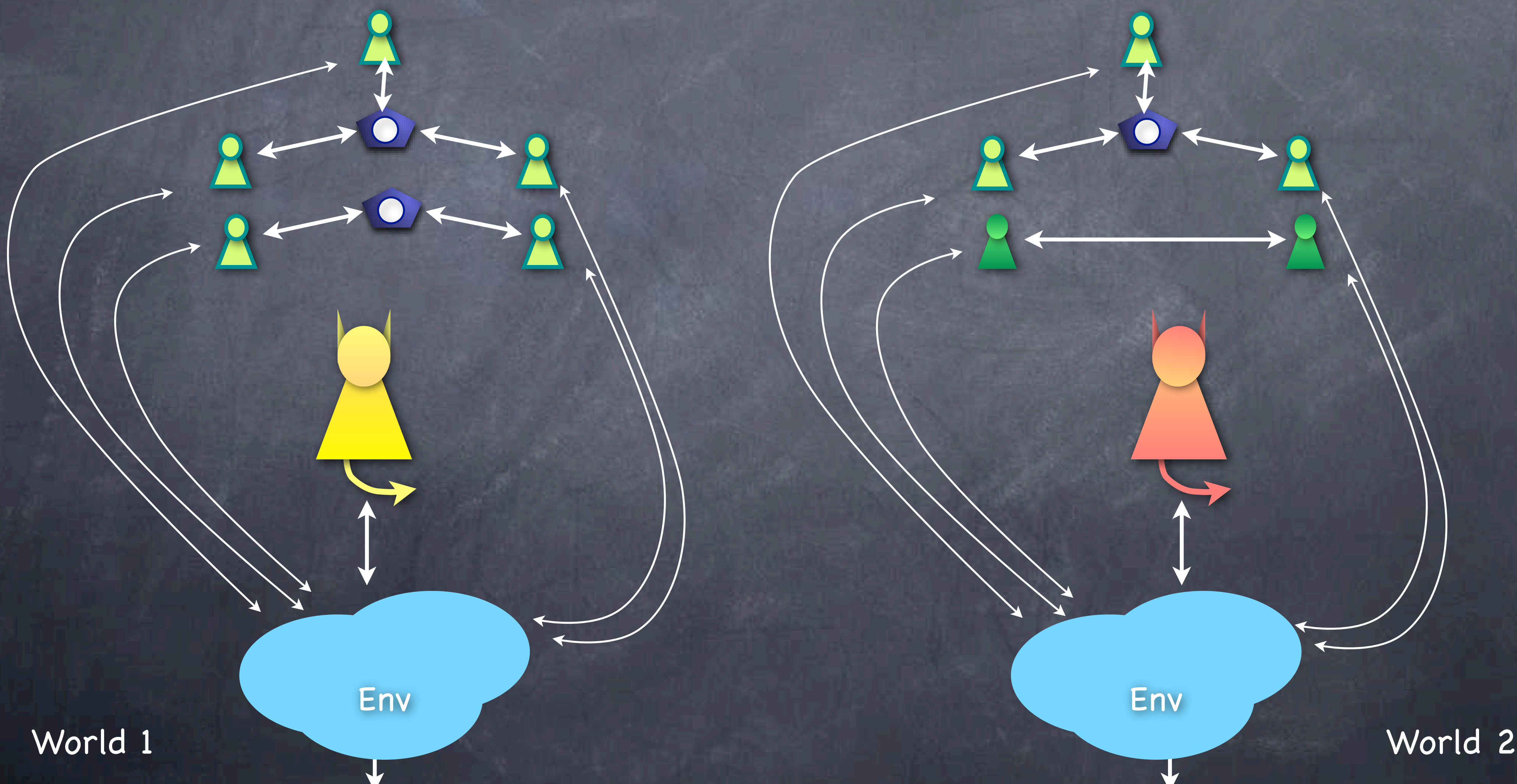
Replace protocol  with  which is as SIM-secure, etc.



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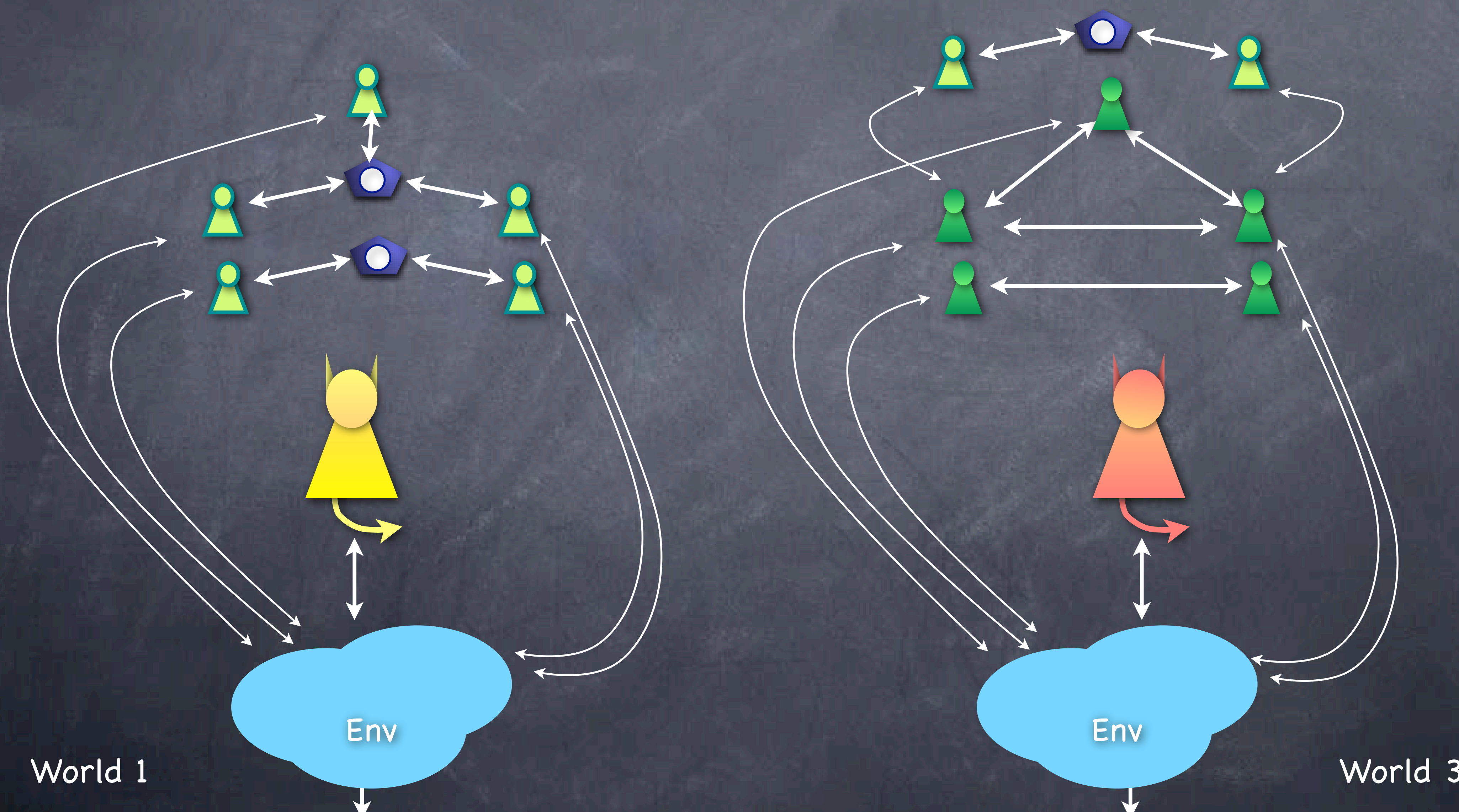

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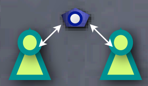
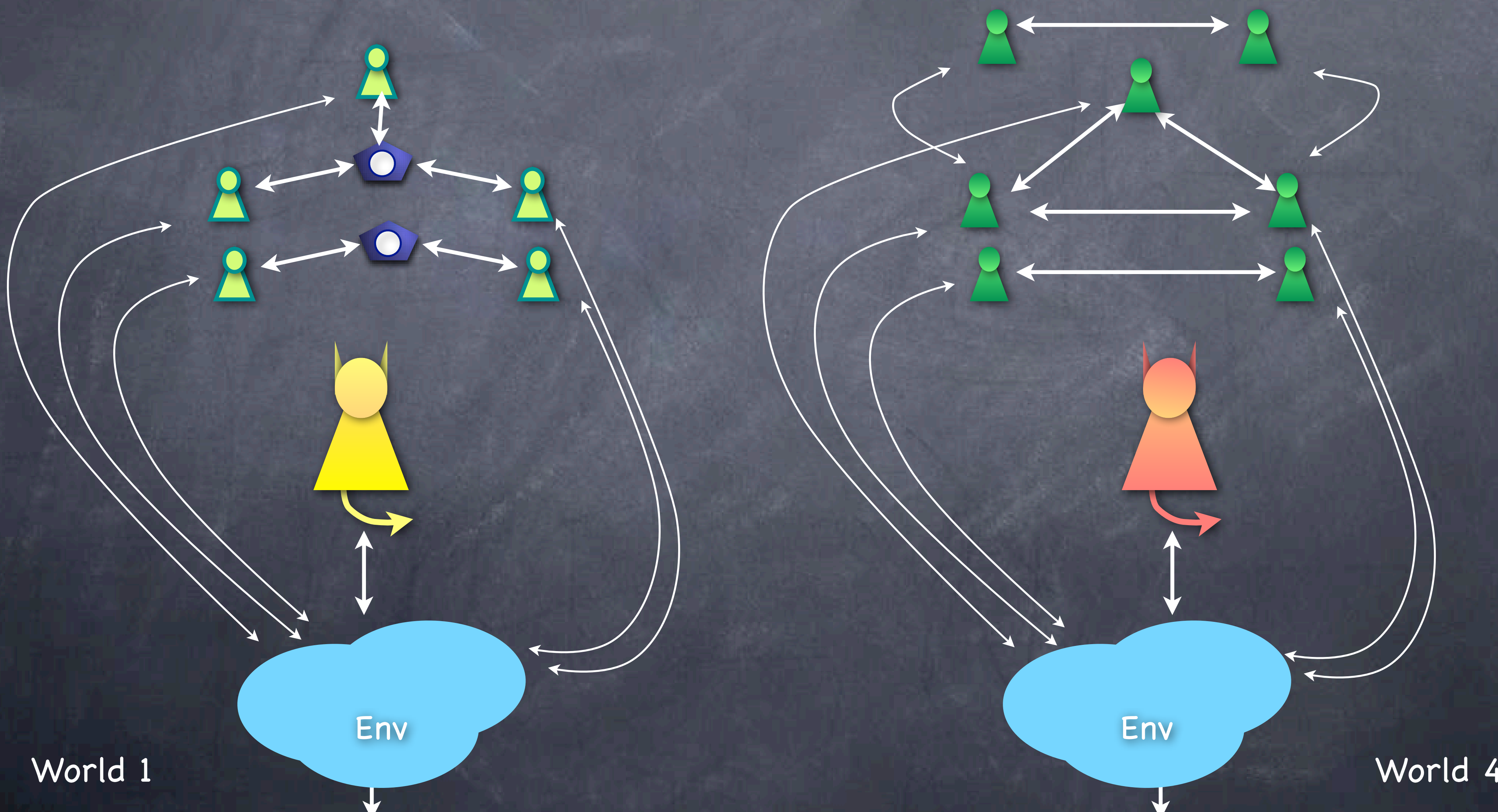
Replace protocol  with  which is as SIM-secure, etc.



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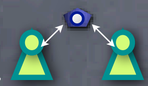
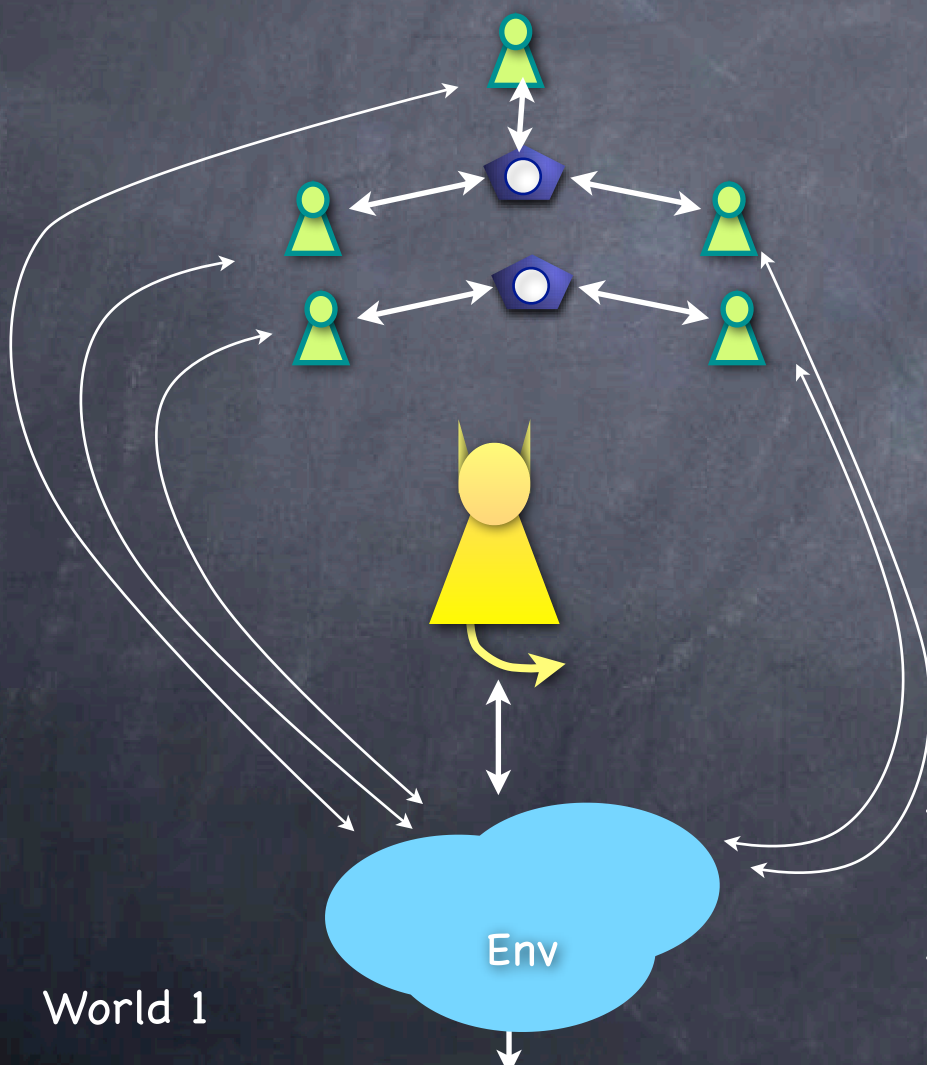
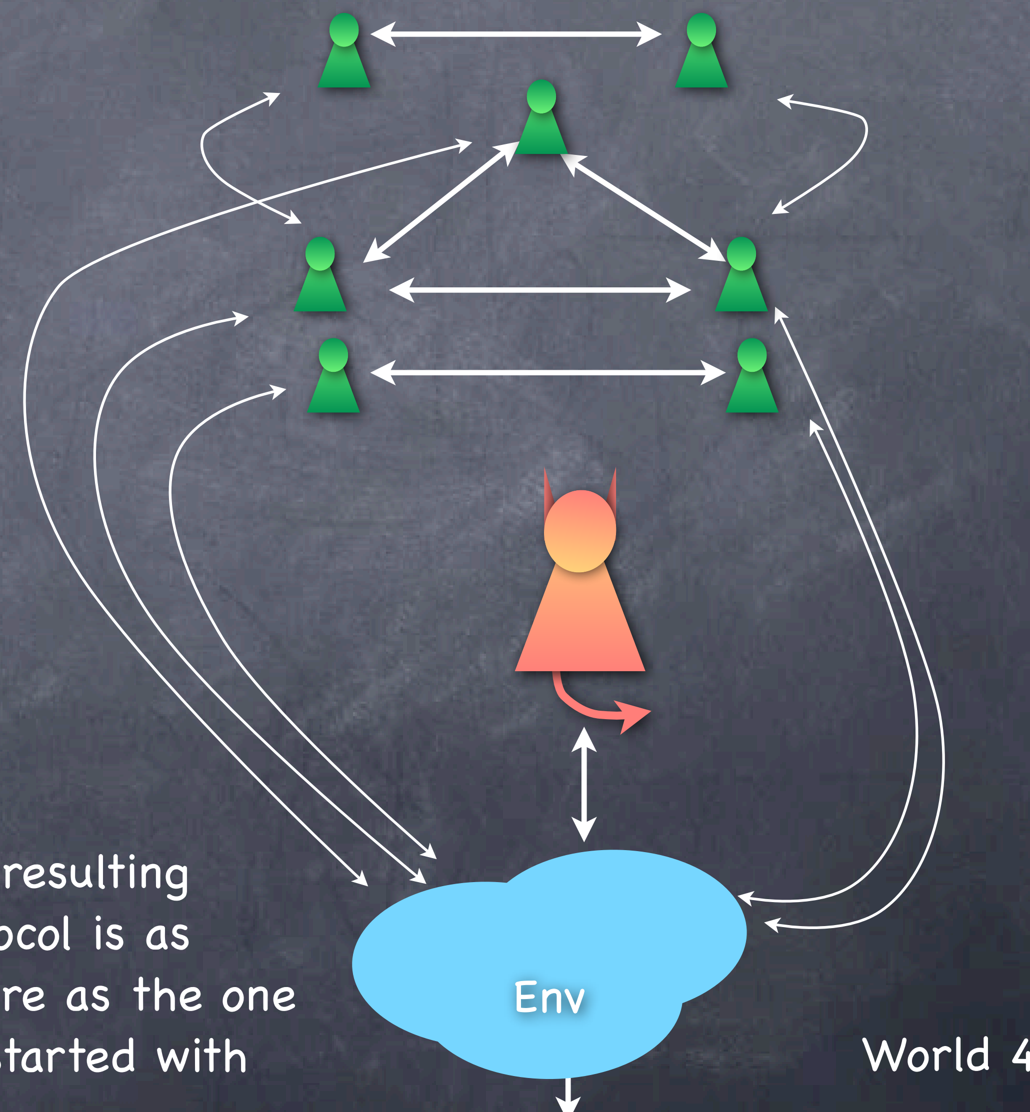
Replace protocol  with  which is as SIM-secure, etc.



The resulting protocol is as secure as the one we started with



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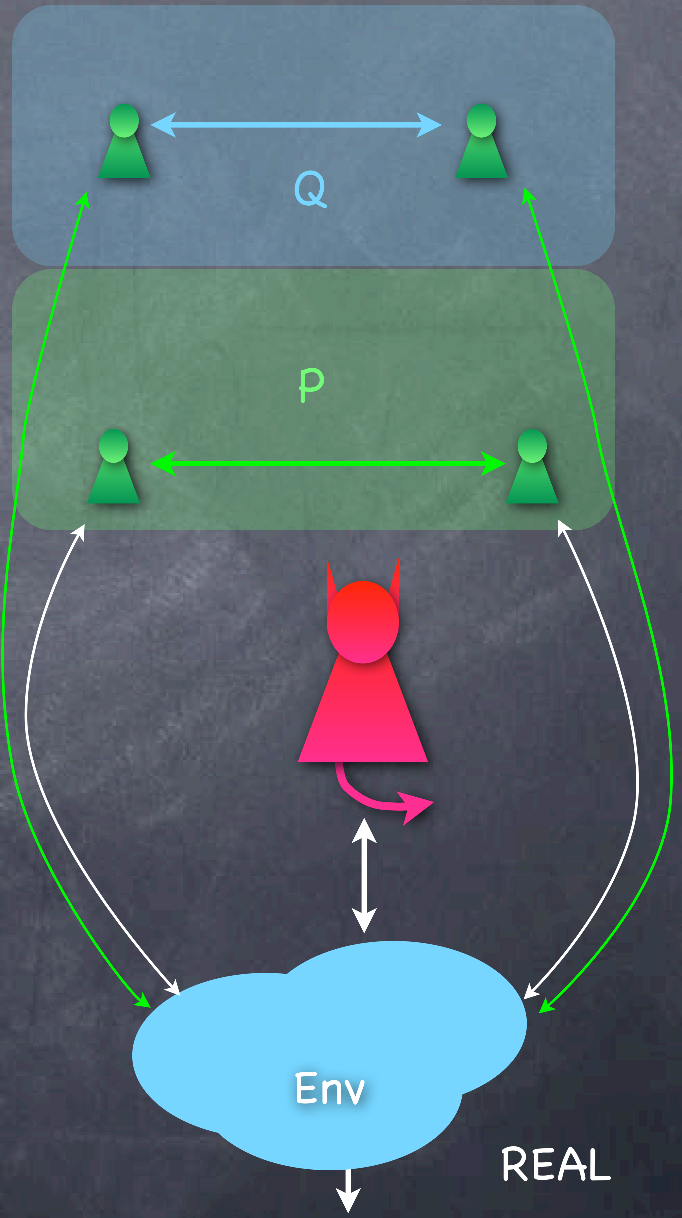
- Gives a modular implementation of the IDEAL world

Proving the UC theorem



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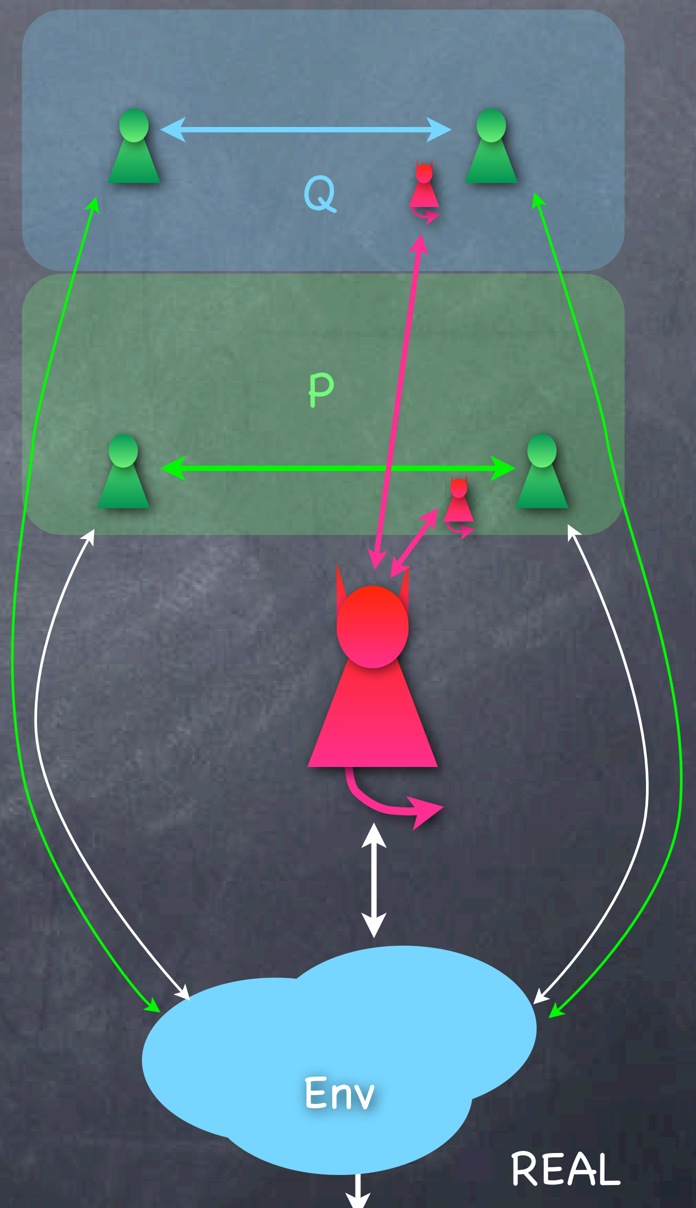

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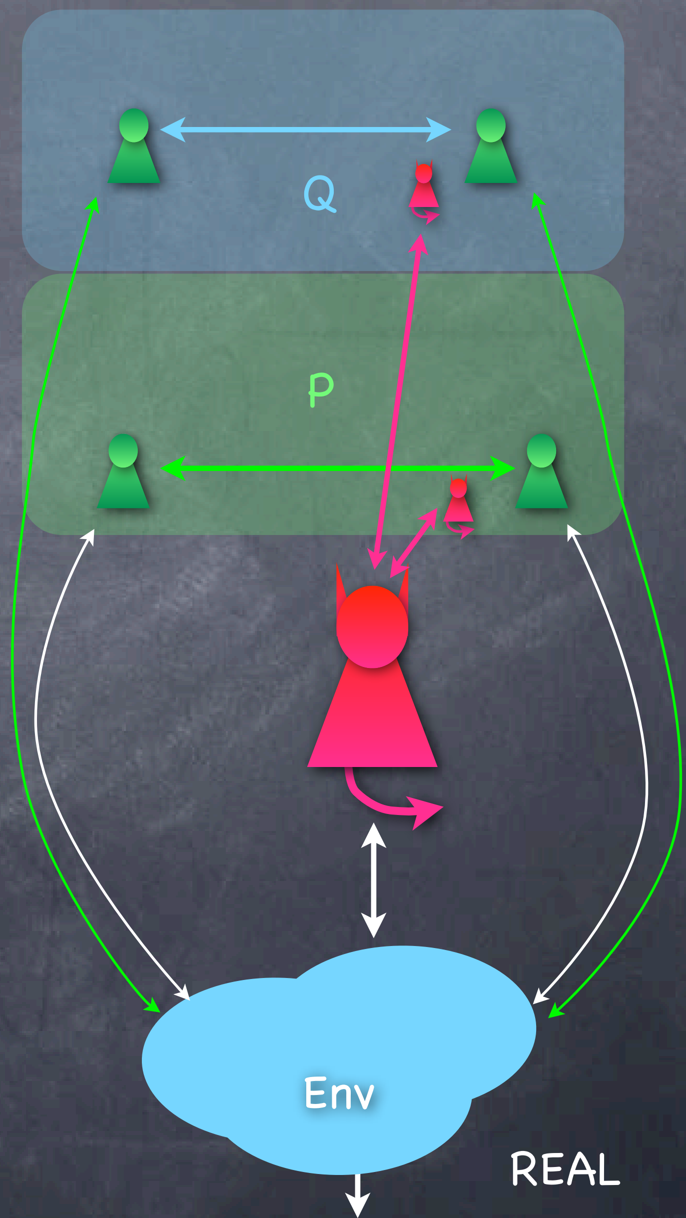
- Consider environment which runs the adversary internally, and depends on "dummy adversaries" to interface with the protocols



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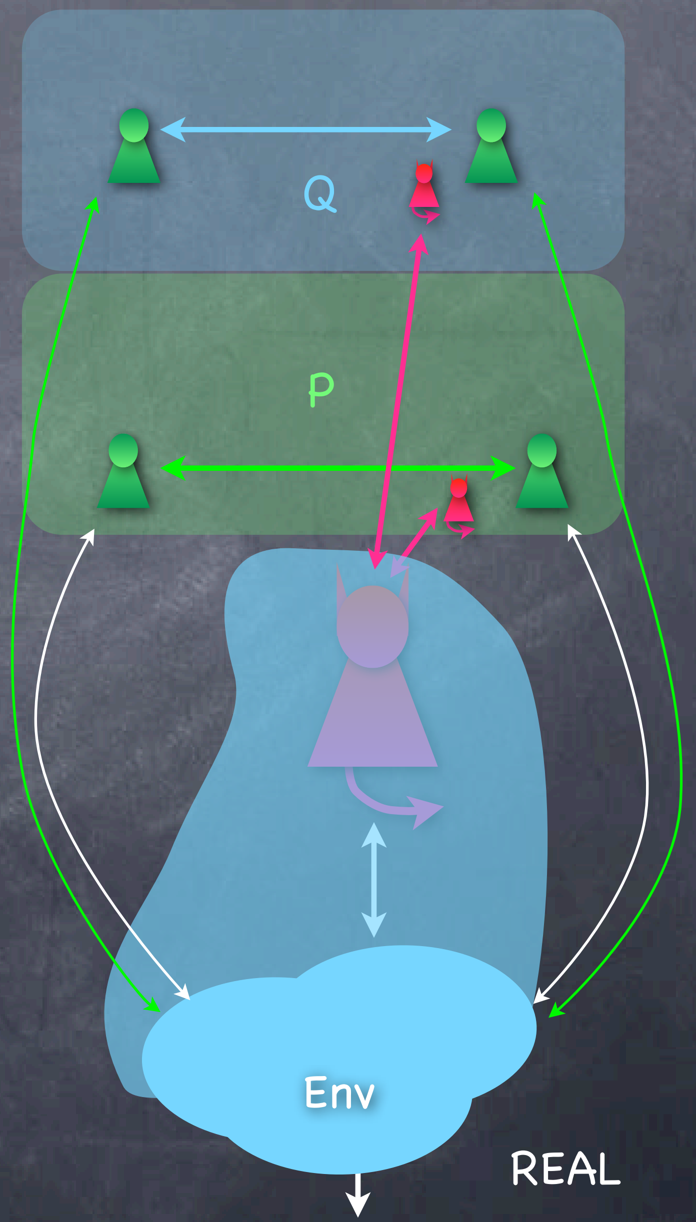

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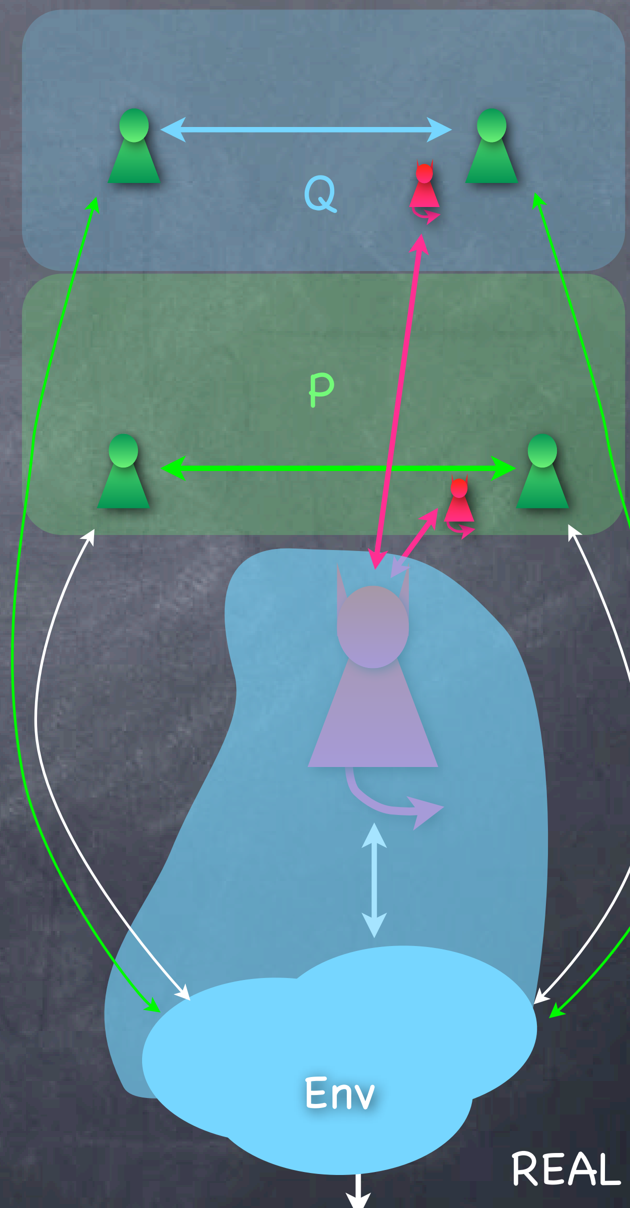

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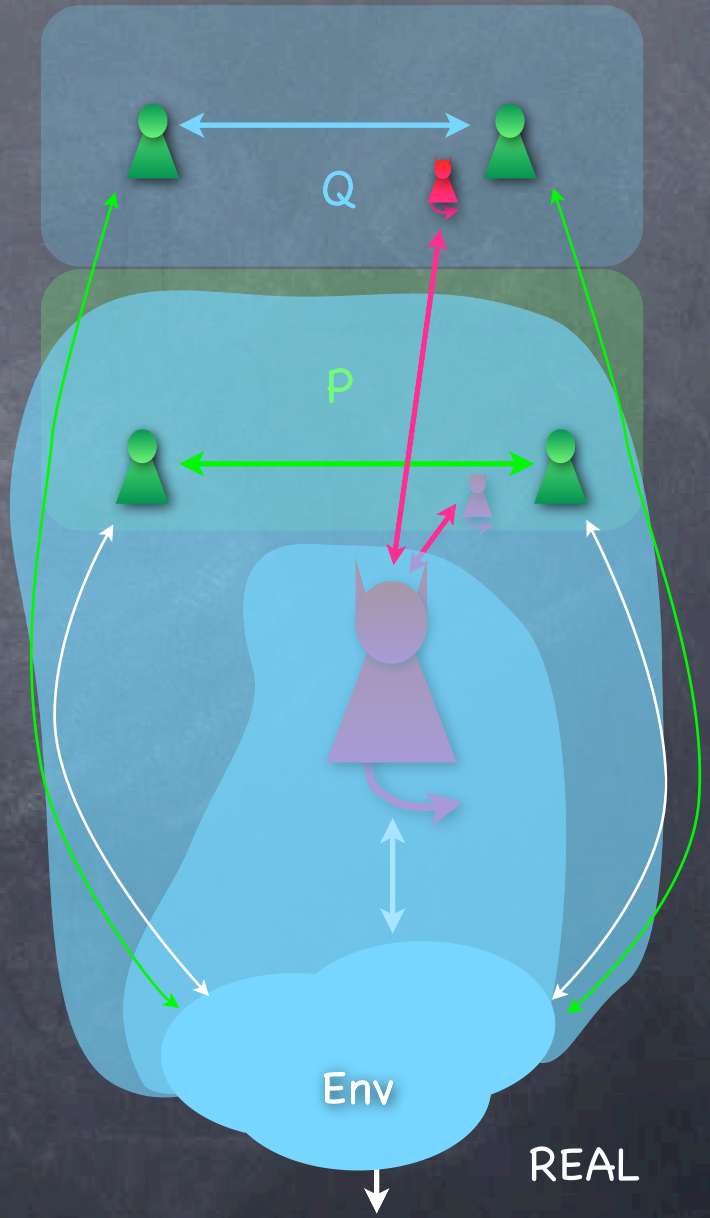

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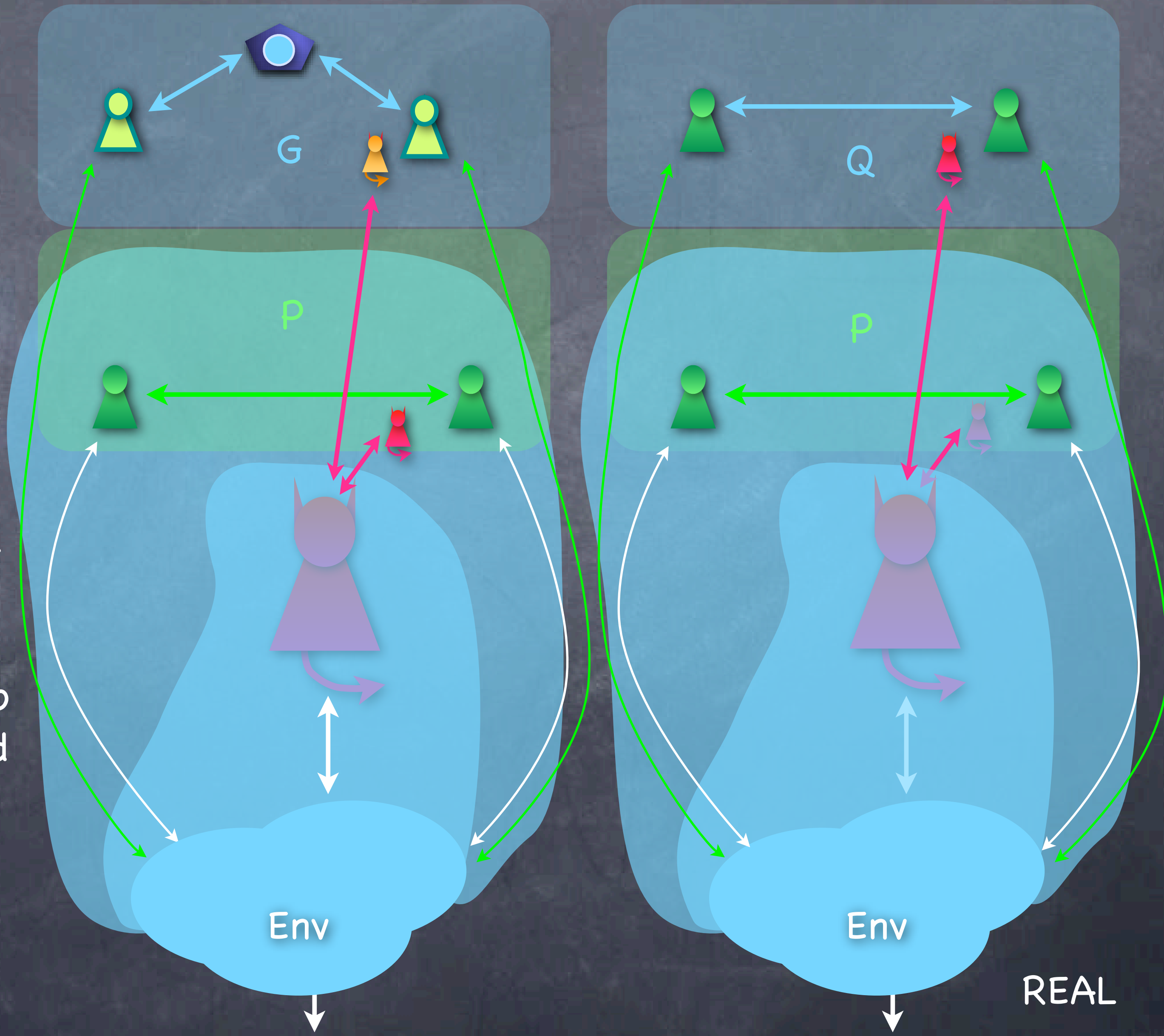

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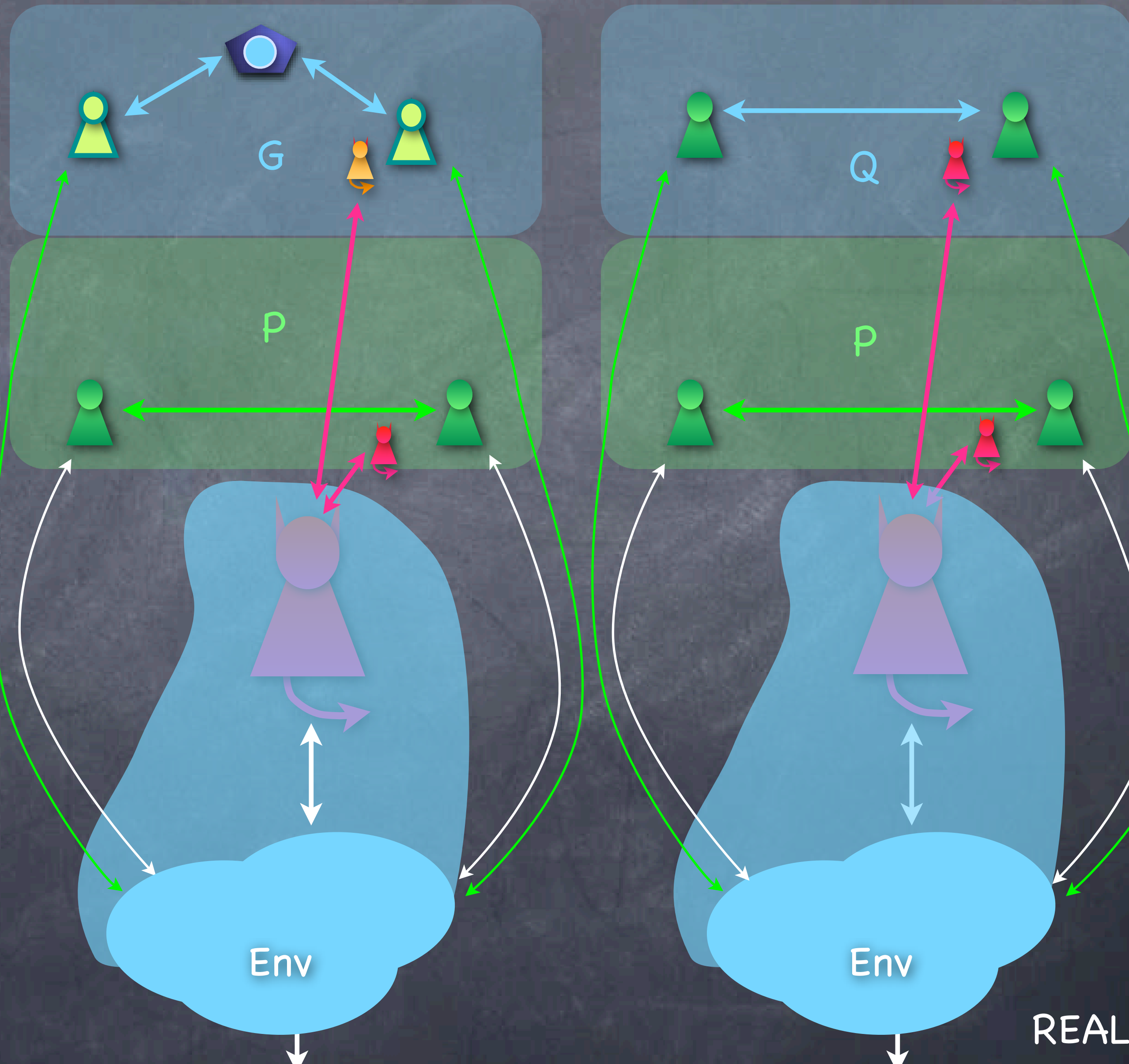

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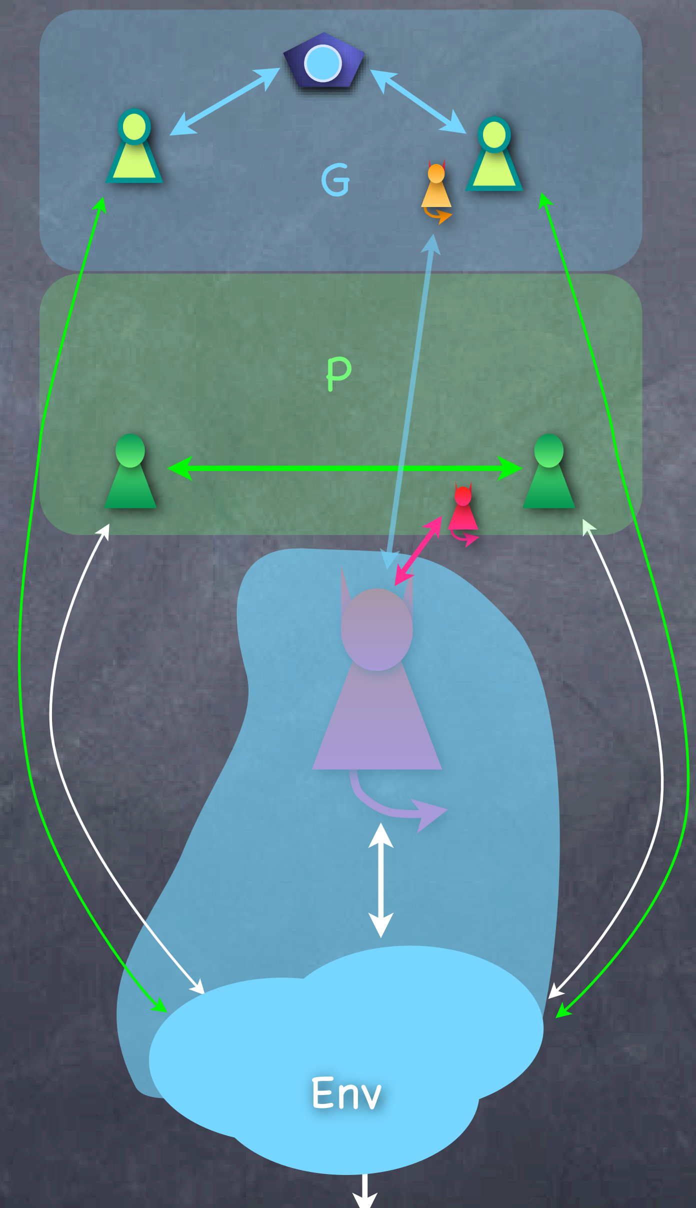

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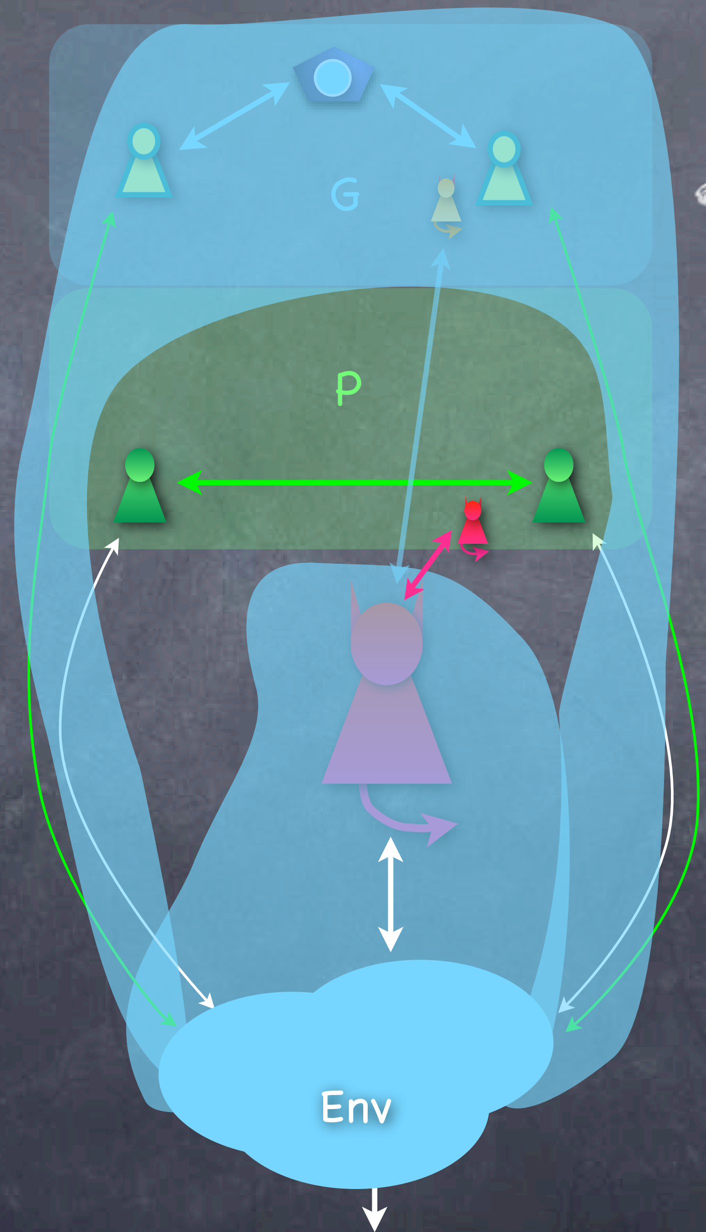

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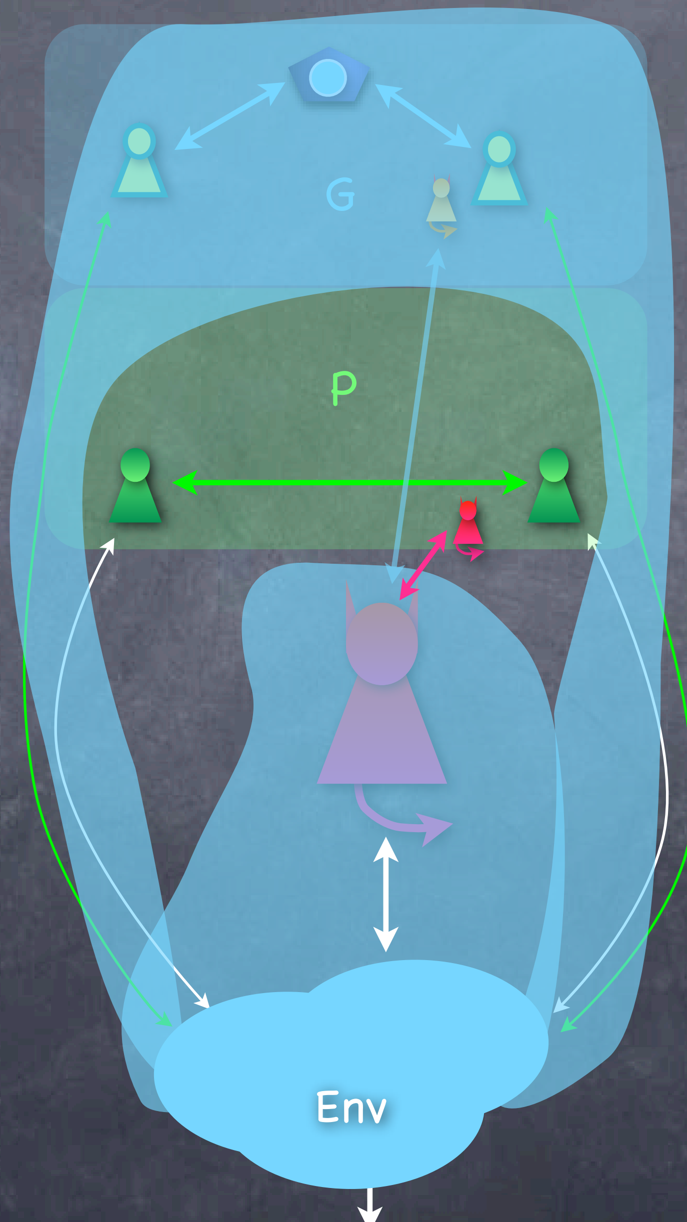

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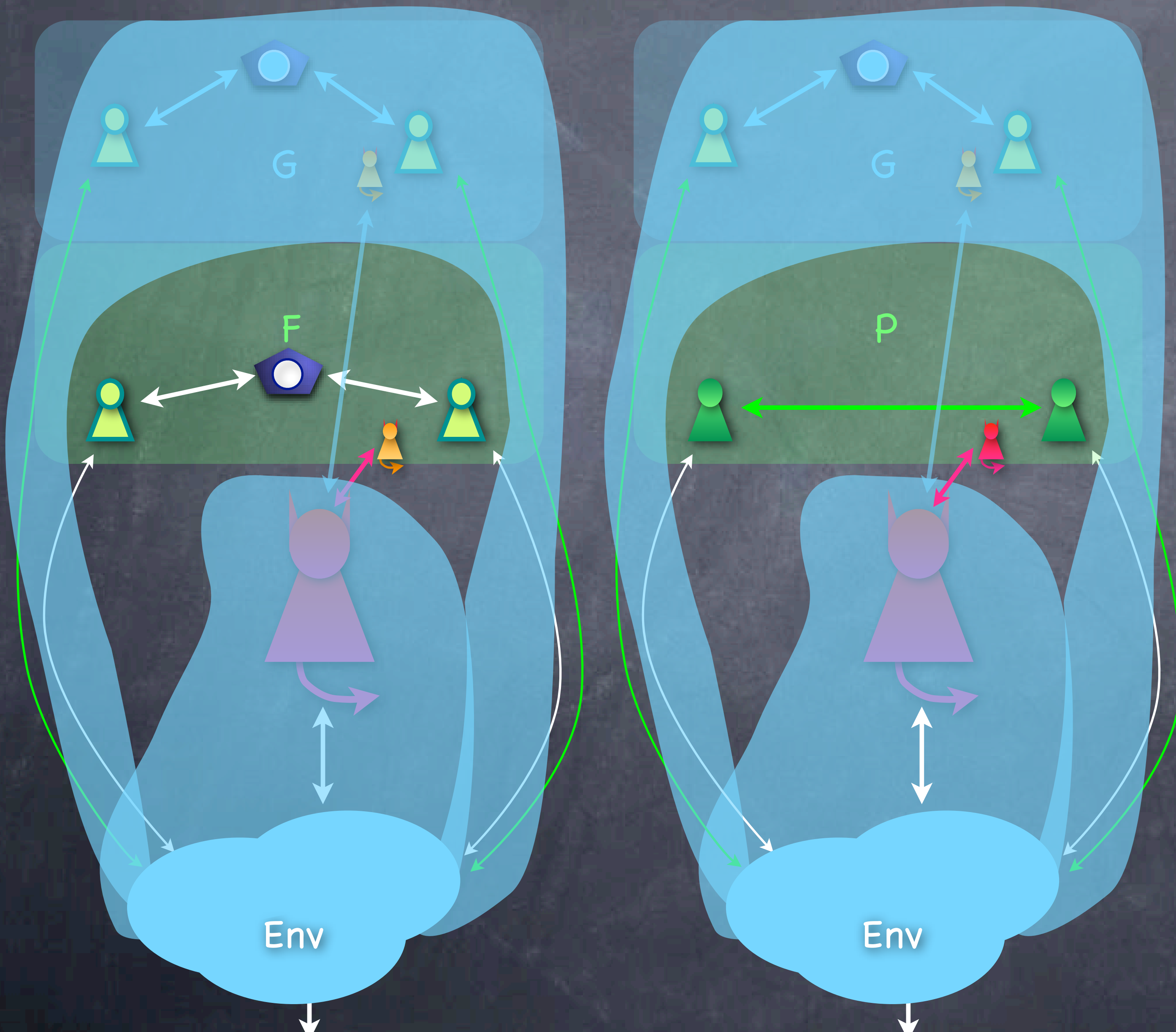

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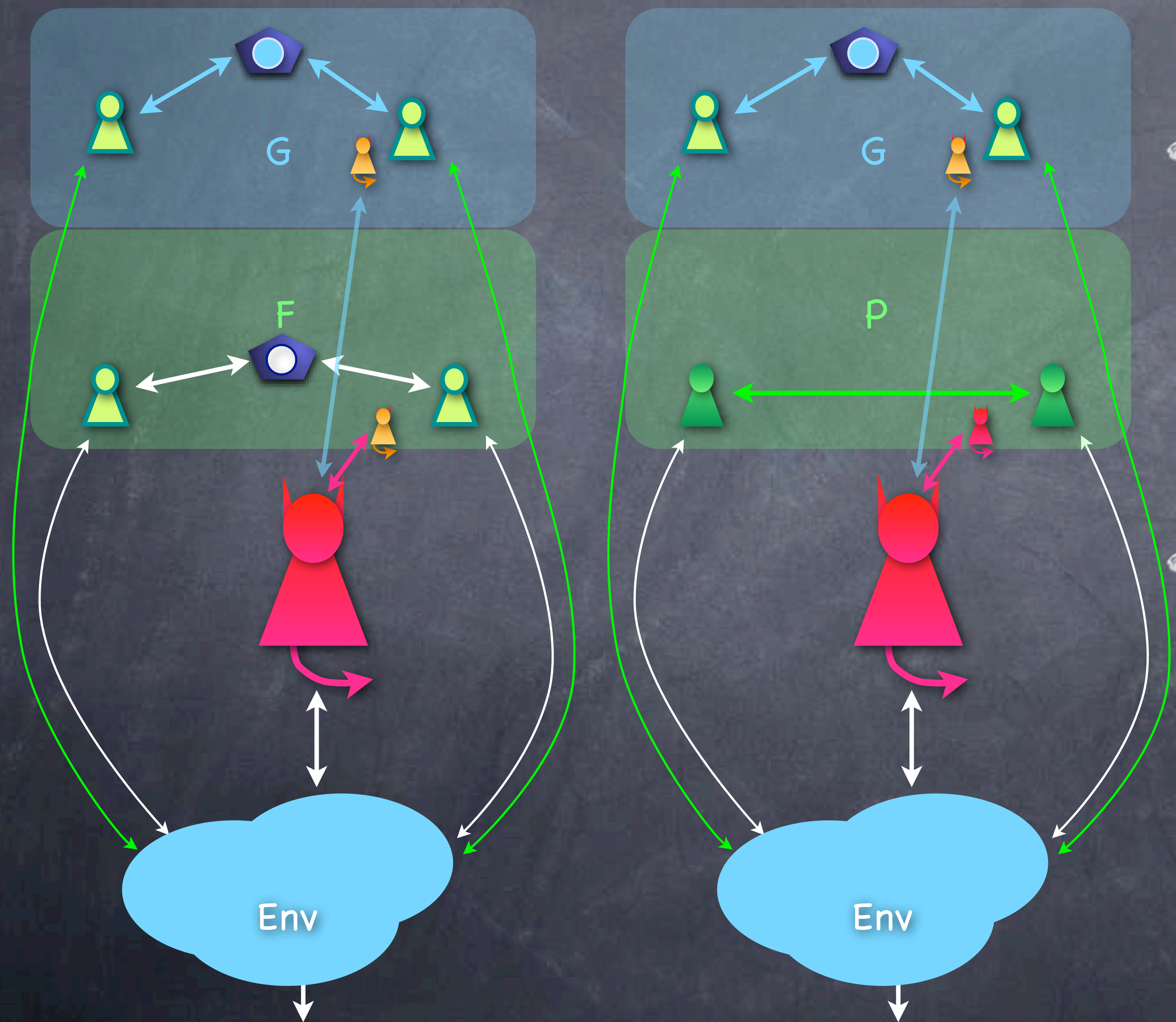

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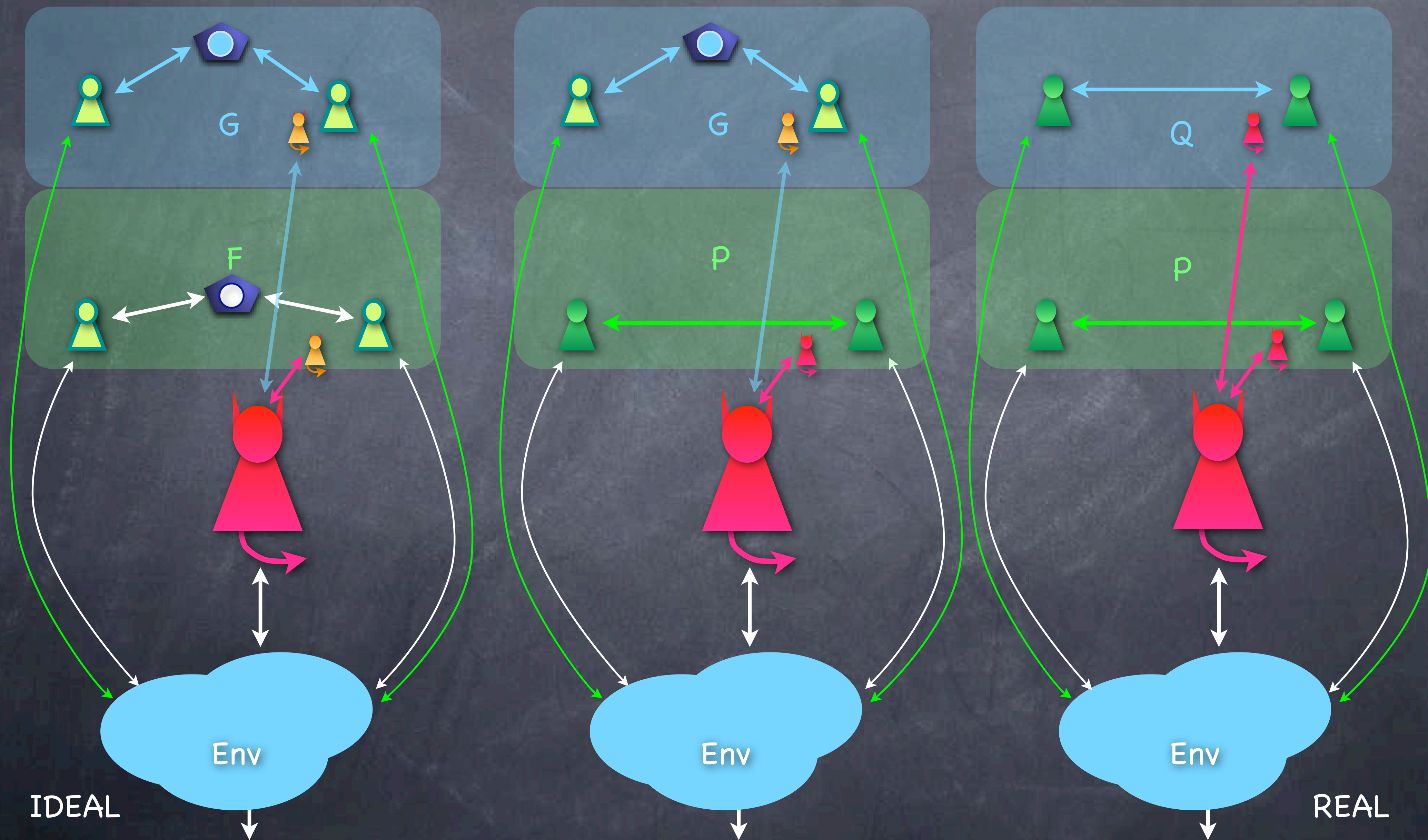

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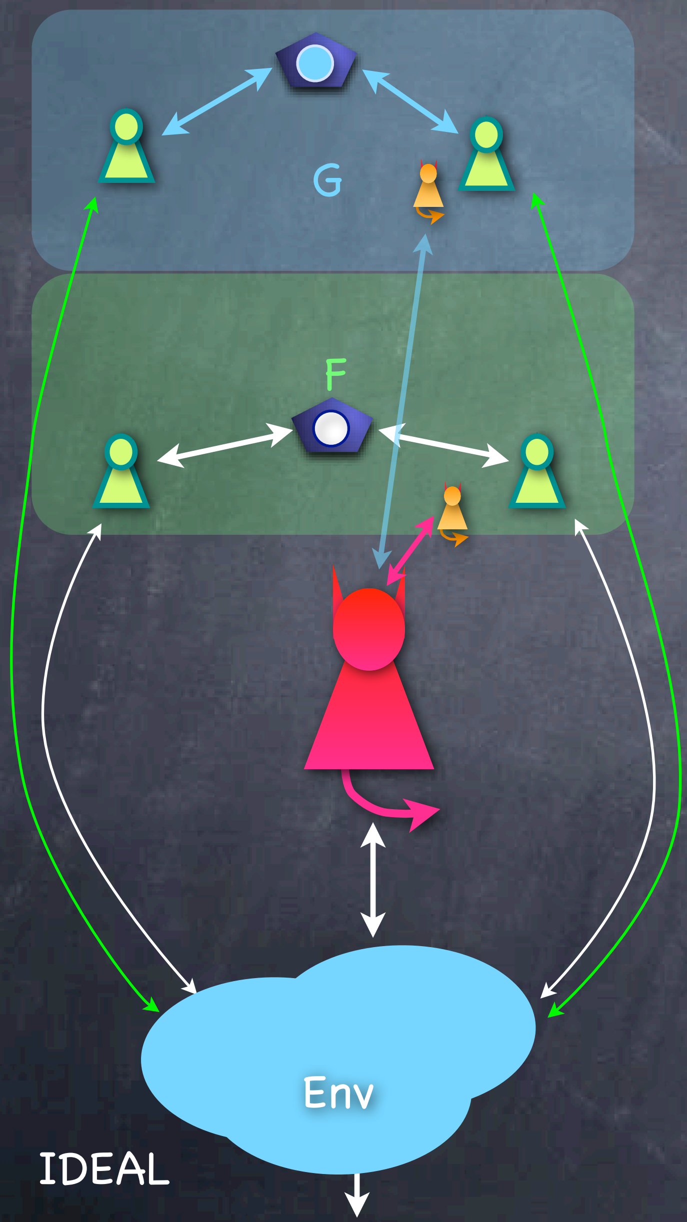

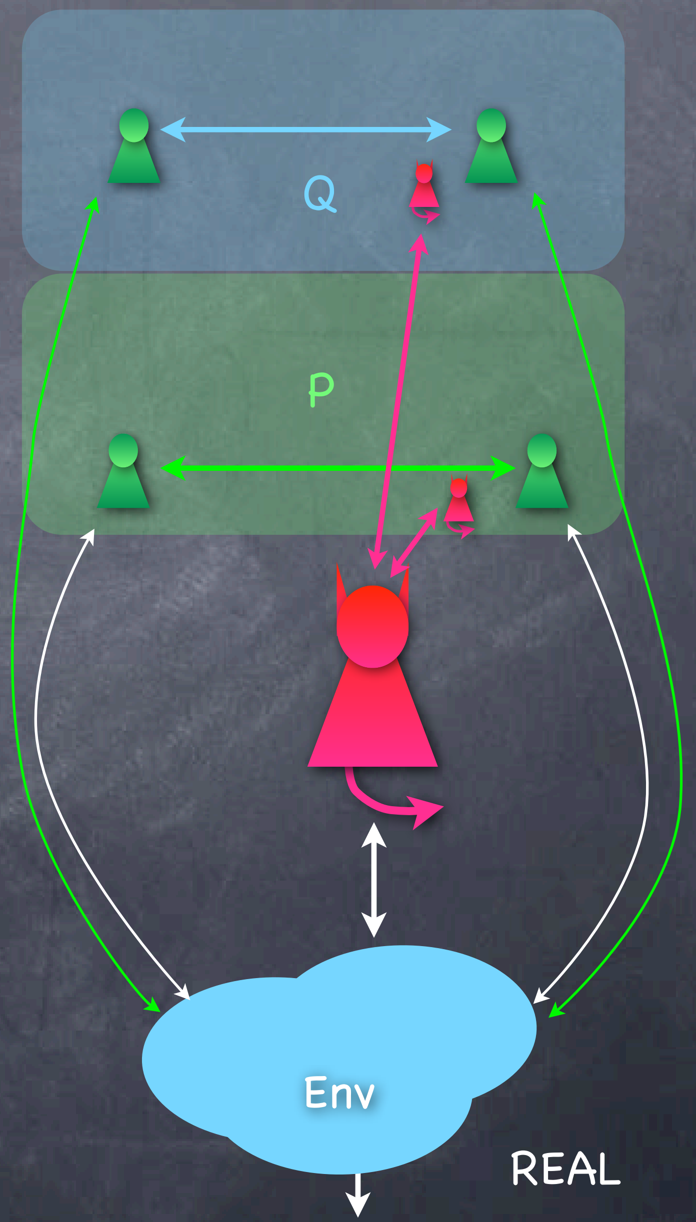

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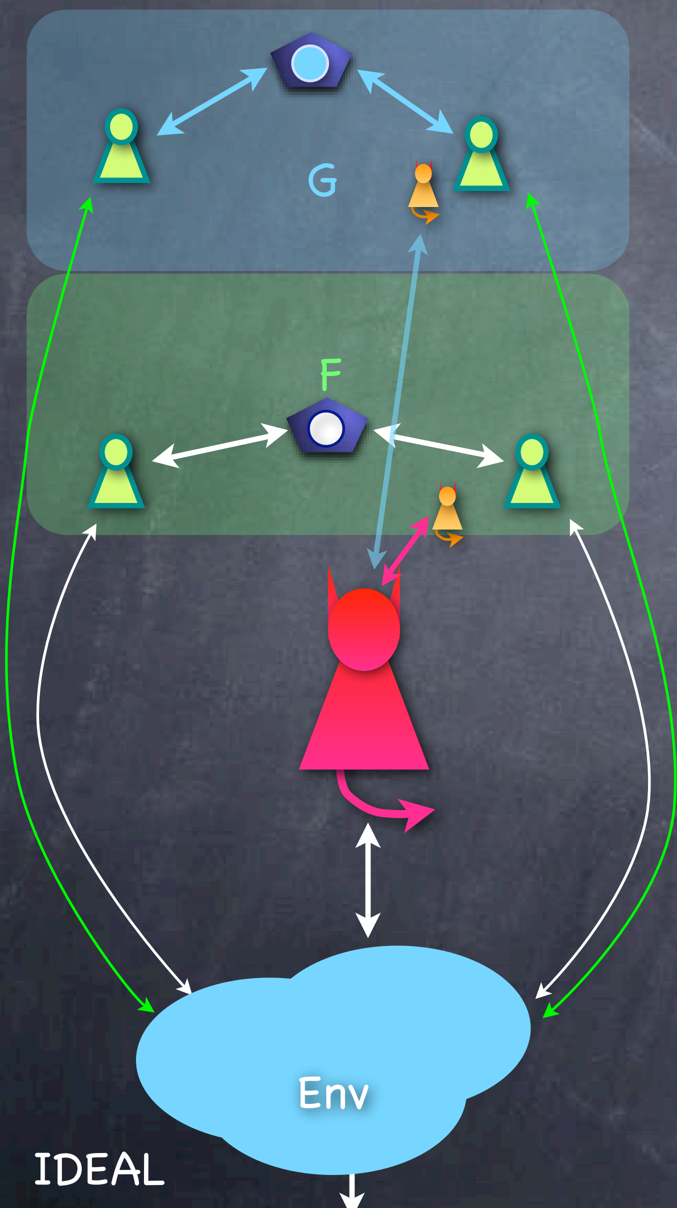
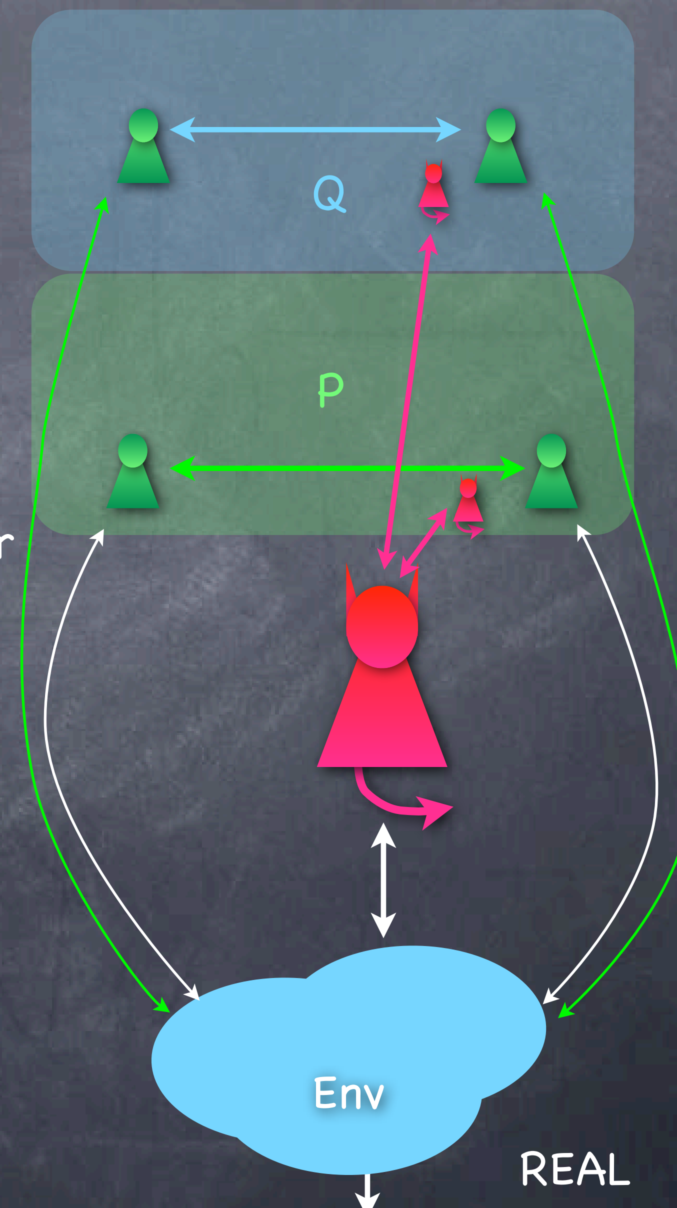


- Hence REAL ≈ IDEAL
- Main idea: Environment can model other sessions (real or ideal)



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  - 2-Party: Yao's Garbled circuit
  - General Multi-party: "Shared Evaluation"
    - Use OT (realizable, for passive corruption, using TOWP)
- Turn it into secure against active corruption
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    - This is a statement about the messages so far (publicly known) and randomness and input (both committed using CaP)

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    - Very general (but not very efficient)