Accounting Value Effects for Responsible Networking

ACM SIGCOMM 2021 Workshop on Technologies, Applications, and Uses of a Responsible Internet (TAURIN 2021), 23 August 2021

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University of Amsterdam

Why responsible computing?

the more we delegate activities to machines,

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the more we need machines to behave "responsibly"

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Today, focus on this issue is mostly on ML-based AI, however, any technology -- because it has effects on the world -- should fulfill the same requirement.

Including the *Internet and networking*!

Looking at application level, data-sharing has practical effects

because having access to relevant information has value for agents!

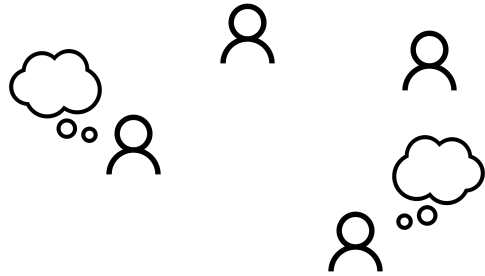# Looking at application level, data-sharing has practical effects

people, organizations, systems which act to achieve certain purposes
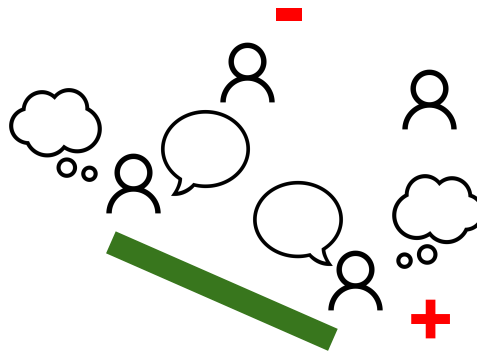
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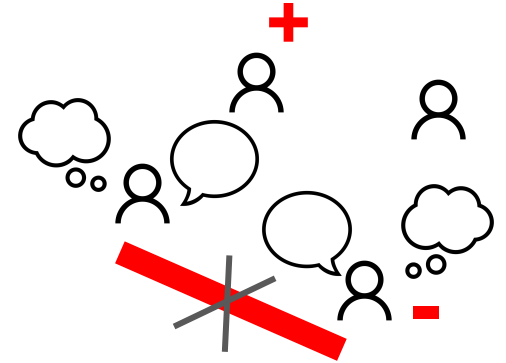
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no exchange   exchange enabled/allowed   exchange disabled/disallowed

Looking at application level, data-sharing has practical effects

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- technologies provide new abilities

  e.g. Internet with new forms of knowledge sharing, aggregation, making business, etc.

ability (power) dimension

Looking at application level, data-sharing has practical effects

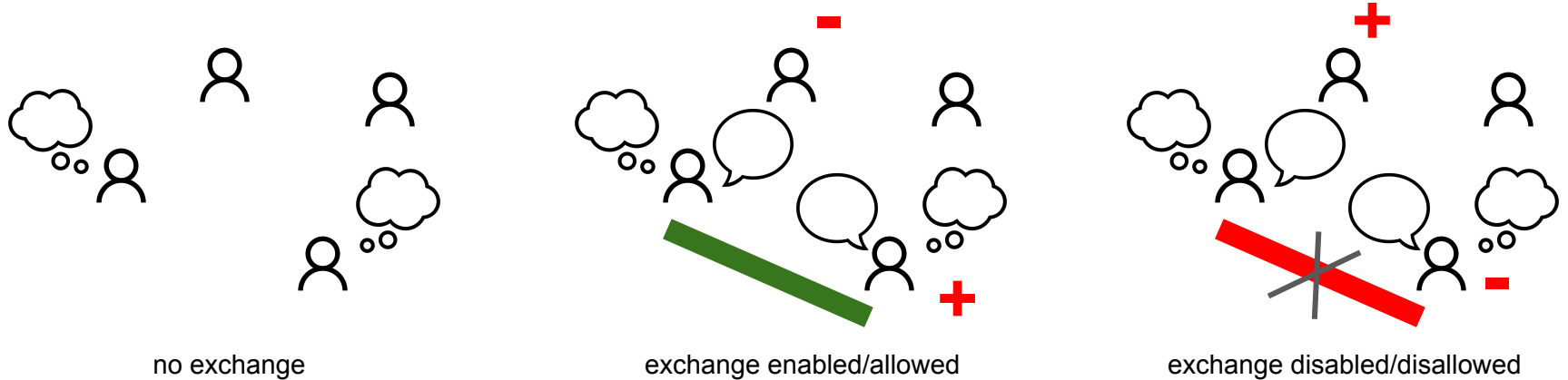because having access to relevant information has value for agents!

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- societies introduce checks & balances

➡ **e.g. norms on privacy, data regulation (e.g. GDPR), competition laws, etc.**

ability (power) dimension   **permission** dimension

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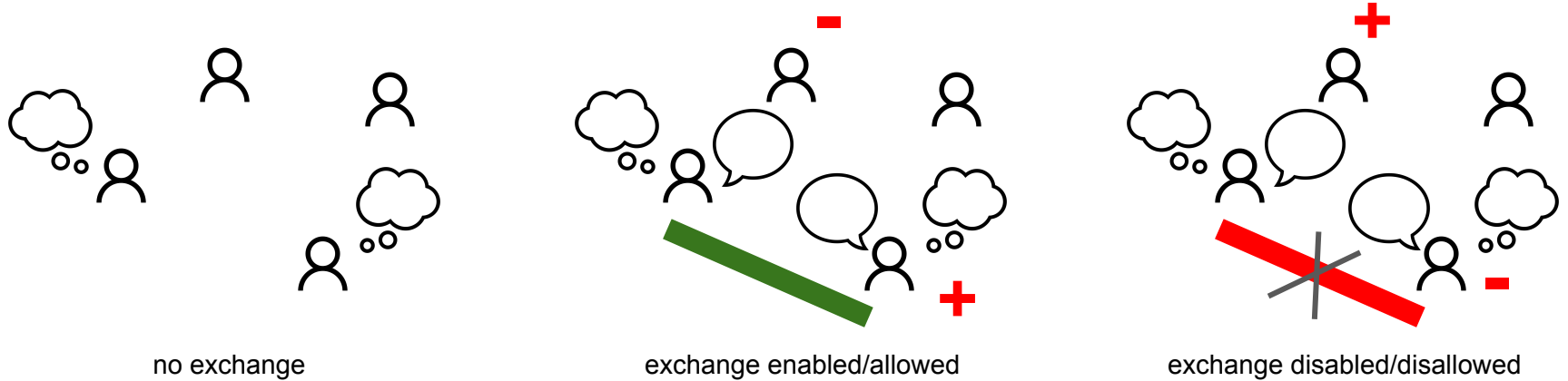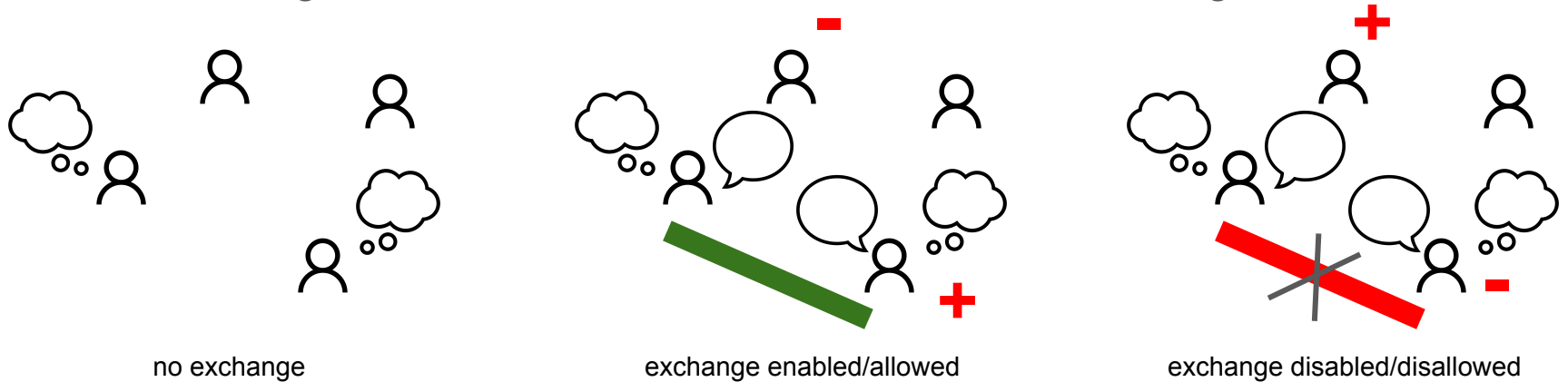no exchange   exchange enabled/allowed   exchange disabled/disallowed

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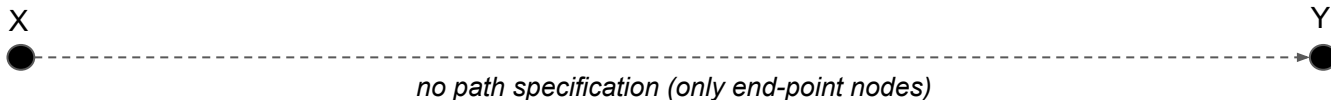e.g. norms on privacy, data regulation (e.g. GDPR), competition laws, etc.

How these checks and balances are reflected at infrastructural level?

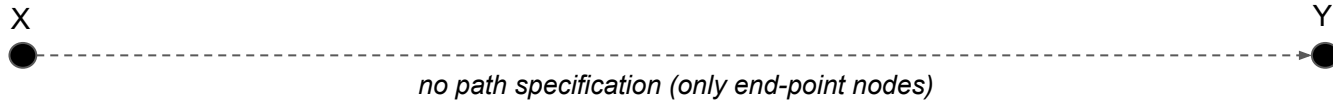# Data transmission as "logistic" task

How to transport data from node X to node Y?

X   Y

no path specification (only end-point nodes)

Data transmission as "logistic" task

How to transport data from node X to node Y?

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●- ●
no path specification (only end-point nodes)

- Enabling transmission from X to Y requires the network
  to provide some form of **routing services.**

X   Y
●- - - - - - - - - - - - - - ●- - - - - - - - - - - - - ●- - - - - - - - - ●
partial path specification (with intermediary steps)

X   Y
●——→●——→●——→●——→●——→●——→●
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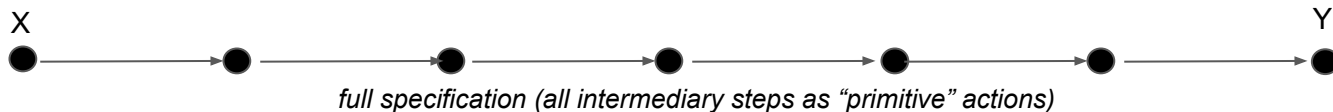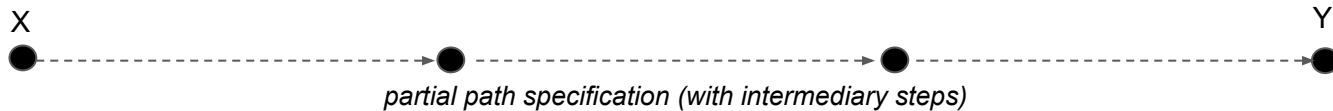
Data transmission as "logistic" task

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For ***inter-domain routing***, network operators typically rely on BGP policies and community tags.
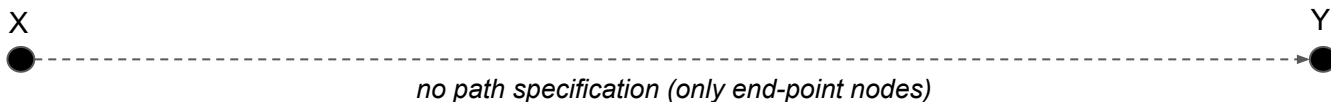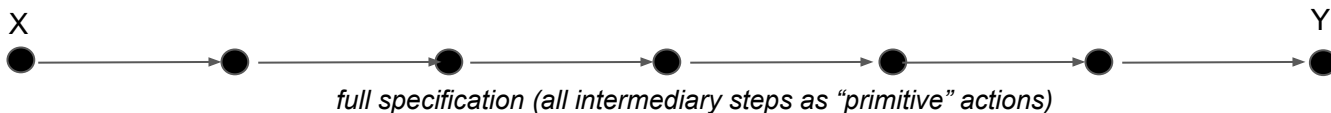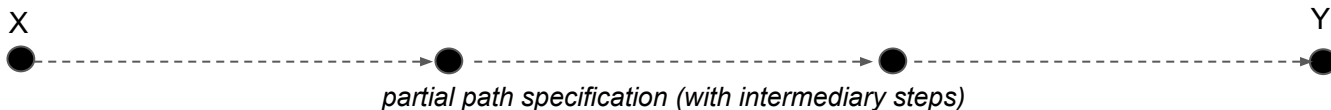
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Data transmission as "logistic" task

Main issues possibly occurring at network level:

faulty transmission

X   Y

abusive
transmission
(e.g. data-leak)   Z

X   Y

inefficient or expensive transmission (in terms of
resources load/usage, environmental impact, etc.)

X

Data transmission as "logistic" task

Main issues possibly occurring at network level:

Intuitively, a 'responsible' networking should reduce these issues.

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Intuitively, a 'responsible' networking should reduce these issues.

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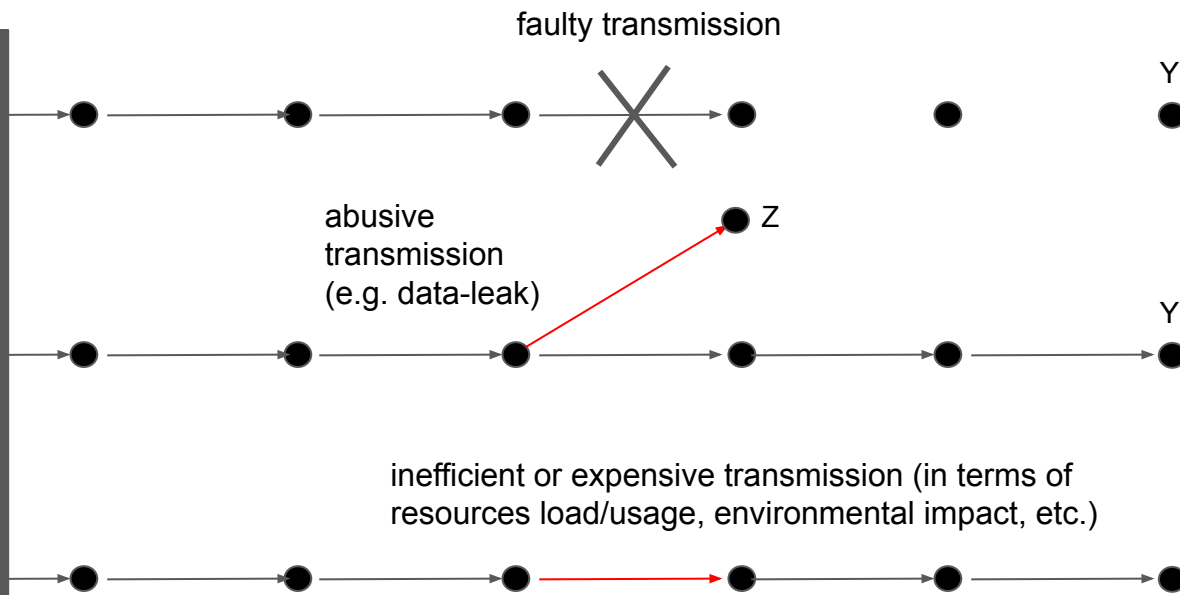
who defines what is faulty, abusive, expensive?
  who monitors? who prevents (predicts) or reacts to failures?

Data transmission as "logistic" task

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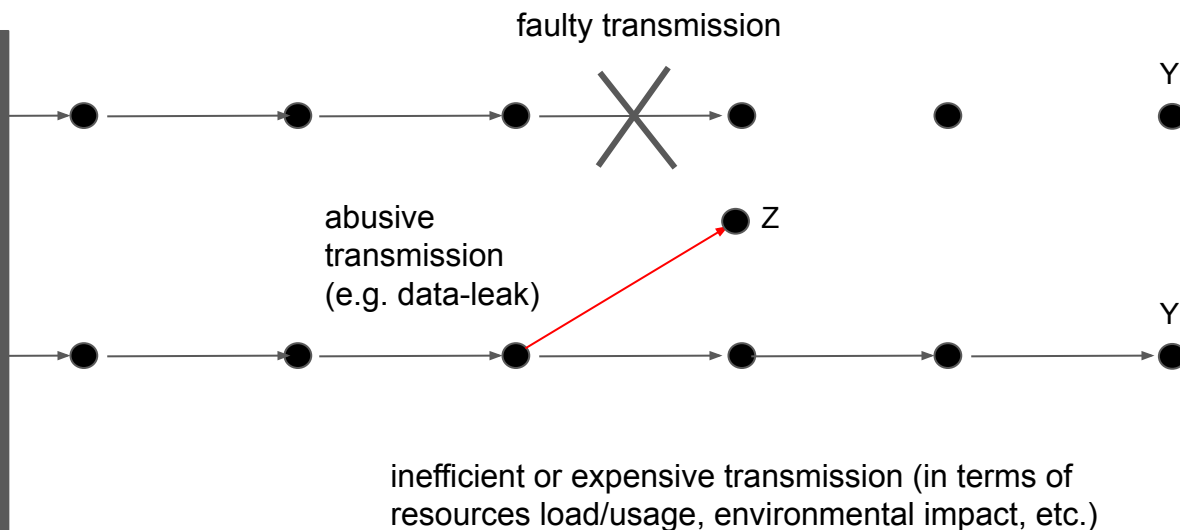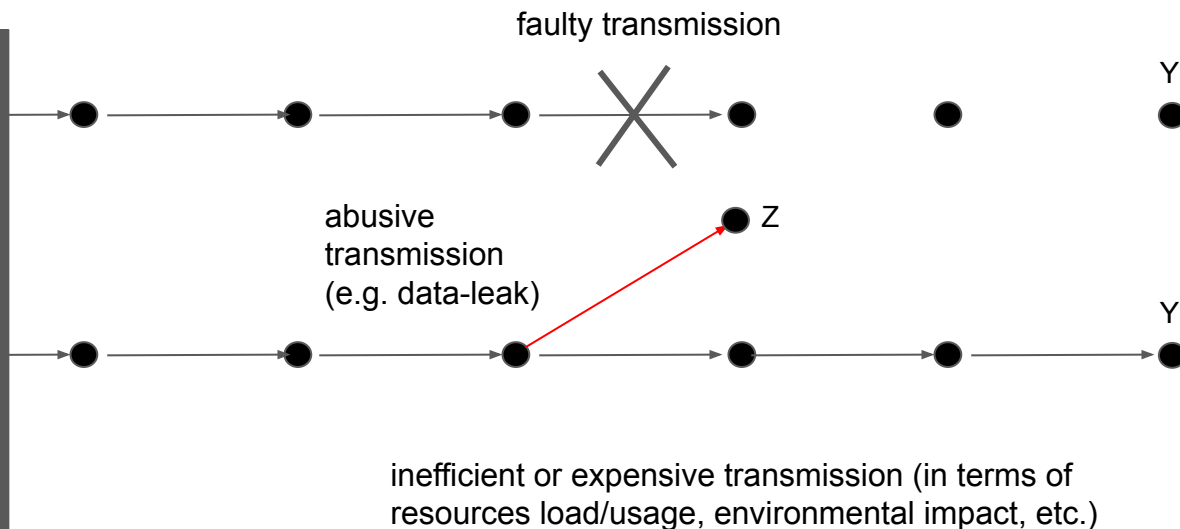Intuitively, a 'responsible' networking should reduce these issues.

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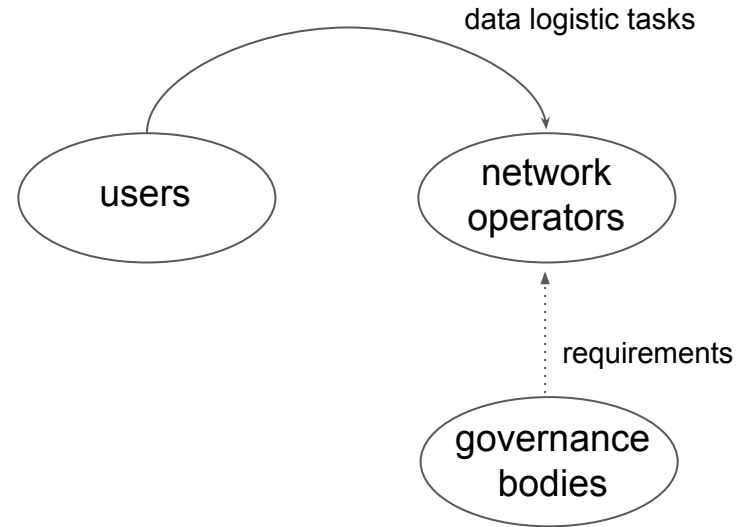*who monitors? who prevents (predicts) or reacts to failures?*

"responsibility" is a matter of **social coordination** policy
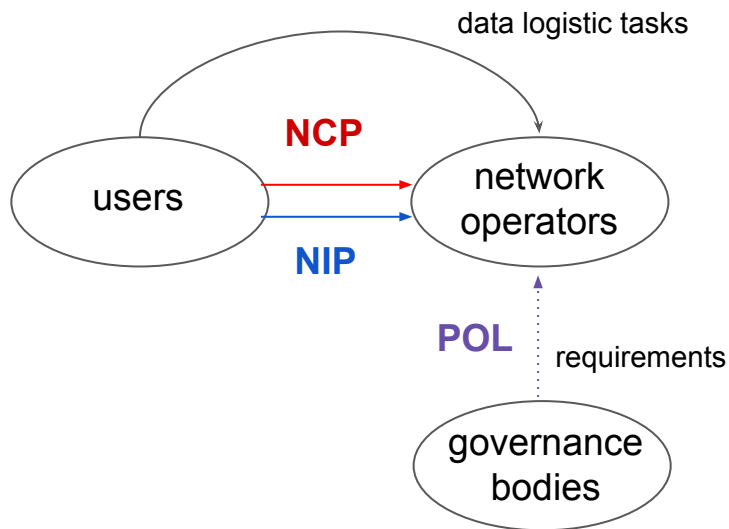
Internet social structure

Three main roles can be recognized around Internet's activities:

- users (applications, software agents, etc.)
- network operators
- governance bodies

data logistic tasks

users

network operators

requirements

governance bodies

Responsible Internet social structure

The Responsible Internet proposal
(Hesselman et al., 2020) essentially envisions
to **redistribute** control and monitoring abilities
to *users*, supported by regulations issued by
relevant societal stakeholders.

Cristian Hesselman, Paola Grosso, Ralph Holz, Fernando Kuipers, Janet Hui Xue, Mattijs Jonker, Joeri de Ruiter, Anna Sperotto, Roland van Rijswijk-Deij, Giovane C.M. Moura, Aiko Pras, and Cees de Laat. *A Responsible Internet to Increase Trust in the Digital World.* Journal of Network and Systems Management 28, 4 (2020), 882–922.

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open-source programmable networks (e.g. for routing, via BGP policies)

large-scale measuring techniques

data logistic tasks

NCP

users → network operators

NIP

POL

requirements

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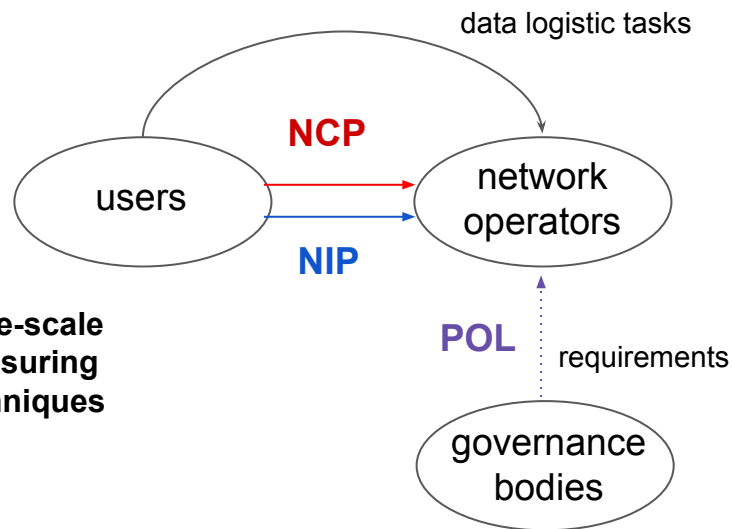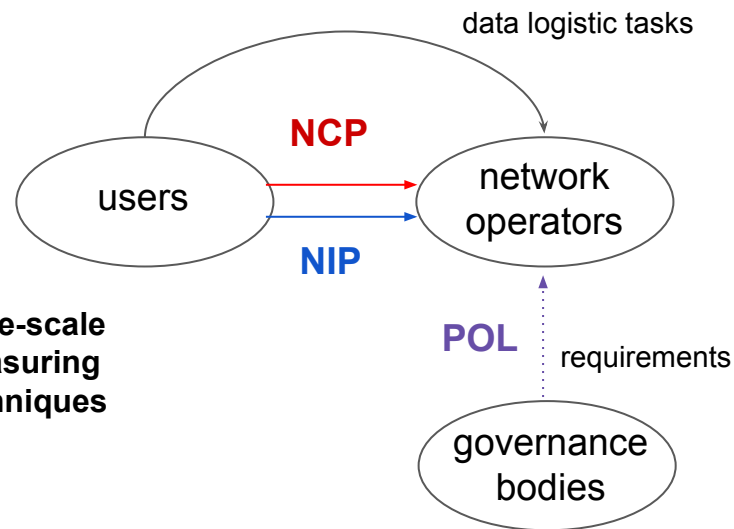
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**informed
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Cristian Hesselman, Paola Grosso, Ralph Holz, Fernando Kuipers, Janet Hui Xue, Mattijs Jonker, Joeri de Ruiter, Anna Sperotto, Roland van Rijswijk-Deij, Giovane C.M. Moura, Aiko Pras, and Cees de Laat. *A Responsible Internet to Increase Trust in the Digital World.* Journal of Network and Systems Management 28, 4 (2020), 882–922.
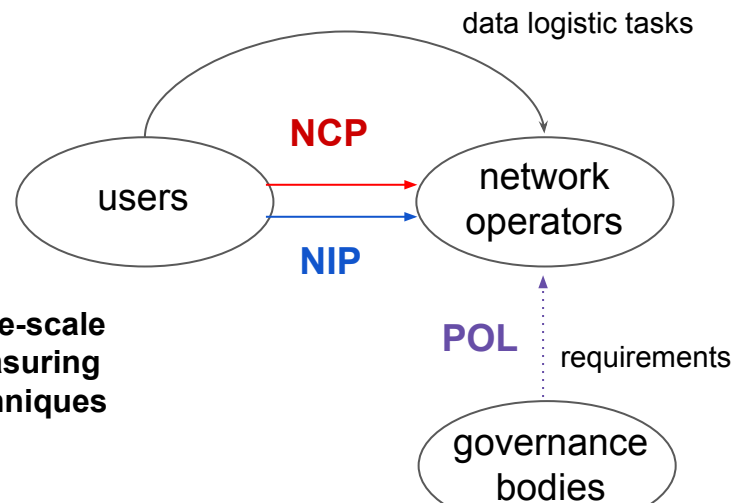
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IS THIS COMPLETE?

Cristian Hesselman, Paola Grosso, Ralph Holz, Fernando Kuipers, Janet Hui Xue, Mattijs Jonker, Joeri de Ruiter, Anna Sperotto, Roland van Rijswijk-Deij, Giovane C.M. Moura, Aiko Pras, and Cees de Laat. *A Responsible Internet to Increase Trust in the Digital World.* Journal of Network and Systems Management 28, 4 (2020), 882–922.

Our paper raises two critiques

- **RESPONSIBILITY GAP**: Low-level programmability (e.g. for routing, via BGP policies) is not sufficient to capture and behaviourally operationalize the value structure of users.

- **REGULATIVE CONTINGENCY:** Power-relationships between roles should not be hard-coded (that is, should be partially programmable).

Requirements for responsibility
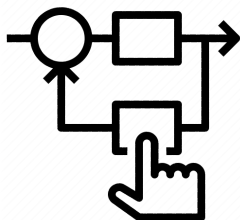
An agent has (agentive) *responsibility* if it:

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control its own
behaviour

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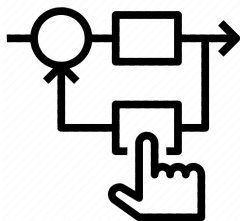**foresee** the
associated outcomes

has the ability to
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according to a certain
preference/value
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Sileno, G., Boer, A., Gordon, G., Rieder, B., Like Circles in the Water: Responsibility as a System-Level Function.
Proceedings of 3rd XAILA workshop: Explainable and Responsible AI and Law, in conjunction with JURIX 2020 (2020)

Requirements for responsibility

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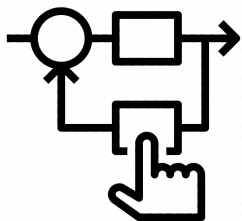has the ability to **control** its own behaviour

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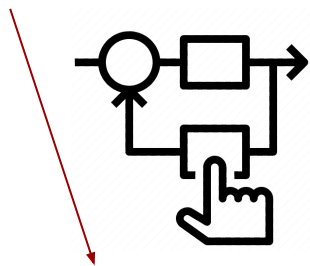
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In the *Responsible Internet* proposal, users gain *controllability* by low-level programmability (via the NCP).

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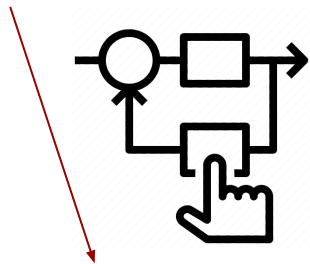
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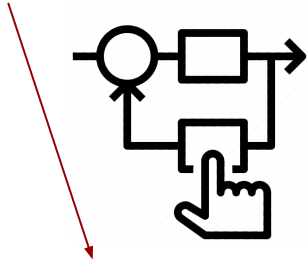has the ability to **foresee** the associated outcomes

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HOW CAN WE REPAIR THIS?

Reducing the responsibility gap

[1] We need a model of how the world functions.

➡️ **EXPECTATIONS artefact**

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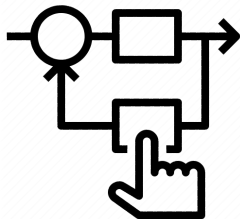
Reducing the responsibility gap

[1] We need a model of how the world functions.

→ **EXPECTATIONS artefact**

[2] We need a model of what is valuable in the world.

→ **high-level POLICY artefact**

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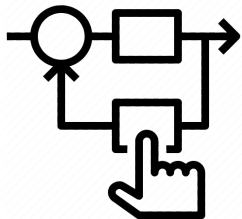
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norm as in normal

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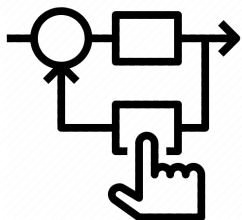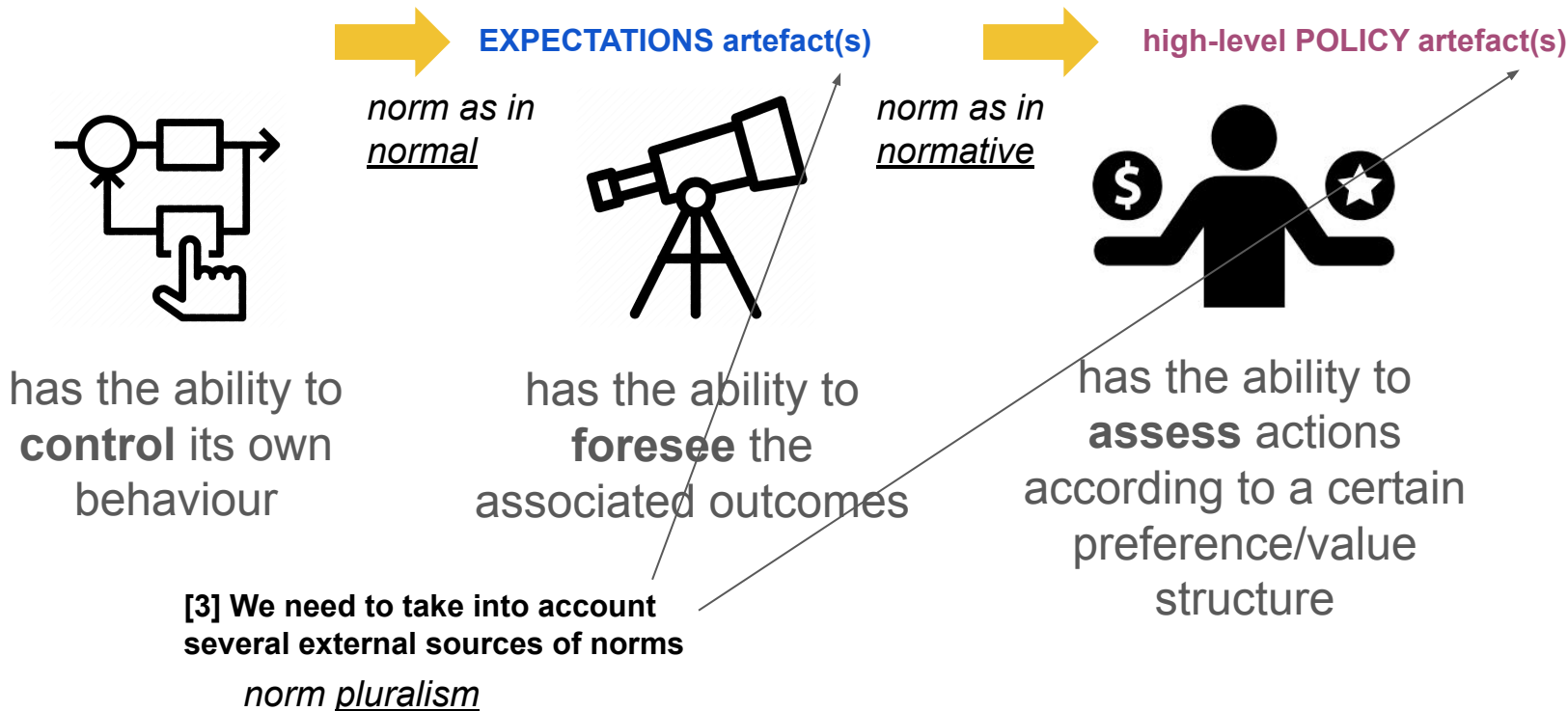**[1] We need a model of how the world functions.**

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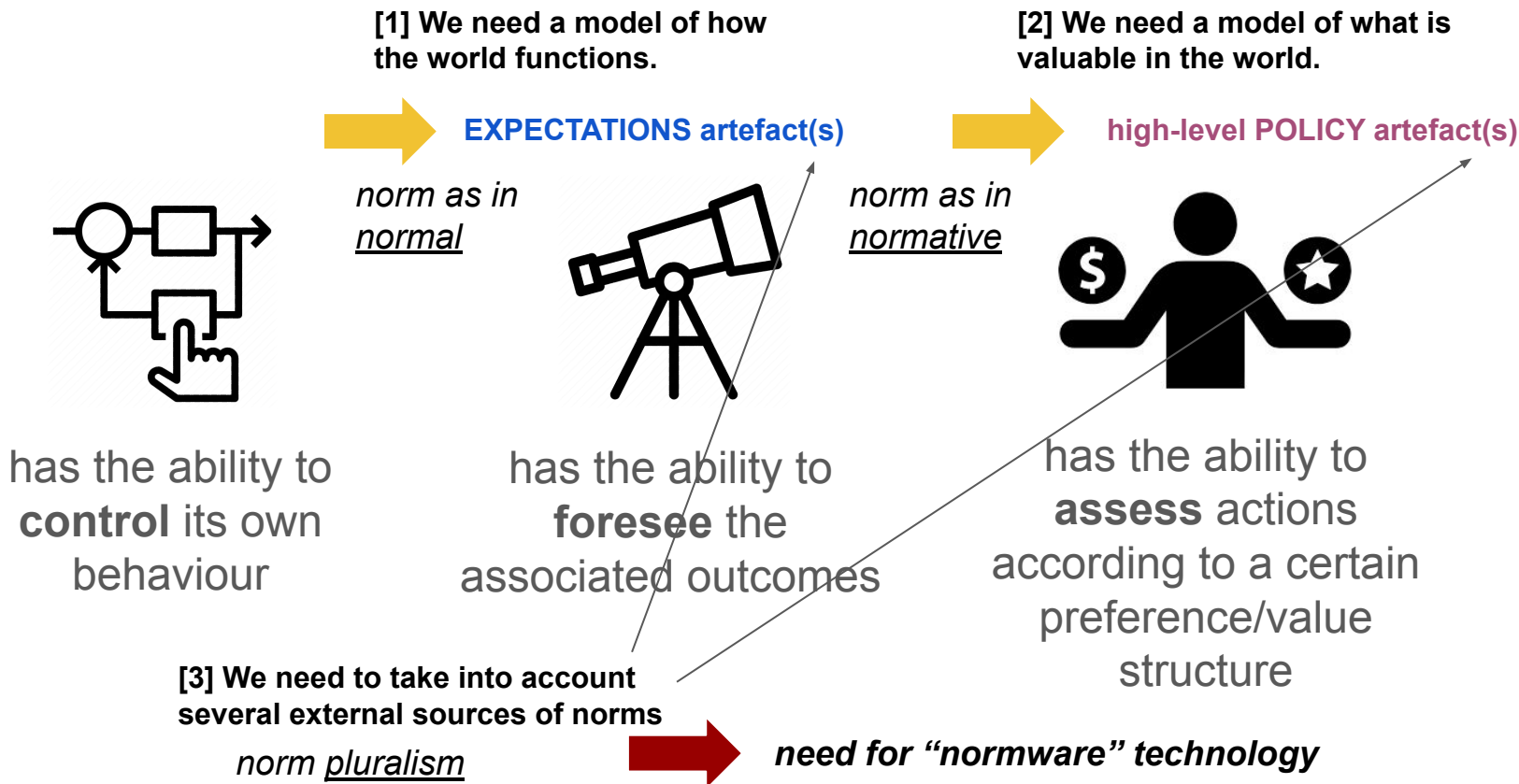**[3] We need to take into account several external sources of norms**

norm pluralism

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norm pluralism

→ ***need for "normware" technology***

From higher-level to lower-level policies

The paper elaborates on the functions required to pass from high-level specifications to low-level policies (e.g. BGP policies and community tags for routing)...
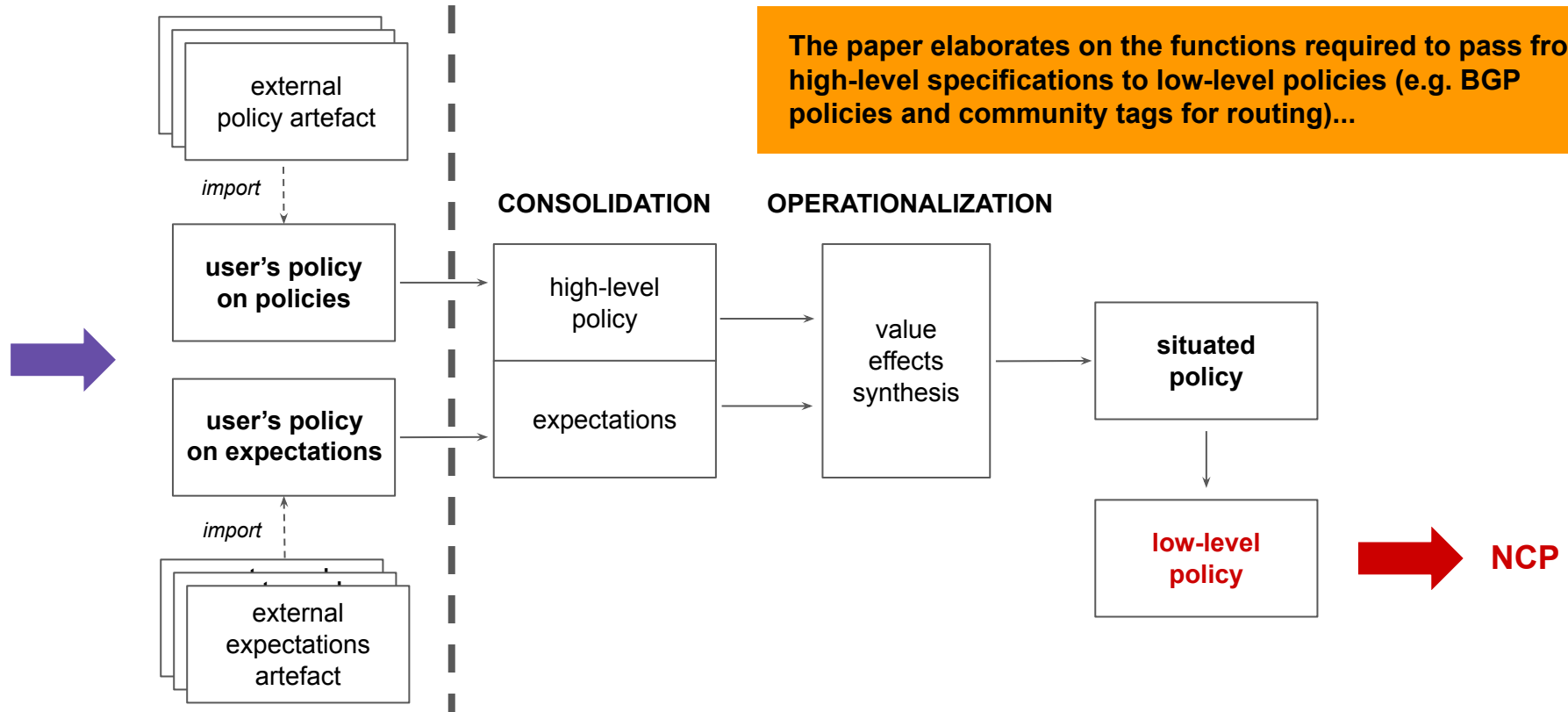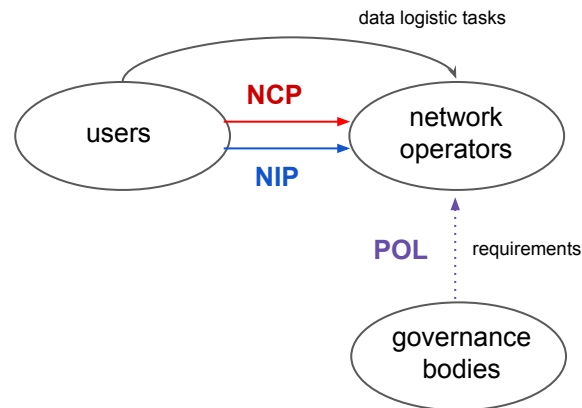
Regulative contingency

Users, network operators, and the various governance bodies have all legitimate interests to play a role in policy-making.

Prototypical conflictual design choice: *anonymity vs accountability*.

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Governmental, public agencies are users of the infrastructure, and play a role in the infrastructure governance bodies.

The Responsible Internet proposal says that POL

- should *be informed* by NIP and
- should *drive* the NCP.

data logistic tasks

NCP

users

network operators

NIP

POL   requirements

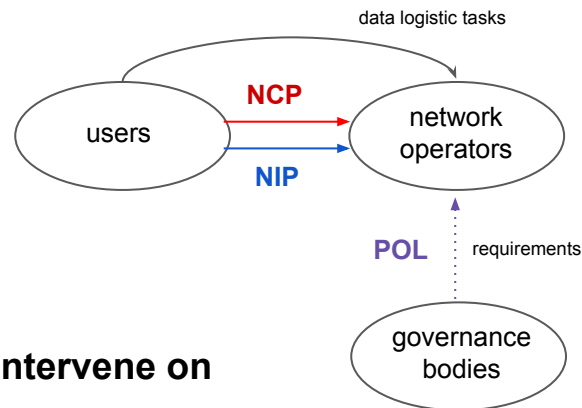governance bodies

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but how? to what extent regulators can intervene on users' activity on the infrastructure?
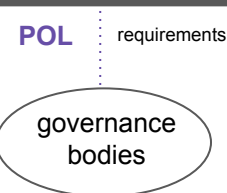
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POL ⋮ requirements

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- Power-relationships between roles should not be hard-coded, but programmable. → *an additional use case for a policy-based technology*

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POL ┆ requirements

governance bodies
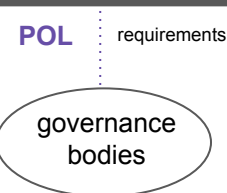
Conclusions (1a)

"give me eyes, and I'll know where I'll go" Computation cannot be "responsible" if the computational agent has no means to evaluate the effect of its actions, and then to prevent wrong outcomes.

Conclusions (1b)

"give me eyes, and I'll know where I'll go" Computation cannot be "responsible" if the computational agent has no means to evaluate the effect of its actions, and then to prevent wrong outcomes.

"pipes are dumb, water drinkers are not" Networks are supposed to operate blindly with respect to the content they transport, by making decisions on packets and unaware of the value of the whole transactions. *But this information is (to some extent) available at the users' endpoints!*

In full control, users should be able to provide some artefact specifying their preference/value structure and their expectations. Network operators should operate, still blindly, just according to these directives.

Conclusions (2a)

"do not hard-code what is soft-coded" It is premature, if not wrong, to aim to a definitive solution concerning power-relationships (e.g. full-control for users and full-blindness for network operators). Too many local contextual factors intervene to set which are the "right" checks and balances. We need **programmability** also at this level. *But what to program?*

Conclusions (2b)

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"what works, it may work" For a global network like the Internet, possible starting points would be normative constructs and frameworks developed in non-computational contexts, as in international law, or most plausibly in *international private law*, already operative across very diverse jurisdictions.

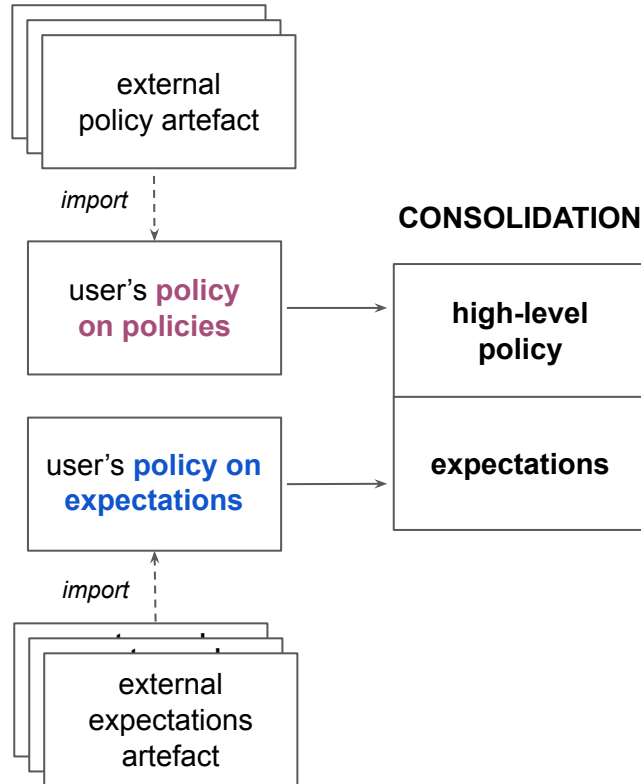# Accounting Value Effects for Responsible Networking

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University of Amsterdam

BACKUP

From higher-level to lower-level policies

external
policy artefact

import

user's **policy on policies**

user's **policy on expectations**

import

external
expectations
artefact

CONSOLIDATION

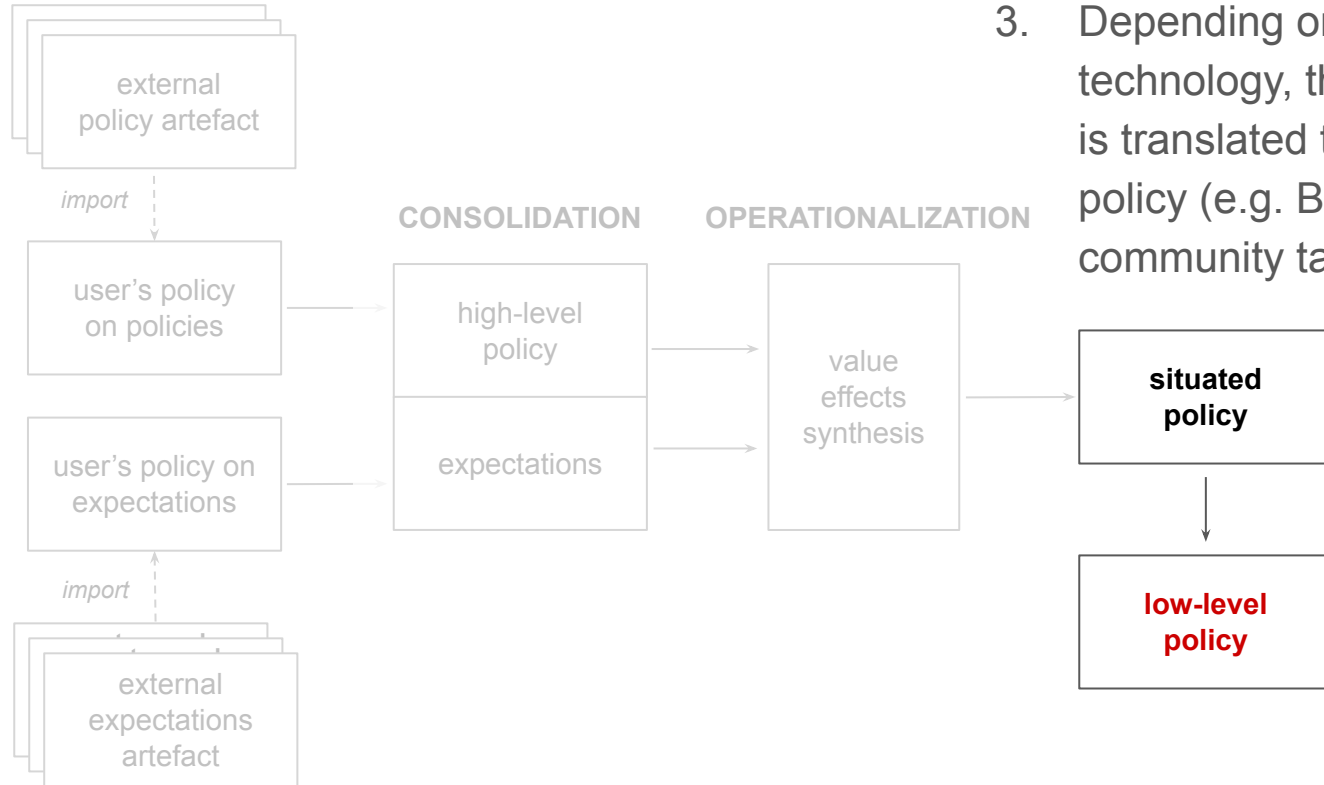**high-level policy**

expectations

1. Following user's specifications, external artefacts are imported with relative priority

From higher-level to lower-level policies

external policy artefact

import

user's policy on policies

user's policy on expectations

import

external expectations artefact

CONSOLIDATION

OPERATIONALIZATION

high-level policy

expectations

value effects synthesis

situated policy

2. High-level policy and expectations, by some form of *derivation*, are used to form behavioural policies fit to the current situation.

From higher-level to lower-level policies

external
policy artefact

import

CONSOLIDATION

OPERATIONALIZATION

user's policy
on policies

high-level
policy

value
effects
synthesis

user's policy on
expectations

expectations

import

external
expectations
artefact

3. Depending on task and technology, the situated policy is translated to a low-level policy (e.g. BGP policy, community tags for routing)

**situated
policy**

**low-level
policy**

Responsible networking

- Novel standpoint on responsible computing
  - *single high-level task*: data logistic problem
  - (extreme) **distribution** of resources, computational load
  - (extreme) **decentralization** of control
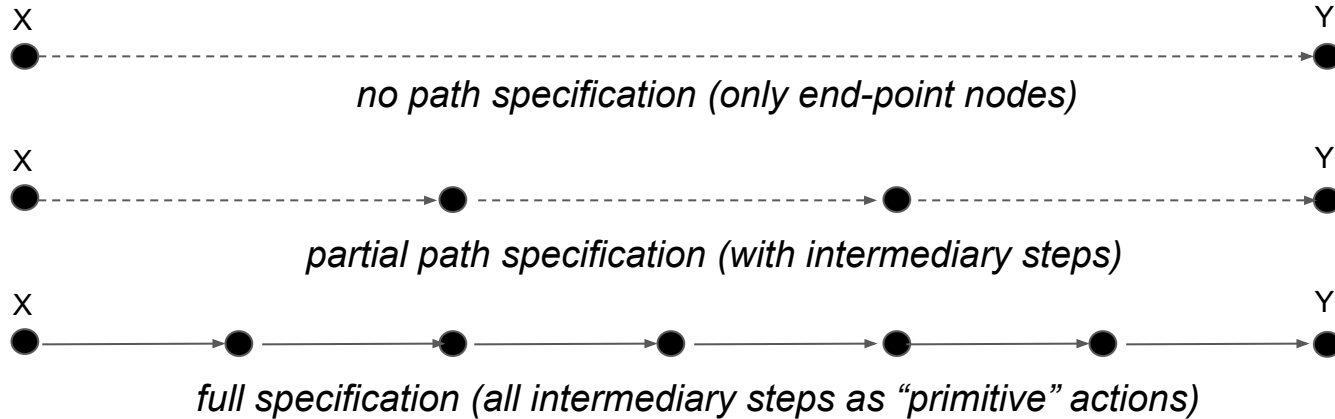
Responsible networking

- Novel standpoint on responsible computing
  - *single high-level task*: data logistic problem
  - (extreme) **distribution** of resources, computational load
  - (extreme) **decentralization** of control

fundamental dimensions of computing overlooked
in responsible AI contexts

"Logistic" problem of data transmission

`transporting data from node X to node Y`

X   Y

no path specification (only end-point nodes)

X   Y

partial path specification (with intermediary steps)

X   Y

full specification (all intermediary steps as "primitive" actions)

- Enabling transmission from X to Y requires the network to provide some form of **routing services.**
- "*dumb pipe*" principle: the data logistics activity is unconditioned by what the transmission is about or other application properties.

What defines "responsible" behaviour?

- personal values and preferences
- social acceptability
- social opportunity

me

the group

What defines "responsible" behaviour?

- personal values and preferences
- social acceptability
- social opportunity

demotion **promotion**

	demotion	promotion
individual level		
collective levels		

collective levels
(group, organization, societal, etc.)

➡️ *several dimensions at stake!*

Responsibility attribution

Responsibility is used in diverse domains as moral discourse, law, (software) engineering (e.g. the single-responsibility principle, *one module, one function*), ...

FUNCTION OF RESPONSIBILITY

Localization of failures in systems whose components are deemed to be independent/autonomous.
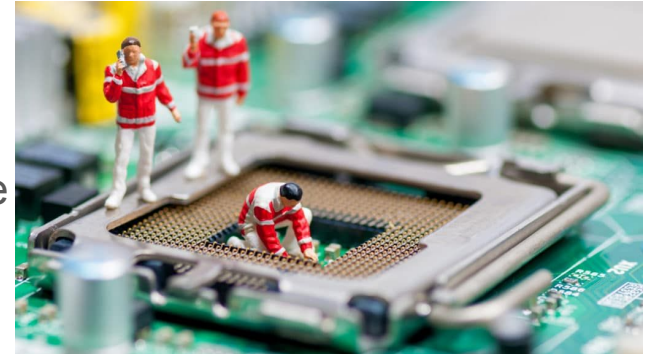
- **Causal Responsibility** (physical, operational, etc.)
- **Moral Responsibility** (legal, social, etc.)

Sileno, G., Saillenfest, A., Dessalles, J.L.: A Computational Model of Moral and Legal Responsibility via Simplicity Theory. JURIX 2017 FAIA 302, 171–176 (2017)