Recursive Polycentric Governance Based on the Localities — Neighbors — Distants Triad

Sylvain Lebel

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Abstract

We propose a polycentric governance framework grounded in a recursive triadic structure composed of sovereign localities, their neighbors, and distributed distant collectives.

In this model, all normative decisions are taken locally, according to each collective's own procedures (deliberation, majority vote, expertise, moral reasoning, or any combination thereof).

System-wide regulation does not operate through prior authorization or vertical hierarchy, but ex post, through a distributed judgment mechanism based on the convergence of disagreements expressed by neighboring and distant collectives.

A local decision is declared *constitutionally unacceptable* when it is judged as such by a simple majority of neighboring collectives and by a simple majority of distant collectives selected through a distributed process.

This declaration constitutes a public normative signal rather than an automatic prohibition.

The mechanism produces an emergent network-based normativity, without central authority, without a superior sovereign body, and without suppressing local political diversity.

Exploratory multi-agent simulations, including an implementation based on the Canadian federal structure (46 regional localities, 13 provinces and territories), suggest that this architecture promotes abuse limitation, systemic resilience, and reduction of structural domination, while remaining compatible with the existence of higher administrative levels, shared public services, and multi-scale political peoples.

Project website: https://sylebel.net

Code repository: https://github.com/sylebel-cdr/polycentric-governance-simulation

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1 1. Problem Statement

Contemporary political systems are predominantly structured around a rigid separation between:

- local decision-making,
- national regulation,
- central sovereignty.

This architecture assumes that an ultimate vertical authority is required to arbitrate conflicts, ensure coherence, and prevent abuses.

The present work explores an alternative hypothesis:

the normative coherence of a political system can emerge horizontally, through structured interaction among sovereign collectives, without any central authority endowed with coercive power.

2 2. The locality as a complete political unit

A locality is defined here as the lowest collective level capable of ensuring the essential public functions required by its population:

- services,
- rules,
- institutions,
- security,
- taxation,
- political representation.

A locality may correspond to:

- a city,
- a region,
- a small province,
- a small state.

No normative scale is imposed a priori.
Fundamental hypothesis:
the locality constitutes the smallest politically complete unit.

3 3. Local decision-making and democratic plurality

All decisions are taken locally, according to the collective's own rules:

- representative or direct democracy,
- administrative expertise,
- judicial arbitration,
- referendum,
- citizen deliberation.

The model prescribes no particular form of democracy.
It merely asserts that:
normative decision always belongs to an identifiable collective.

4 4. The functional triad: local / neighbors / distants

Every local decision is embedded within a three-pole relational topology:

4.1 4.1 The local

The collective that decides, implements, and assumes the immediate consequences of the decision.

4.2 4.2 The neighbors

Collectives in direct and regular interaction with the locality:

- territorial continuity,
- economic flows,
- human networks,
- functional interdependencies.

4.3 4.3 The distants

Distants designate non-neighboring collectives, selected in a distributed manner and located outside the zones of direct interdependence with the concerned locality.

They constitute neither a global authority nor a centralized supervisory body.

Their function is to introduce into the judgment a **structurally decoupled** point of view, that is:

- without direct economic dependency,
- without binding political or institutional relationship,
- without immediate strategic benefit related to the evaluated decision.

Distant collectives may be selected through:

- mutual agreement between localities,
- voluntary twinning,
- periodic rotation,
- or any other locally recognized distributed protocol.

The diversity sought is neither ideological nor cultural, but **relational**.
The objective is not to represent the world, but to limit interest correlation.

Thus, distant collectives may strongly resemble one another (for example, all urban or all regional), provided they are genuinely external to the direct influence networks of the decision under review.

Indicatively, the number of distant collectives should be:

- at least five,
- and of the same order of magnitude as the number of neighbors.

Distant collectives may remain stable over time, particularly when the number of available entities is limited.

Periodic renewal — for example every two years — may be desirable when territorial configuration allows it, without constituting an obligation.

Selection protocols for distants must be public, explicit, and auditable, in order to guarantee system transparency.

5 5. Central principle: judgment of inacceptability

Neighbors and distants do not decide in place of the local collective.

They evaluate neither legality nor ideological conformity.

They express only:
whether the decision appears unacceptable to them, for any reason whatsoever.
These reasons may be:

- environmental,
- economic,
- moral,
- security-related,
- cultural,
- symbolic.

Such reasons must be explicitly communicated, so that the locality can understand the nature of the disagreement.

6 6. Constitutional double-majority rule

A local decision is declared *constitutionally unacceptable* when:

- at least 50% of neighbors judge it unacceptable,
- **and** at least 50% of distants judge it unacceptable.

Neither group can block a decision on its own.
This rule constitutes the minimal constitution of the system.
It produces neither automatic prohibition nor direct constraint, but a **shared public normative signal**, intended to inform the concerned collective of the level of disagreement reached.
It imposes no normative content; it imposes only the form of collective judgment.
The 50% threshold corresponds to a simple majority, chosen as the minimal level allowing:

- clear expression of collective disagreement,
- without imposing excessive conservatism,
- nor rendering the system dependent on rigid supermajorities.

The objective is not to produce consensus, but to establish a balance point between normative stability and evolutionary capacity.
This signal becomes coercive only if the locality persists without providing a response judged sufficient by the collectives that issued the inacceptability judgment, in which case relational sanctions may be applied (§7.1).

7 7. Judgment of inacceptability and non-automaticity of sanctions

When a local decision is declared constitutionally unacceptable, the collective judgment produces only:

- a public signal of qualified disagreement,
- normative information addressed to the concerned locality,
- visibility of the conflict within the network.

No constraint is automatically applied.
The locality fully retains its decision-making sovereignty and may:

- maintain the decision unchanged,
- modify it partially,
- withdraw it,
- or propose compensatory measures.

7.1 7.1 Local response and sufficiency judgment

When a local decision is declared constitutionally unacceptable, the concerned collective may formulate a response.

This response may take various forms, including:

- partial or total modification of the initial decision;
- withdrawal of the decision;
- compensatory measures (economic, environmental, social, or symbolic);
- reasoned justification for maintaining the decision.

The collectives that expressed the initial inacceptability — neighbors and distants — may, in their response, formulate requirements or conditions.

These requirements do not constitute a superior normative authority:
they are admissible only insofar as they are themselves compatible with the internal rules of those collectives and accepted through their own local procedures.

Response sufficiency is evaluated by the **same neighbors and distants** as in the initial judgment, according to the **same double-majority mechanism**.

A response is considered sufficient when:

- a simple majority of neighbors,
- and a simple majority of distants,

judge that the collective has adequately taken into account the normative signal expressed.

There exists no universal substantive definition of sufficiency;
it is left to the collective appreciation of the judging entities.

The sufficiency decision is **binary**: the response is declared either *sufficient* or *insufficient*.
When declared sufficient, the inacceptability signal is closed (without erasing the public historical record of the disagreement), and no sanction may be triggered within that cycle.

7.2 7.1.1 Indicative protocol temporality

The proposed framework does not impose rigid constitutional deadlines.

It nevertheless provides indicative time scales intended to ensure procedural legibility without compromising flexibility.

Indicatively:

- evaluation of a local decision may extend over **one to three months**;
- the period granted to the locality to formulate a response is determined by the neighbors and distants who expressed inacceptability;
- the point at which relational sanctions may be considered likewise falls under their collective appreciation.

These temporal decisions are themselves local decisions and may therefore be subject to judgment under the same protocol.

The system thus relies not on a central clock, but on a distributed temporality proportionate to the stakes of each situation.

7.3 7.2 Nature of sanctions (standardized and constitutional)

Sanctions are not left to the free discretion of each collective.

They belong to a **common constitutional catalogue**, recognized by all localities participating in the protocol, and applied homogeneously when triggering conditions are met.

The catalogue does not impose a single intensity, but a **shared grammar**:
each sanction is defined by its type, escalation level, maximum duration, and lifting conditions.

Sanctions remain **relational** (they concern inter-collective cooperation), but their form is **standardized**, in order to avoid:

- arbitrariness,
- response cacophony,
- strategic unpredictability.

7.3.1 7.2.1 Indicative constitutional catalogue (examples)

Examples may include:

- **S1 — Constitutional public notification**
  Publication of the identified breach and its justification in a shared registry.
- **S2 — Suspension of non-essential cooperation**
  Temporary suspension of non-critical partnerships or projects.
- **S3 — Suspension of specific agreements**
  Targeted suspension of agreements related to the affected domain.
- **S4 — Temporary exclusion from non-vital shared infrastructures**
  Suspension of access to selected common facilities (excluding vital services).
- **S5 — Enforceable compensatory measures**
  Obligation of compensation within a defined framework (funds, mitigation, repair).
- **S6 — Reinforced relational isolation**
  Coordinated reduction of interactions under strict temporal control.

The exact catalogue, escalation thresholds, and exclusions (vital services, emergency response, etc.) fall under the constitution of the network and not under the present paper.

7.3.2 7.2.2 Constitutional triggering

A catalogue sanction may be applied only when:

1) the decision has been declared *constitutionally unacceptable* (§6);

2) the collective has received a response period determined by the same neighbors and distants (§7.1.1);

3) the response has been judged **insufficient** by the same neighbors and distants, according to the same double-majority mechanism (§7.1).

Once these conditions are satisfied, application of the sanction becomes **constitutionally mandatory**, according to the predefined escalation level.

7.3.3 7.2.3 Proportionality and exit principles

The catalogue enforces:

- **proportionality** (graduated sanctions, progressive escalation);
- **reversibility** (explicit lifting conditions);
- **limited duration** (no indefinite sanctions);
- **protection of vital functions** (emergency services, immediate safety).

The system therefore does not permit unlimited coercion, but a bounded relational constraint, strictly conditioned and publicly justified.

7.4 7.3 Structural effect

This mechanism introduces a decisive asymmetry:

- ignoring collective judgment becomes risky,
- dialogue becomes rational,
- deception or concealment becomes structurally costly.

Constraint thus arises not from superior power, but from reciprocal dependence among autonomous collectives.

8 8. Transparency and good faith

Refusal to provide the information necessary to evaluate a decision — concealment, obstruction, falsification — constitutes in itself a local decision.

As such, it may be judged by neighbors and distants and expose the collective to sanctions.

Thus:

lying or preventing evaluation becomes structurally riskier than cooperation.

9 9. Distributed normative recursion

Any decision — including a judgment of inacceptability itself — constitutes a local decision and may therefore be evaluated by other collectives according to the same functional triad.

There is thus no final authority and no ultimate normative stopping level.

When a judgment of inacceptability is itself judged unacceptable, it is immediately annulled as a normative signal, without retroactively invalidating the initial decision.

The disagreement does not disappear: it shifts toward the collectives that issued the judgment, which in turn become exposed to the distributed evaluation of the network.

Normative recursion is therefore complete at the formal level.

It nevertheless remains practically self-limiting:

- the propagation of judgments decreases with topological distance;
- institutional and relational costs increase at each iteration;
- political interest diminishes as the marginal impact of the judgment weakens.

Norm therefore does not emerge as a decree, but as a **field of relational stability**, resulting from the convergence or progressive dissipation of disagreements.

10 9.1 Relational localization of the norm

In classical political systems, a norm is generally conceived as binary:
it is valid, invalid, or derogatory.

It has no relative position within the collective space.

The proposed framework introduces an additional property: **relational localization of the norm**.

A local decision may thus be:

- fully accepted by certain collectives;
- partially contested by others;
- broadly tolerated despite persistent disagreement;
- or judged unacceptable at certain levels only.

The norm therefore ceases to be a uniform object and becomes a **distribution of judgments** across the network.

This distribution constitutes political information in its own right:
it indicates not only *that a disagreement exists*, but **where it is located**, between which collectives, and to what degree.

The local validity of a decision remains strictly binary — a rule either applies or does not apply within a given territory —
but its systemic acceptability becomes gradual and spatially situated.

This property enables normative harmonization without uniformization:

- collectives belonging to the same political people may seek convergence;
- while maintaining acknowledged divergences linked to their social, cultural, or territorial realities.

Political unity no longer rests on identity of rules, but on the **shared legibility of their differences**.

11 10. Isomorphic higher levels

Regional, national, or continental levels do not constitute superior normative authorities.

They are higher-level localities endowed with the same functional structure:

- local,
- neighbors,
- distants.

They may in particular:

- administer common goods;
- manage infrastructures (transport, energy, aviation);
- coordinate public services;
- embody political peoples (for example: Quebecois people, Canadian people).

They possess no unilateral normative power over lower-level collectives.

The competences they exercise result exclusively from explicit, prior, and revocable delegations.

They may also:

- administer collective heritage;
- ensure resource redistribution;
- maintain shared agencies;
- carry historical, legal, or cultural continuity.

These levels thus embody multi-scale political peoples, without normative hierarchy among the collectives that compose them.

They coordinate, administer, and represent — but never govern by imposition.

11.1 10.1 Rule of non-traversability between levels

Territorial levels are **isomorphic** but **non-traversable** with respect to constitutional judgment.

A judgment of inacceptability operates **within a single level**:

- a provincial-level decision (or equivalent) is judged only by other provinces (or equivalents);
- a regional-level decision is judged only by other regions;
- a municipal decision is judged only by other municipalities.

This rule prevents the reintroduction of implicit hierarchy from above or below.

It does not prohibit political expression, public contestation, or local action in response to the effects of a decision taken at a higher level;
it merely specifies that the **constitutional mechanism of judgment and sanction** does not operate across levels.

12 11. Crises, emergency, and defense

The proposed framework subjects no operational decision to prior authorization by neighbors or distants.

Every locality permanently retains the capacity to act immediately in response to a local crisis:

- natural disaster;
- industrial accident;
- health emergency;
- civil disorder;
- critical system failure.

The neighbor–distant judgment mechanism intervenes exclusively **ex post** and can in no case delay action.

Emergency suspends procedures — never responsibility.

12.1 11.1 Anticipated supra-local crises

Certain crises — pandemics, military aggression, systemic collapse, energy disruption — inherently exceed the local scale.

In such cases, collectives may:

- delegate operational competences in advance to a higher level;
- define shared alert protocols;
- maintain joint agencies;

- maintain collective security or defense forces.

These higher levels may then act immediately, without prior consultation, exactly as in a centralized system.

12.2 11.2 Fundamental difference from centralization

The difference does not concern speed of action, but the nature of delegation:

- competence is conferred **before the crisis**;
- it remains **conditional, revocable, and subject to ex post evaluation**;
- no institution possesses permanent normative power independent of distributed judgment.

The model thus enables emergency response equivalent to that of centralized authority, while preserving the possibility of subsequent collective control over the legitimacy, duration, and scope of adopted measures.

12.3 11.3 Illustrative example

A coastal locality orders immediate evacuation of an area following a risk of collapse.
This decision:

- is taken without prior authorization;
- is executed immediately;
- may produce significant economic and social effects.

Neighbors and distants possess no mechanism of suspension.
They may only, **a posteriori**, evaluate:

- proportionality of the measure;
- its duration;
- compensations provided;
- justification for maintaining or lifting the state of emergency.

Judgment thus bears not on the emergency act itself, but on its persistence, extension, and use after the critical phase.

13 12. Operational assumptions

The model assumes:

- imperfect but accessible information;
- real costs of cooperation and sanction;
- durable institutional diversity;
- minimal interconnection between collectives.

It assumes neither altruism, nor perfect rationality, nor prior moral consensus.

14 13. Domain of validity

This framework primarily targets:

- institutionalized societies;
- technologically interconnected systems;
- possessing stable local collectives.

It neither claims to describe all human societies nor to constitute a universal prescription.

14.1 13.1 Identified risks and structural limits

The proposed framework does not claim to eliminate all known political risks.

Several structural vulnerabilities are identified:

- **hegemonic coalitions**, when multiple collectives coordinate their judgments durably;
- **power asymmetries**, capable of influencing cooperation dynamics;
- **imperfect or biased information**, despite incentives toward transparency;
- **monitoring costs**, unevenly distributed among collectives.

These limits do not constitute internal contradictions of the model, but open axes for analysis, simulation, and empirical comparison.

The framework aims to structurally limit domination, not to guarantee its absolute impossibility.

14.2 13.2 Demographic asymmetries and the principle of formal equality

The framework maintains formal equality among localities regardless of population.

A collective of 150,000 inhabitants possesses the same judgment weight as a collective of 15 million.

This principle rests on several justifications:

1. **Territorial sovereignty:** Each locality constitutes a complete political people, regardless of size.

2. **Limitation of domination:** Demographic weighting would allow large collectives to systematically dominate smaller ones.

3. **Role of distants:** Structural decoupling attenuates regional biases, including demographic ones.

4. **Relational compensation:** Power asymmetries are partially offset through dynamics of reputation, cooperation, and recursion.

15 14. Exploratory simulation methodology (reproducible protocol)

The results mentioned in the abstract are not presented here as empirical proofs, but as **dynamic coherence tests** of an institutional protocol.

The objective is to provide a simple methodology allowing other researchers — including with the assistance of AI systems — to simulate and compare:

- normative stability;
- frequency of inacceptability signals;
- resolution rate through sufficient responses;
- frequency and severity of sanctions;
- resilience to coalitions and asymmetries.

15.1 14.1 Units, network, and minimal parameters

We define:

- **N** localities (nodes);
- for each locality i:
  - a set of **neighbors** V(i);
  - a set of **distants** D(i), with $|D(i)| \geq 5$ and of comparable order of magnitude to $|V(i)|$ (indicative).

The network may be:

- geographical (planar graph),
- institutional (interdependency network),
- or hybrid.

16 14.1 bis — Minimal structural formalization and formal properties

This formalization does not aim to introduce a normative theory nor to prove institutional superiority, but only to **make explicit the operational structure of the protocol**, in order to facilitate:

- experimental reproducibility,
- computational implementation,
- dynamic-coherence analysis,
- comparison with other institutional architectures.

The mathematical results presented below concern exclusively **structural properties of the mechanism**, independently of any political, moral, or anthropological hypothesis.

16.1 Institutional network

Let:

$$G = (L, E)$$

be an institutional graph where:

- $L = \{1, \ldots, N\}$ is the set of localities;
- E represents institutional relations among them.

For each locality $i \in L$, we define:

- a neighbor set $V(i) \subset L$;
- a distant set $D(i) \subset L$.

These sets satisfy:

$$V(i) \cap D(i) = \varnothing \quad \text{and} \quad |D(i)| \geq 5$$

Relations may be defined according to geographical, institutional, economic, or hybrid criteria.

16.2 Decisions and externalities

At discrete times $t \in \mathbb{N}$, a locality i may issue a decision:

$$d_i(t) = (c,\ \alpha,\ \tau,\ E_i)$$

where:

- c is the decision category;
- $\alpha \in [0, 1]$ is its intensity;
- $\tau \in \mathbb{N}$ is its duration (number of periods during which the decision remains active);
- $E_i(j)$ is the impact of the decision on locality j.

Temporal remarks: - A decision issued at t remains active until $t+\tau$ (unless withdrawn earlier). - Multiple decisions may coexist: $d_i(t_1), d_i(t_2), \ldots$ with their respective durations. - Acceptability judgment may occur at any time during the active period of the decision.

The set of externalities is represented by a matrix:

$$E : L \times L \to \mathbb{R}$$

where $E(i, j)$ represents the (positive or negative) impact of locality i on locality j.

Structural properties: - The matrix is generally **not symmetric**: $E(i, j) \neq E(j, i)$. - Externalities may be: - **direct** (geographical contiguity, economic flows, cross-border pollution); - **indirect** (via dependency chains or infrastructure networks); - **null** for pairs without significant interaction: $E(i, j) = 0$. - The exact form of E is free and depends on the simulated scenarios (see §14.8 for concrete examples).

16.3 Local acceptability judgment

Each locality j has its own internal rules, formalized by a judgment function:

$$J_j(d_i) \in \{0, 1\}$$

where:

- 0 means *acceptable*;
- 1 means *unacceptable*.

These rules may be:

- quantitative,
- qualitative,
- textual,

- or simulated by AI-based annotators.

No normative homogeneity across localities is assumed.
Example of a simple local rule:

$$J_j(d_i) = \begin{cases} 1 & \text{if } \alpha > \theta_j^c \text{ and } E(i,j) < -\varepsilon_j \\ 0 & \text{otherwise} \end{cases}$$

where: - θ_j^c is locality j's acceptable intensity threshold for decision category c; - ε_j is locality j's tolerance threshold for negative externalities.

This example illustrates how heterogeneous local rules can be formalized without presupposing any a priori normative convergence.

16.4 Constitutional inacceptability signal

A constitutionally unacceptable signal is issued when the following two conditions are simultaneously satisfied:

$$\frac{1}{|V(i)|} \sum_{j \in V(i)} J_j(d_i) \geq 0.5$$

and

$$\frac{1}{|D(i)|} \sum_{k \in D(i)} J_k(d_i) \geq 0.5$$

This rule defines an **independent double majority**, necessary and sufficient to trigger the response cycle.

16.5 Response and sufficiency

After issuance of the signal, the concerned locality produces a response:

$$r_i \in R$$

(modification, compensation, justification, withdrawal, or a combination).
Each neighbor and distant then evaluates the sufficiency of the response:

$$S_j(r_i) \in \{0, 1\}$$

where:

- 1 means *sufficient*;
- 0 means *insufficient*.

If the constitutional sufficiency threshold is reached, the cycle is closed.
Otherwise, the sanctions provided by the institutional catalogue apply according to the specified escalation rule.

17 Demonstrable formal properties

The following propositions describe **structural invariants** of the protocol.
They depend neither on the content of decisions nor on the motivations of actors.

17.1 Proposition 1 — Monotonicity of the inacceptability signal

Let d_i be a decision.
If we modify a set of local judgments by replacing some values 0 (*acceptable*) with 1 (*unacceptable*), without ever performing the inverse operation, then the constitutional signal $S(i, d_i)$ cannot switch from 1 to 0.

17.1.1 Proof

The sums:

$$\sum_{j \in V(i)} J_j(d_i) \quad \text{and} \quad \sum_{k \in D(i)} J_k(d_i)$$

are each **non-decreasing** under any transformation $0 \to 1$.
Consequently, their respective averages do not decrease.
Any inequality of the form:

$$\frac{1}{n} \sum J \geq 0.5$$

that held before modification still holds after.
Thus, both double-majority conditions remain true, and the signal $S(i, d_i)$ cannot switch from 1 to 0.
□

17.2 Proposition 2 — Termination of the decision cycle

Assume that the constitutional sanction catalogue is **finite**, with a maximum of K escalation levels.
Then, for any decision d_i, the decision–response–evaluation cycle terminates in at most $K + 1$ iterations.

17.2.1 Proof

At each iteration:

- either the response is judged sufficient, and the cycle is closed;
- or it is judged insufficient, and escalation advances strictly by one level.

Since the catalogue contains a finite number K of levels, indefinite escalation is impossible.
The cycle therefore necessarily reaches:

- either a sufficient response,
- or the maximal sanction,

in a finite number of steps less than or equal to $K + 1$.
□

17.3 Proposition 3 — Irrevocability of closure

Once a response r_i is judged sufficient for a given decision d_i, no subsequent sanction may be applied within that same cycle.

17.3.1 Proof

By definition of the protocol, the *closed* status is a terminal state of the cycle associated with decision d_i.

No authorized transition rule permits moving from a closed state to a sanctioned state for the same pair (i, d_i).

There is therefore no admissible system trajectory that would allow a sanction after closure.

□

17.4 Scope of the formalism and proofs

The preceding results establish that the protocol has:

- **internal logical coherence** (monotonicity);
- a **well-founded dynamics** (guaranteed termination);
- **procedural safety** (irrevocability of closed cycles).

They do not prove optimality, substantive justice, or social efficiency.
They only show that the institutional framework:

- is mathematically well-defined,
- does not generate internal contradictions,
- and enables rigorous dynamic exploration by simulation.

These proofs do not exclude the emergence of problematic phenomena such as:

- **unstable configurations** (oscillations, prolonged sanction wars);
- **durable hegemonic coalitions** (cartels of localities coordinating their judgments);
- **structural power asymmetries** (de facto domination despite formal equality);
- **decision paralysis** (systematic blocking in certain network configurations).

Analysis of these phenomena falls under dynamic exploration by simulation (§14.8) and empirical comparison with other institutional architectures.

18 14.2 Decision space and impacts

Each locality makes decisions at discrete times.

A decision is modeled by:

- a type (environment, economy, security, etc.);
- an intensity (low → high);
- a duration (punctual → persistent);
- an impact profile on other localities (externalities).

Externalities can be simulated by an impact matrix **E(i→j)**.

19 14.3 Inacceptability judgment rule

When a decision is made by i:

- each neighbor $j \in V(i)$ issues a judgment (acceptable / unacceptable) according to its internal rules;
- each distant $k \in D(i)$ does the same.

The *constitutionally unacceptable* signal is issued if:

- $\geq 50\%$ of $V(i)$ judge it unacceptable
- and $\geq 50\%$ of $D(i)$ judge it unacceptable.

20 14.4 Response, sufficiency, sanctions (full cycle)

After issuance of the signal:

1) i produces a response (modification, compensation, withdrawal, justification, etc.);
2) the same neighbors and distants evaluate **sufficiency** (binary);
3) if insufficient, sanctions from the constitutional catalogue apply according to the planned escalation;
4) if sufficient, the cycle is closed (history preserved; sanctions impossible within this cycle).

21 14.5 AI integration (annotation and scenario generation)

AI systems may be used in a controlled manner to:

- generate decision scenarios (types, intensities, contexts);
- simulate local judgment rules as textual criteria;
- produce justifications and responses, then evaluated by explicit rules.

To avoid arbitrariness, any use of AI must be accompanied by:

- a documented prompt,
- an explicit set of local rules,
- a validation protocol (e.g., double AI annotation + human arbitration).

22 14.6 Performance indicators

The minimal recommended indicators are:

- rate of decisions triggering a signal;
- rate of responses judged sufficient;
- rate of sanctions triggered;
- mean resolution time;
- spatial distribution of disagreements (relational localization);
- robustness to coalitions (cartels) and asymmetries (dependencies).

23 14.7 Limits

A simulation does not demonstrate normative superiority of the framework.

It serves to:

- test dynamic coherence,
- identify unstable regimes,
- compare parameter variants (set sizes, rotation frequency, sanction catalogue structure).

24 14.8 Implementation on the Canadian federal structure: protocol and preliminary results

A preliminary implementation of this framework was developed using the Canadian federal structure as a case study, enabling dynamic-coherence testing of the protocol in a realistic institutional context.

24.1 14.8.1 Simulation architecture

The model simulates:

Regional level: - 46 regional localities distributed across 13 provinces and territories - Realistic geographic neighborhood configuration (territorial contiguity) - Distributed selection of distant collectives ($|D(i)| \geq 5$, order comparable to $|V(i)|$)

Provincial level: - 13 provinces/territories as isomorphic higher-level localities - Distinct neighbor–distant network at the provincial level - Strict application of the non-traversability rule (§10.1)

Simulated decision types: - Cultural and linguistic policies (e.g., Quebec) - Extractive economic regulations (e.g., Alberta, Saskatchewan) - Environmental policies - Urban regulation and planning

Each decision is characterized by: - Type (c): policy category - Intensity ($\alpha \in [0,1]$): degree of constraint or impact - Duration (τ): application temporality - Externalities $E(i \to j)$: impacts on other localities

24.2 14.8.2 Judgment protocol

Local judgment rules: Each locality j evaluates a decision d_i according to: - compatibility with its own internal norms - externality impacts $E(i \to j)$ - intensity thresholds specific to each decision type - historical and institutional context (regional normative diversity)

Application of the constitutional mechanism: - Inacceptability signal if double majority (§6) - Response–sufficiency–sanctions cycle according to the full protocol (§7) - Standardized sanction catalogue with progressive escalation

24.3 14.8.3 Preliminary results

Normative diversity preserved: The double-majority mechanism allows: - maintenance of distinct Quebec cultural policies (language, education) - coexistence of Alberta extractive economies and British Columbia environmental policies - regional variation in urban and social policies

Limitation of extreme intensities: Decisions with intensity $\alpha > 0.70$–0.80 systematically trigger: - constitutionally unacceptable signals - response–sufficiency cycles - relational sanctions when responses are judged insufficient

Functional isomorphism verified: The non-traversability rule (§10.1) preserves: - decision autonomy at each level - absence of implicit normative hierarchy - full recursion of judgment

Observed asymmetric configurations: Certain situations — notably when two neighbors of a small province form a regional solidarity block — produce: - inacceptability signals by distants (up to 100% rejection) - without automatic sanction triggering (absence of double majority) - consistent with the structural logic of the framework

These configurations show that: - the double majority effectively prevents unilateral blocking - power asymmetries are partially compensated by structural decoupling of distants - the system tolerates localized disagreements without producing paralysis

Relational stability: Over 1000 iterations of regional decisions (10 Monte Carlo runs, seeds 42–51):

- inacceptability signal rate: **7.5%** (95% CI: [5.4%, 9.6%])
- responses judged sufficient: **63.5%** (95% CI: [52.0%, 75.1%])
- sanctions triggered: **2.5%** (95% CI: [1.7%, 3.3%])
- mean resolution time: **2.6** evaluation cycles (95% CI: [2.5, 2.8])

Structural decoupling verified: The mean correlation between distant localities and the judged locality is **2.2× lower** than that between neighbors and the judged locality (95% CI: [2.1×, 2.3×]), confirming the structural decoupling hypothesis (§4.3).

Reproducibility: Configuration hash: `30a45cf425dc14a2`
All results are reproducible with seeds 42–51.
The full source code and raw data are available on request.

24.4 14.8.4 Limits and scope of the implementation

These preliminary results do **not** constitute: - empirical validation of the theoretical framework - proof of institutional superiority - a predictive model of real Canadian collective behavior

They constitute only: - an exploration of the protocol's dynamic coherence - a test of computational feasibility - identification of stable and unstable regimes - a comparative baseline for other institutional architectures

24.5 14.8.5 Required developments

A full analysis should include:

Monte Carlo simulations: - systematic parametric variations (network size, thresholds, durations) - sensitivity tests to initial conditions - exploration of the space of stable configurations

Robustness tests: - durable coalitions between collectives - economic or demographic power asymmetries - corruption or defection of actors - systemic crises (pandemics, economic collapses)

Institutional comparisons: - classical federations (USA, Germany, Switzerland) - confederal systems (EU, historical confederations) - centralized architectures with administrative decentralization

Validation through real cases: - retrospective analysis of historical federal conflicts - simulation of known political crises (Quebec referendum, Trans Mountain pipeline) - comparison between simulated results and historical resolutions

24.6 14.8.6 Source code availability

The source code of this implementation is available on request for: - reproduction of results - extension to other institutional contexts - methodological critique - development of protocol variants

The code is documented and accompanied by: - complete specifications of local judgment rules - network configuration parameters - decision generation protocols - analysis and visualization scripts

25 14.9 Comparative analysis with a hierarchical federal architecture

Exploratorily, the polycentric protocol was compared to a standard hierarchical federal architecture, simulated using the same decision sets, the same territorial networks, and the same stochastic parameters (n = 1000 decisions, seeds 42–51).

The reference federal model relies on classical vertical regulation:
local decisions exceeding a predefined threshold trigger intervention by the higher level, which has arbitration power and direct coercive authority.

The comparison does not aim to evaluate normative superiority, but to observe the **differences in institutional dynamics** produced by the two architectures.

Simulations indicate that:

- the polycentric framework requires significantly fewer coercive interventions to maintain overall system stability;
- it preserves a higher share of local decision autonomy, since adjustments are obtained primarily through responses, compensations, and negotiations rather than vertical arbitration;
- extreme-intensity decisions are limited in both models, but through distinct mechanisms:
  - by prohibition or substitution in the hierarchical model,
  - by exposure to distributed judgment and relational cost in the polycentric model.

These results suggest that horizontal coordination grounded in inacceptability judgments can produce systemic stability comparable to that of vertical control, while maintaining higher normative diversity and lower dependence on central intervention.

They constitute neither empirical validation nor proof of superior effectiveness, but highlight that two deeply different institutional architectures can reach similar stability regimes through structurally opposed mechanisms.

The table below summarizes the differences observed between the proposed polycentric framework and a standard hierarchical federal architecture, based on simulations performed on identical decision sets.

Dimension analyzed	Hierarchical federal architecture	Neighbor–distant polycentric framework
Decision locus	Shared across levels	Strictly local
Regulation mode	Vertical, ex ante or ex post	Horizontal, exclusively ex post
Arbitration authority	Central higher level	No final authority
Intervention trigger	Exceeding centralized normative thresholds	Neighbors + distants double majority
Signal nature	Order, veto, or annulment	Public inacceptability signal
Coercive character	Immediate or automatic	Conditional and progressive
Constraint type	Legal or administrative	Relational
Handling of extreme decisions	Prohibition or substitution	Limitation via relational cost
Intervention frequency	High (frequent arbitration)	Low (primarily local resolution)
Role of the higher level	Decides and arbitrates	Coordinates, administers, represents

Dimension analyzed	Hierarchical federal architecture	Neighbor–distant polycentric framework
Local normative diversity	Reduced through harmonization	Preserved and legible
Possibility of durable disagreement	Low	High without systematic deadlock
Judgment recursion	Limited or absent	Complete and distributed
Cross-level traversability	Yes (hierarchy)	No (§10.1)
Systemic stability	Depends on the center	Emerges from the network
Critical failure point	Central authority	No single point
Dominant resolution mode	Imposed decision	Response, adjustment, compensation
Type of legitimacy produced	Hierarchical	Relational and situated
Nature of the norm	Uniform	Localized in the network
Primary system cost	Centralization, institutional overload	Distributed coordination and monitoring

Table reading:
Both architectures reach comparable stability regimes in exploratory simulations, but through fundamentally different mechanisms.
The hierarchical model concentrates normative legitimacy in a decision center, whereas the polycentric framework distributes it across the relational structure of the network.

This table does not constitute a normative assessment, but a synthesis of the structural differences observed between two alternative institutional topologies.

26 Main contribution

The contribution of this work is not a turnkey political system.

It consists in making explicit:

- a local / neighbors / distants normative triad;
- a minimal constitutional protocol grounded in inacceptability;
- a recursive horizontal regulation mechanism;
- an isomorphic multi-layer architecture.

This framework identifies a possible topology of distributed political stability, open to critique, simulation, and falsification.

26.1 Structural interests of the proposed framework

The framework presented is not intended to promote any particular political program.

It nevertheless highlights several structural properties that may constitute comparative advantages relative to centralized or strictly federal architectures.

26.1.1 a) Reduction of centralizing constraints

The absence of prior authorization allows collectives to:

- experiment locally;
- adapt norms to their specific contexts;

- retain institutional innovation capacity.

Coordination does not limit diversity; it makes it legible.

26.1.2 b) Active preservation of local diversity

Normative diversity is not treated as an anomaly to be corrected, but as a normal feature of the system.

Divergences are observed, discussed, and situated, rather than erased.

26.1.3 c) Structural limitation of domination

The combination of:

- local sovereignty;
- distributed judgment;
- non-centralized relational sanctions;

makes durable power capture costly, unstable, and difficult to sustain.

26.1.4 d) Institutional resilience

The absence of a single decision center removes critical failure points.

Local crises do not entail global collapse, and systemic crises can be handled without durably suspending local autonomy.

26.1.5 e) Compatibility with multi-level political peoples

The framework permits the simultaneous existence of:

- local identities;
- regional identities;
- national or continental identities;

without rigid normative hierarchy among them.

Each political people may seek internal coherence without requiring full uniformity of its components.

26.2 Preliminary computational validation

The theoretical contribution formulated above (§15) benefits from an initial dynamic-coherence test through computational simulation.

The implementation on the Canadian federal structure (§14.8) shows that the protocol:

- is **computationally feasible** with modest resources;
- produces **identifiable stability regimes** without arbitrary parameters;
- maintains **normative diversity** while limiting extremes;
- operates **without central authority** in a realistically sized network;
- generates an empirically observable **relational localization of norms** (§9.1).

These results do not validate the normative framework, but establish that it:

- is not trivially unstable;
- does not produce manifest dynamic contradictions;
- warrants deeper empirical and comparative investigation.

The simulation methodology (§14) enables other researchers to:

- reproduce the results;
- test other institutional configurations;
- identify conditions of stability and instability;
- compare rigorously with alternative architectures.

This approach fits within a falsificationist epistemology:
the framework is proposed as a testable structural hypothesis, not as a universal political prescription.

27 16. Emergence of a distributed political order

The proposed system relies neither on a global plan nor on prior institutional overhaul, nor on simultaneous adherence by all collectives.

Its emergence is gradual, local, and self-selective.

27.1 16.1 Bottom-up construction principle

Any locality may adopt the protocol independently of others.

It requires only two minimal commitments:

1. accept that its decisions may be judged by its neighbors and distants;
2. accept to take their judgments into account when they reach the constitutional threshold.

No higher authority is required.

27.2 16.2 Voluntary pairing of collectives

Two or more collectives may mutually recognize one another as:

- neighbors;
- or distant participants.

This pairing may rely on:

- existing administrative agreements;
- regional cooperation;
- or simple bilateral arrangements.

Each new connection increases the reach of the network.

27.3 16.3 Asymmetric incentive effect

A collective that complies with neighbor–distant judgments benefits from:

- normative predictability;
- increased trust;
- relational stability;
- reduced systemic risk.

A collective that systematically refuses to take them into account:

- sees its reputation degrade;
- becomes exposed to cross-sanctions;
- progressively tends toward isolation.

Adherence to the protocol thus becomes rationally advantageous, while never becoming mandatory.

27.4 16.4 Network self-reinforcement

When several neighboring collectives adopt the protocol simultaneously:

- their decisions become mutually legible;
- conflicts decrease;
- cooperation stabilizes.

This mechanism can reproduce at each territorial level.

27.5 16.5 Absence of a single founding moment

There is:

- no institutional revolution;
- no world constitution;
- no abrupt transfer of sovereignty.

The system can coexist durably with existing structures.
Powers are not abolished; they become progressively superfluous where the network functions.

27.6 16.6 Nature of the emergent order

The resulting political order is:

- neither decreed;
- nor planned;
- nor designed by a central intelligence.

It emerges as a **field of stable relational constraints**, produced by the repetition of local interactions.
The norm is not imposed; it crystallizes statistically within the network.

27.7 16.7 Real scope of the proposal

This work does not claim to define humanity's future political system nor a universal institutional model.

It identifies a **minimal possible architecture** allowing sovereign collectives to:

- coordinate;
- mutually limit one another;
- produce stability;

without ever relinquishing their political autonomy.

28 17. Positioning of the proposed framework

The framework presented is neither a simple variant of an existing system nor a hybrid combination of known political models.

It is distinguished by an explicit dissociation between:

- **the locus of decision**, always local,
- **the locus of judgment**, distributed,
- **the locus of constraint**, relational and conditional.

This section positions the model relative to the main contemporary political architectures.

28.1 17.1 State centralization

In centralized systems:

- the norm is defined at the top,
- applied uniformly,
- and imposed vertically.

The proposed framework differs radically:

- no authority produces general norms,
- no local decision requires prior authorization,
- no institution has unilateral coercive power.

Coherence is not decreed; it emerges from convergence of distributed judgments.

28.2 17.2 Classical federalism

In federalism:

- sovereignty is shared across levels,
- competences are hierarchized,
- an ultimate constitutional arbiter resolves conflicts.

In the proposed framework:

- sovereignty remains entirely local,
- higher levels have no normative primacy,
- no body exercises final arbitration.

Higher levels exist as **isomorphic administrative localities**, not as constitutional authorities.

28.3 17.3 Confederalism

Confederal systems rely on:

- treaties among sovereign entities,
- reciprocal commitments,
- often fragile and reversible.

The proposed framework does not rely on fixed treaties, but on:

- a minimal common normative protocol,
- applicable to any decision,
- producing continuous rather than merely contractual effects.

Coordination is not episodic, but permanent and relational.

28.4 17.4 Deliberative democracy

The proposed framework is not opposed to deliberative democracy as a mode of local decision-making.

Each collective remains free to organize its normative choices through:

- citizen deliberation,
- majority decision,
- administrative expertise,
- or any combination of these procedures.

Local collective will thus fully constitutes the foundation of political decision.

The framework's distinction concerns not deliberation itself, but its scope.

Unlike models aiming to produce a unified collective will at the scale of a global people or an extended political space, the present framework does not assume the existence of a single demos capable of deliberating for the whole system.

Deliberation remains local;
systemic legitimacy emerges instead from a distributed relational mechanism grounded in convergence of inacceptability judgments among collectives.

Thus, deliberative democracy is not replaced, but situated:
it operates fully at the level of decision, without claiming to ground common normativity by itself.

28.5 17.5 Algorithmic or technocratic governance

Unlike models grounded in:

- optimization,
- central expertise,
- or automated decision,

the proposed framework:

- does not evaluate what is "optimal,"
- does not rank reasons,
- does not aggregate quantitative preferences.

It relies exclusively on qualitative inacceptability judgments expressed by sovereign collectives.

28.6 17.6 International law and soft law

The model presents analogies with:

- international law,
- non-binding norms,
- reputation and reciprocity.

It differs, however, by:

- its systematic recursion,
- its application at all territorial levels,
- the absence of dominant sovereign states.

It generalizes the logic of *soft law* to the whole political architecture.

28.7 17.7 Specificity of the proposed framework

The framework introduces a novel configuration:

- **local** decision,
- **distributed** judgment,
- **relational** constraint,
- **situated** normativity,
- **recursive multi-level** architecture.

It does not replace existing systems;
it describes an **alternative political topology**, compatible with:

- local democracy,
- the existence of political peoples,
- shared public services,
- durable normative plurality.

It is less an institutional model than a **structure for the circulation of normative legitimacy in a network**.

29 18. Academic positioning and distinction from existing polycentric approaches

The proposed framework belongs to the field of polycentric governance theories, while differing from them on several fundamental conceptual points.

This section clarifies its relation to major existing works and makes explicit the specific theoretical contribution provided.

29.1 18.1 Empirical polycentric governance (Ostrom)

Foundational works by Elinor Ostrom and collaborators describe polycentric governance as:

- a set of partially autonomous decision centers,
- coordinated through adaptive rules,
- empirically observed in common-pool resource governance.

These works rely primarily on:

- comparative analysis of real cases,
- identification of design principles,
- an inductive and descriptive approach.

The present framework differs in several respects:

- it does not start from empirical cases, but from an **abstract formalization**;
- it does not aim at optimizing commons management;
- it relies on no shared substantive rules.

It proposes not *principles of good governance*, but a **minimal architecture for normative legitimation**.

29.2 18.2 Institutional polycentrism (McGinnis, Aligica)

Institutionalist approaches to polycentrism emphasize:

- multiplicity of decision arenas,
- institutional competition,
- adaptive learning.

In such models:

- coordination relies on performance,
- rules are selected by comparative efficiency.

The proposed framework differs in that it:

- does not select norms by performance,
- does not rely on institutional competition,
- assumes no global efficiency metric.

Coordination emerges not from economic or functional success,
but from **collective inacceptability judgment**.

29.3 18.3 Federalism theories and multilayer governance

Multilevel governance theories describe:

- layered decision levels,
- shared competences,
- often characterized by normative ambiguity.

The proposed framework is not multilevel governance in the classical sense:

- levels do not share sovereignty,
- they possess no proper normative competence,
- they do not arbitrate cross-level conflicts.

They exist only as **isomorphic administrative localities**, not as legally superior levels.

29.4 18.4 Social choice theories and preference aggregation

Most formal political models rely on:

- aggregation of individual preferences,
- voting,
- pursuit of a collective optimum.

The proposed framework differs radically:

- it aggregates no preference,
- seeks no optimum,
- produces no collective will.

It does not answer the question: *"what do we want together?"*
but a different question:
"how far do we accept that others go?"

29.5 18.5 Conceptual originality: distributed negative normativity

The central contribution of this work lies in introducing a principle of:
distributed negative normativity.
Instead of producing the norm through:

- common deliberation,
- consensus,
- global majority vote,
- or hierarchical authority,

the system produces the norm through:

- convergence of inacceptability judgments,
- expressed by independent collectives,
- structurally decoupled.

The norm is not decided;
it appears as an **emergent boundary of the tolerable**.

29.6 18.6 Explicit normative recursion

While some approaches implicitly evoke plurality of rule levels,
the proposed framework is, to our knowledge:

- the first to explicitly formalize full normative recursion,
- without a stopping level,
- without a final meta-authority.

Any judgment can be judged.
This recursion is not a defect to be corrected, but a structural property of the system.

29.7 18.7 Comparative synthesis

The proposed framework differs from existing approaches through the joint combination of:

- strictly local decision sovereignty,
- neighbor–distant distributed normative judgment,
- conditional ex post relational sanction,
- total absence of a final arbiter,
- multi-level isomorphism,
- gradual emergence through voluntary adoption.

This combination does not appear simultaneously in any known polycentric theory.
It is therefore not a mere extension of polycentrism,
but a **formal reformulation of how political legitimacy is produced in networks**.

30 19. Conclusion

This work suggests that a political order can emerge:

- without a sovereign central authority,
- without normative uniformity,
- without suppression of local democracy,

provided that local decisions are exposed to structured judgment by their neighbors and by distant collectives, within a recursive network of mutual responsibility.

The proposed framework thus makes it possible to think governance in which the norm can be situated, discussed, and collectively revised, without ever ceasing to be locally decided.

It is not a finished model, but a minimal formal structure capable of shedding light on new forms of polycentric governance.

31 Data and code availability

The simulation code and datasets used in Section 14.8 are publicly available at:
https://github.com/sylebel-cdr/polycentric-governance-simulation
The exact version corresponding to this paper is archived on Zenodo under DOI:
https://doi.org/10.5281/zenodo.18303790

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