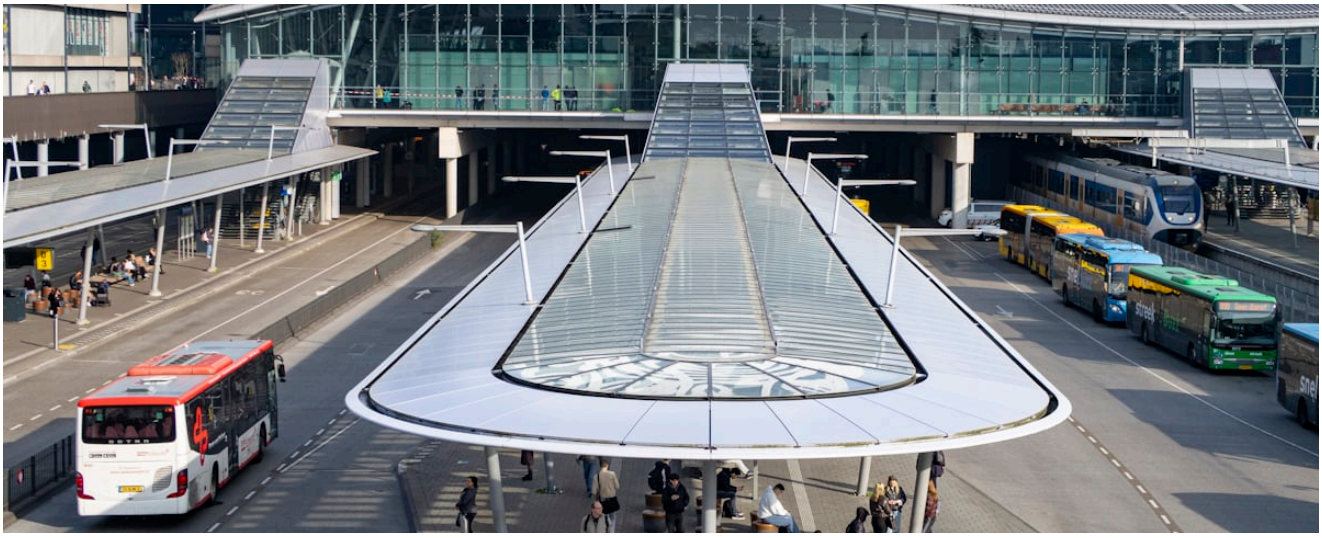
ANALYTICAL MEMORANDUM · WORKING DRAFT

# CONNECTIVITY 2.0

## Infrastructure, flows and the digital framework of settlement



*Count the connectivity achieved, not the volume built*

Passenger flows · logistics · connectivity · utilities · the digital twin of settlement

Analytical platform **gosplan2.ru**

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# Contents



**On the status of this document.** This is an analytical memorandum: a measurement framework, a set of design decisions and an order in which to test them. It is not design documentation, a transport scheme or investment advice. The threshold values quoted are proposed standards for discussion, not requirements in force; they must be calibrated against actual measurement on a specific territory. Section 14 lists separately what the author considers unverified.

**On the photographs.** Every illustration is a real photograph of an existing place, not a visualisation. The caption under each states what it shows. Source: Unsplash, Unsplash licence.

# 1. Executive summary: one page for the region

**The substance.** Infrastructure today is planned and assessed in volumes: kilometres, hospital beds, megabits, square metres. Volume does not answer the only question a person and a shipment actually ask — **can I get there, can it get there, and in how long**. This memorandum proposes replacing the unit of measurement: count connectivity and cycle time rather than volume built. Different priorities, different contracts and a different order of works follow from that replacement.

> The unit of planning is neither a facility nor a sector but the **daily cycle**:
> the human cycle "home → service → home" and the freight cycle "production → consolidation → market"

### Five consequences

1. **The timetable is worth more than the asphalt.** A guaranteed transfer at an interchange raises connectivity more than extra runs outside a clock-face pattern: connectivity grows with the number of reliable connections, not with the number of vehicles.
2. **Backhaul is the largest unused reserve in logistics.** A vehicle arriving full and leaving empty doubles the delivery cost for everyone involved.
3. **The decisive connectivity parameter is not speed but uplink and time to restore.** A "100 down / 5 up" link is formally excellent and practically unusable for remote work and telemedicine.
4. **The first investment in utilities is a meter, not a pipe.** Expanding capacity in a system with unknown losses partly feeds those same losses.
5. **Duplicating a service costs more than guaranteeing a trip to it.** A clinic in every small settlement is unattainable; a guaranteed same-day trip is attainable and cheaper.

A stop beside a field. The infrastructure is physically present; the question it does not answer is whether one can travel from here to the district centre, receive a service and return the same day.

### What the region gets

A map showing which residents are cut off from services measured in time rather than distance; comparable metrics that allow investment in timetables, roads, fibre and logistics to be compared against one another; and contracts that pay for connectivity achieved rather than volume delivered.

**AN HONEST CAVEAT**

None of the proposed thresholds (30/60/120 minutes, shares, coefficients) is the result of research on Russian data. They are working values, set so that measurement becomes possible at all. The first round of measurements will most likely show that some of them need revision — which is the normal course of the work, not a failure of the method.

# 2. Changing the unit of measurement: from volume to connectivity

The gap between reporting and reality in infrastructure arises not from bad faith but from the chosen unit. Volume built is easy to measure, so it is measured; connectivity is harder to measure, so it is not measured at all.

## 2.1. What changes in the set of indicators

| Counted today | Proposed instead | Why it changes the decision |
|---|---|---|
| **Kilometres of road** | Share of residents within 30 / 60 / 120 minutes of centres of the corresponding level | A resurfaced road without a change to the timetable does not alter accessibility by a single minute |
| **Number of runs** | Number of achievable chains “settlement → service → settlement” per day | Every run can be delivered while not one chain closes, because of the transfers |
| **Coverage, %** | Actual speed and uplink by address, latency, time to restore | “There is coverage” and “it works in the evening” are different statements |
| **Freight turnover, tonnes** | Cost of the first and last kilometre, share of empty running | Turnover grows while a small producer still cannot move produce out |
| **Square metres delivered** | New permanent residents per unit of infrastructure investment | Metres are delivered and stay empty if the life cycle on the territory does not close |
| **Network capacity, MW** | Free capacity at the connection point and the time to obtain it | Total capacity may be ample while none is free where it is needed |

## 2.2. Why connectivity cannot be obtained by addition

The defining property of connectivity is that it is **not additive**. Two roads that do not meet at a node give fewer connections than one road passing through a node. Two routes with unsynchronised timetables give fewer trips than one route with a guaranteed transfer. Two channels from the same operator along the same route provide no redundancy at all.

Hence the practical implication: **an investment decision cannot be taken facility by facility**. It is taken on the change in connectivity of the whole network — which requires a model of the network, not an estimate for a facility. Section 10 describes how such a model is built and what it needs.

### 2.3. The three places where time is lost

```
THE HUMAN CYCLE                    WHERE TIME IS LOST

home -> stop                       last mile: 20-40 min on foot,
                                   impassable in winter

stop -> interchange                waiting: the run exists, at the wrong hour

interchange -> service             transfer: 40-90 min because timetables
                                   are not synchronised

service -> back                    last departure before the service closes:
                                   the trip does not close
```

Three of the four losses are solved organisationally and one requires capital works. Practice allocates money the other way round: the capital part receives nearly everything, the organisational part nearly nothing. That is the principal reserve discussed in section 4.

# 3. The settlement framework: four levels and the rule of time

A polycentric settlement model is achievable only if a firm accessibility standard exists. Otherwise “polycentricity” stays rhetoric while the actual distribution of services keeps contracting towards the largest centre.

## 3.1. Levels are defined by function and time, not by population

```
L0  SETTLEMENT         daily: school, health point, shop,
                       community centre, local work
    ──────── 15 min on foot / 30 min by transport ────────
L1  ANCHOR CENTRE      weekly: clinic, public services, college,
                       sport, market, logistics hub
    ──────── 60 min ────────
L2  SMALL TOWN         monthly: hospital, court, technical college,
                       larger retail, distribution centre
    ──────── 120 min ────────
L3  REGIONAL CAPITAL   rare: university, specialised medicine,
                       airport, regional agencies
```

Classification by function rather than population matters: a settlement of 800 people serving five neighbouring ones is an L1 by role, even though by headcount it looks like an L0. The reverse holds as well.

## 3.2. The standard worth adopting

> From any L0 there exists a connection to its L1 allowing one to **travel, receive the service and return the same day**,
> on at least five days a week

This is a formulation verifiable from a timetable and a map, without surveys. It replaces the undeliverable promise of “a service in every settlement” with a deliverable and measurable obligation. And it immediately exposes the price of the alternative: maintaining a clinic in every L0 costs more than guaranteeing the trip — but only if the trip is genuinely guaranteed.

## 3.3. The same-day accessibility index

| | |
|---|---|
| **What it measures** | The share of residents for whom the cycle “out — service — back” to their L1 centre (and separately L2) fits within daylight hours under the timetable in force |
| **How it is computed** | From published timetables and the road network; waiting and transfer time counts, not only time in motion |
| **What is required** | Machine-readable timetables, the road network, service locations and their opening hours |
| **Frequency** | On every timetable change; summarised twice a year |
| **The critical subtlety** | Counting opening hours. A run that delivers a passenger to a closed office does not close the cycle |

**WHAT THE FIRST MEASUREMENT WILL SHOW**

The author’s expectation: in most districts the index will prove materially lower than current programmes assume, and the main loss will fall not on distance but on unsynchronised timetables and on the opening hours of institutions. If that is confirmed, investment priority shifts from capital construction to organisation — which is orders of magnitude cheaper and years faster.

## 3.4. What this framework does not solve

The framework says nothing about territories where same-day accessibility is unattainable under any timetable — because of distance, seasonality or the absence of a road. Those need a separate regime: outreach services on a guaranteed schedule, remote formats where applicable, and an honest admission that some services here will be available differently. Pretending the standard is met everywhere is the surest way to discredit it.

# 4. Passenger flows: the timetable is worth more than the asphalt

The most underrated instrument in the transport of small territories is the clock-face timetable. It requires no new rolling stock and changes connectivity more than capital investment of comparable cost.

## 4.1. How the clock-face pattern works

```
WITHOUT A CLOCK-FACE PATTERN       WITH ONE

route A arrives      :10           all routes arrive     :55
route B departs      :05           all routes depart     :05
        wait 55 min                          wait 10 min

3 routes -> 2 reliable links       3 routes -> 6 reliable links
```

Connectivity grows multiplicatively with the number of guaranteed transfers and only linearly with the number of runs. Synchronising timetables at a node therefore usually yields a greater gain than adding runs at the same cost. The price is rigidity: a clock-face pattern demands punctual arrival, which means slack in the schedule and working dispatch control.


Wayfinding at an interchange. A guaranteed connection is useless if the passenger cannot tell where to go during a two-minute transfer: signage and displays are part of the transport solution, not decoration.

## 4.2. Instruments and their order of cost

| Instrument | What it solves | Order of cost |
|---|---|---|
| **Clock-face timetable** | Guaranteed transfer; connectivity gain with no new fleet | Organisational cost, dispatch control, schedule slack |
| **Equipped interchange** | Canopy, heat, toilet, displays, cycle parking, parcel point — transfer stops being a punishment | Small capital, high effect on usage |
| **Through ticket and information** | One journey instead of three separate ones; predictability | Moderate; mostly IT and contracting |
| **Consolidating dedicated services** | School, medical and postal runs in one contour instead of three parallel ones | A saving on existing spending |
| **Priority on the approach to the centre** | Time is lost on the final kilometres, not in open country | Small cost, high political difficulty |
| **A new line or road** | Connects what is physically unconnected | Large capital; justified once organisational measures are exhausted |

The school run. One of the few rural transport flows that is guaranteed and funded. It is also the largest unused resource: the route, the vehicle and the driver exist, yet serve one category of passenger twice a day.

## 4.3. The contract: what the operator should be paid for

Current practice pays for runs delivered or for mileage. Under that metric an operator who delivered everything and secured not a single connection counts as compliant. The proposed replacement:

- **Base payment** — for achieved chains “settlement → service → settlement”, accounting for the actual opening hours of the service.
- **Penalty** — for missed guaranteed connections, since it is those that destroy trust in the system fastest.
- **Bonus** — for median cycle time below the target and for growth in passengers completing a full cycle.

**THE RISK IN THIS DESIGN**

"Achieved chains" is harder to administer than mileage and is open to manipulation where record-keeping is weak. It requires machine-readable timetables, recorded actual arrivals and independent validation. Introducing it without that base means swapping a clear bad metric for an opaque bad one. The order is the reverse: records first, contract second.

# 5. The last mile and demand-responsive transport

Even a perfectly synchronised timetable does nothing for someone living four kilometres from the stop. The last mile is the part of the cycle where most time is lost and where conventional scheduled transport does not work economically.

## 5.1. The threshold at which a route breaks down

A scheduled route requires a flow at which a run makes sense. Below that threshold four options remain, and all of them are worse than a bus in a city:

| Option | When it applies | Weak point |
|---|---|---|
| **Infrequent scheduled route** | Flow is stable but small; trips are predictable | One or two runs a day do not close the cycle with the service |
| **Demand-responsive transport** | 5–20 trips a day, scattered origins | Requires dispatch, connectivity and a payment habit; economics unproven |
| **Consolidation with dedicated runs** | A school or medical route already exists | Regulatory and insurance limits on mixed carriage |
| **Supporting private mobility** | Flow below any viability threshold | Does nothing for those who cannot drive: the elderly, teenagers |

The last row is the most uncomfortable and the most honest. At very low flows public transport in any form may cost more than direct support for private mobility. But that support does nothing for the two groups the system exists for — the elderly and children. Acknowledging this fork must be part of the design, not a discovery in year three.

## 5.2. What makes demand-responsive transport workable

- **A guaranteed window, not "sometime".** A booking is accepted for a specific interval and connects to the clock-face pattern at the interchange; otherwise it is a taxi, not transport.
- **Booking by phone on equal terms with an app.** Requiring a smartphone excludes the core audience.
- **Dispatch at L1, not at settlement level.** Pooling bookings from several settlements is the only way to reach density.
- **A through ticket with the trunk route.** Paying twice kills demand more reliably than journey time.

## 5.3. The pedestrian last mile

Part of the problem is solved without transport at all. A lit pavement from the housing group to the stop, cleared in winter, moves a distance of 700–1,200 metres from "impassable" to

“normal”. It is the cheapest transport measure in existence, and it almost never appears in transport programmes because it is formally classed as landscaping.

**A PRACTICAL RULE**

Before designing a feeder service, check whether the existing distance can simply be made walkable. A lit pavement with winter maintenance costs less than one year of operating a minibus and works around the clock.

## 6. Logistics: consolidation and backhaul

Rural logistics is expensive not because of distance but because of empty running and the absence of consolidation. Both causes are removed organisationally and digitally, without building new roads.

A trunk run. The economics of delivery to a small settlement are set not by this stretch of road but by what happens on the first and last kilometre — and by what the vehicle carries on the way back.

### 6.1. Where the cost actually arises

```
COST STRUCTURE OF DELIVERY FOR A SMALL PRODUCER

first kilometre    loading, packaging, waiting, paperwork
                   -> a high share when the consignment is small
trunk haul         predictable and relatively cheap
last kilometre     unloading, acceptance, returning packaging
                   -> a high share when the consignment is small
return run         frequently empty
                   -> doubles the cost for everyone
```

Two conclusions follow. First, what needs shortening is not the trunk haul but the ends — that is, the consignment must be enlarged through consolidation. Second, the return run is capacity already paid for and standing idle; filling it is cheaper than arranging a new run.

### 6.2. Two-tier consolidation

```
L0  MICRO-HUB                      L1  DISTRICT HUB

acceptance, weighing               consignment build-up, palletising
packing, labelling                 paperwork, veterinary, quarantine
small cold store                   industrial cold store
parcel pickup point                cross-docking, backhaul
                                   access for carriers and marketplaces
```housed in the existing            ```requires capital investment but
community building```              serves 10-40 settlements```
```
```

The key economy of an LO micro-hub is that **it is not built**: it is a function placed inside an already existing and already heated public building — the one discussed in the SELO 2.0 memorandum. The additional cost comes down to scales, shelving, a cold store and a workstation.

A district hub: consignment build-up, paperwork, cross-docking, access for carriers.

Standard packaging — a dull but decisive condition: without it consolidation degenerates into manual reloading.

### 6.3. Backhaul: a load exchange

Technically this is a simple task: a register of runs with direction, free volume and time, plus a register of consignments awaiting despatch. The difficulty lies entirely on the organisational side:

| Barrier | What to do about it |
|---|---|
| **Mutual distrust** | The territory operator as guarantor, and cargo insurance in the early stages |
| **Non-standard packaging** | A single district pallet and crate; a deposit system for their circulation |
| **Paperwork** | An electronic waybill as the condition of access to the exchange |
| **Mismatched schedules** | Publishing planned runs in advance rather than on departure |
| **Sanitary restrictions** | Separate contours for food and non-food; this limits consolidation but does not cancel it |

### 6.4. Logistics metrics

- **Share of empty running** across the district — a direct and easily verified saving.
- **Cost per tonne-kilometre for a small consignment** — specifically small; the district average hides the problem.
- **Time from production to shelf** for perishables.
- **Share of produce lost in transit** — see the next section.

# 7. The cold chain as the precondition of all agricultural logistics

This section is usually absent from rural development programmes, and without it half the other solutions do not work.

## 7.1. Why everything else is pointless without cold

A substantial part of a small producer's output — milk, meat, berries, greens, fish — loses marketability or safety when the temperature regime breaks. The break happens not on the trunk haul, where the refrigerated unit runs, but at the transition points: in the field, during loading, while waiting, at transhipment in the hub, at handover.

```
WHERE THE CHAIN BREAKS

field/farm --X-- waiting in the sun --OK-- reefer --X-- transhipment
   --OK-- store --X-- handover --OK-- the buyer's fridge

each X cancels every preceding OK
```

The practical conclusion: cold is a **continuous chain**, and its value is set by the weakest link. Investing in a refrigerated vehicle while acceptance at Lo is unrefrigerated produces no effect. It is the same connectivity principle as in transport: the system is not additive.

## 7.2. What this means for the project

| | |
|---|---|
| **Minimum kit at Lo** | Refrigerated acceptance room, scales, packaging, temperature logger, a short leg to the hub |
| **Minimum kit at L1** | Industrial refrigeration, blast freezing where applicable, temperature control at acceptance and despatch |
| **Energy** | Cold is a permanent electrical load. This returns to the ENERGY FIRST principle: capacity is confirmed before, not after |
| **Measurement** | A logger in every consignment; the share of consignments with a regime breach is a mandatory quality indicator for the logistics chain |

**WHAT SHOULD BE MEASURED FIRST**

The share of produce lost to breaks in the cold chain is not systematically measured at small-producer level in Russia. In the author's judgement this quantity explains a significant part of the gap between the price at the farm gate and the price on the shelf. It cannot be asserted as fact — but it can and should be placed first in the pilot's measurement plan, because it is cheap and it changes priorities.

## 8. The internet as the fifth utility

Fibre should be treated as a utility on a par with water, electricity, heat and the road — with the same obligation, the same redundancy logic and the same measurement regime. But the metric “coverage” leads to a systematic error.

An optical patch panel. The physical layer of the network, which in reporting is reduced to a single number — “coverage, %” — and loses with it everything that determines whether the link is usable for work.

### 8.1. Four parameters that determine usability

| Parameter | Why it matters | Why it is not counted |
|---|---|---|
| **Uplink** | Video calls, telemedicine, remote work, uploading files. A 100/5 link is formally excellent and practically unusable | Advertising and reporting quote download speed only |
| **Latency and jitter** | Video conferencing and remote access fail from instability, not from a shortage of megabits | Requires active measurement rather than declared tariffs |
| **Time to restore** | A territory on a single channel loses school, health point, tills and public services at once | Redundancy is expensive and not fixed in any standard |
| **Peak-hour speed by address** | “There is coverage” and “it works in the evening” are different statements | Measured only through complaints |

### 8.2. How to measure

The only reliable method is **active measurement from subscriber points**: software agents on routers, connected voluntarily, with anonymisation and aggregation of results. Operator data about its own network is unsuitable for this task not through bad faith but because it describes a different measurement point.

The result is published as a map by address with four parameters. Subsidy to the operator is tied to measured values rather than declared coverage.

### 8.3. Redundancy for critical points

For Lo points on which the continuity of basic functions depends — school, health point, community centre — a standard of a second channel **over a different physical medium** is proposed (microwave, satellite, cellular as backup to fibre). Two channels from one operator along one route are not redundancy.

### 8.4. Autonomy during an outage

A territory must keep basic functions working when the external channel is entirely absent. This is not a hypothetical scenario: a trunk cable cut during excavation is an ordinary event.

- A local cache of educational materials and reference systems
- Offline acceptance of applications with later synchronisation
- Local telephony within the settlement
- Backup power for the communications node on a par with the health point

> **AN ANALOGY THAT HELPS IN CONVERSATION WITH A FINANCE OFFICER**
> A backup communications channel is the equivalent of a backup power supply. Nobody disputes the need for a generator at a hospital, yet a second channel for the same hospital is usually treated as a luxury. Meanwhile a modern health point without connectivity can neither issue a prescription, nor obtain a consultation, nor transmit a test result.

# 9. Utilities: the INFRA FIRST principle

The ENERGY FIRST principle from the SELO 2.0 memorandum is a special case of a general rule of sequencing that applies to every utility.

> metering and losses → capacity → reserve → connection → **only then** new development

## 9.1. The first investment is a meter, not a pipe

In a system with unknown losses, any expansion of capacity partly feeds those same losses. The order of works: measure actual consumption and actual losses, eliminate the cheap portion, recalculate the capacity required — and only then design the expansion. A dull step that lends itself to no ribbon-cutting, and therefore almost always skipped.

## 9.2. Centralised versus decentralised — by calculation, not by habit

| Situation | What is usually cheaper | Condition |
|---|---|---|
| **Dense settlement core** | Centralised networks | Short runs, high density of connections |
| **Dispersed development** | Local solutions: individual heat sources, on-site treatment, local water supply | An operating organisation and a maintenance regime exist |
| **New quarter beside an existing core** | Connection to the network with simultaneous upgrade of that section | Confirmed free capacity |
| **A remote cluster of houses** | Autonomy almost always | Who maintains it and on what money is settled in advance |

The criterion is the same in every row: **total cost of ownership over 25 years**, including operation, losses and the probability of failure. Not the cost of construction.

## 9.3. Utilities as a constraint in the model

The practical meaning of this section for planning: free capacity at a specific connection point, and the time to obtain it, are **constraints** in the territorial model, not a separate sectoral topic. A housing project, a transport interchange, the hub's cold store and a school compete for the same capacity, and that conflict is visible only in a shared model. Which leads to the next section.

# 10. The digital twin of settlement

In the SELO 2.0 memorandum the digital twin is described at the level of a single settlement. For transport and logistics that is not enough: a flow by definition exists between nodes. The model must be a network model.


A model of the territory. Value comes not from the number of layers but from the links between them: a change in one layer must recalculate the rest automatically.

## 10.1. Layers and what they generate

```
LAYERS                          WHAT IS COMPUTED FROM THEM

population, housing        ┐
jobs, education            ├──► trip demand matrix
services L1 / L2 / L3      ┘              │
and their opening hours                   ▼
                                  timetables and clock-face ──► same-day
road network               ┐              │                    accessibility
routes, timetables         ├──►           │                    index
fleet, drivers             ┘              ▼
                                  network bottlenecks

producers, volumes         ┐
hubs, cold, packaging      ├──► freight matrix ──► cost of delivering
backhaul offers            ┘                      a small consignment

utilities: power, water    ┐
fibre, capacity            ├──► connection constraints and lead times
```

## 10.2. The central requirement: automatic recalculation

The model is meaningful only when a change in one layer immediately recalculates the others. A new residential quarter must at once yield: added trip demand, load on the substation, demand for school places, waste collection volume, and the change in the accessibility index for neighbouring settlements.

Today those calculations are performed by different authorities in different documents and do not reconcile. That is precisely why a new quarter regularly receives grid capacity but no bus: capacity and buses are the responsibility of different agencies with different planning cycles. The model does not resolve that institutional conflict, but it makes it visible and dated — which is the precondition for resolving it.

### 10.3. Who owns the data

| | |
|---|---|
| **Custodian of the model** | The territory operator at regional level. Not a contractor: a model owned by a contractor ends with the contract |
| **Flow data** | Aggregated and anonymised. Personal trajectories are not needed: origin–destination–time matrices suffice for planning |
| **Results** | Public by default: accessibility indices, connectivity map, logistics cost, bottlenecks |
| **Input data** | Public where already public (timetables, network, service locations); commercial data in aggregated form |

**WHY PUBLICITY HERE IS NOT IDEOLOGY**

A non-public accessibility index instantly becomes an object of bargaining between districts and ceases to be a planning instrument. Publication is the only cheap mechanism that keeps a methodology from being tuned to the desired answer. The same conclusion was reached in the Biophilic Cities memorandum with respect to greening metrics, and the repetition is not accidental: an indicator nobody can check has no reason to stay honest.

### 10.4. The minimum workable version

A full model is not needed to begin. Four datasets suffice, each of which either already exists or can be assembled in weeks:

1. Machine-readable timetables for all transport in the district.
2. The road network with seasonal passability.
3. L1/L2 service points with opening hours.
4. Population by settlement.

That is enough to compute the same-day accessibility index and to see the bottlenecks. Everything else is layered on top.

## 11. Economics: four comparable metrics

Transport, connectivity, logistics and utilities compete for one budget with roads and social facilities. For comparison to be possible, a shared unit of usefulness is required.

| Metric | What it allows to compare | How it is computed |
|---|---|---|
| **Cost per passenger-minute saved** | Timetable versus road versus interchange | Change in total cycle time for all affected residents per year, divided by the cost |
| **Cost per point of same-day accessibility gained** | Investment in different territories against each other | Change in the share of residents with a closed cycle, divided by the cost |
| **Cost per unit reduction in small-consignment tonne-kilometre** | Hub versus cold store versus load exchange | Change in actual delivery cost, divided by the cost |
| **CAPEX per new permanent resident** | An infrastructure package against direct relocation incentives | Total investment divided by the confirmed increase in permanent population |

### 11.1. Payment by result

Comparable metrics make it possible to tie part of the funding to the value achieved:

- **The transport operator** — for achieved chains and for honouring guaranteed connections.
- **The connectivity provider** — for measured uplink, latency and time to restore, not for declared coverage.
- **The logistics operator** — for reducing empty running and the cost of delivering a small consignment.
- **The utility** — for reducing losses and connection lead times.

> **A MANDATORY CONDITION**
>
> Payment by result works only with independent measurement. If the indicator is computed by the party being paid for it, the metric degrades within a single contract cycle. The measurement contour (section 13, steps 1–3) therefore comes before the contractual one, not alongside it.

### 11.2. What these metrics do not cover

None of the four reflects reliability and resilience: a system can be optimised into a state where it performs excellently in normal operation and collapses at the first failure. Alongside them there must therefore stand a fifth, qualitative criterion — **does basic connectivity survive the**

**failure of any single element**. It is not counted in money but is verified by running the scenario through the model.

## 12. Anti-patterns that should be banned by standard

What follows happens by default unless expressly prohibited. This is the most practical part of the document.

| No. | Anti-pattern | How it looks | The rule that removes it |
|---|---|---|---|
| 1 | **A road without a timetable** | The route is resurfaced, accessibility is unchanged by a single minute | A transport section is a mandatory part of any road project |
| 2 | **Housing before utilities and before the bus** | The quarter is built, capacity is unconfirmed, there is no route | INFRA FIRST: capacity and transport service confirmed before sales open |
| 3 | **“Coverage” instead of measurement** | A subsidy for declared coverage produces declarations | Payment against independently measured parameters |
| 4 | **A hub without cold** | The logistics centre serves only non-perishables | A cold contour is a mandatory part of the hub design |
| 5 | **Duplication instead of connection** | Promising a service in every settlement blocks organising the trip to it | The same-day accessibility standard as the alternative to duplication |
| 6 | **A single channel to a critical point** | School and health point periodically stop working | A second channel over a different physical medium |
| 7 | **The model held by a contractor** | Planning ends with the contract | Model and data belong to the territory |
| 8 | **Payment for mileage** | Every run delivered, not one connection secured | Payment for achieved chains |
| 9 | **The timetable as a PDF** | Data is formally published and unusable for computation or apps | A machine-readable format as a condition of route authorisation |
| 10 | **Optimisation without a failure scenario** | The system is perfect in normal operation and collapses at the first failure | Connectivity verified against the failure of any single element |

**THE COSTLIEST OF THE TEN**

Number nine. A timetable published as a PDF or a printed sheet on a wall makes everything else impossible: the accessibility index, clock-face planning, passenger apps, outcome-based contracts. It is the cheapest requirement on the list and simultaneously the one without which the other nine are unreachable.

## 13. Roadmap for the first year

Five steps, of which the first three are measurement that pays for itself regardless of what happens to the programme, and the last two are the cheapest of the substantive interventions.

### Step 1. Measure the same-day accessibility index (1–2 months)

- Collect all district timetables in machine-readable form
- Collect L1/L2 service points with actual opening hours
- Compute the share of residents with a closed daily cycle
- Publish the map: who is cut off and why — distance, timetable or opening hours

### Step 2. Active measurement of connectivity (1–2 months, in parallel)

- Deploy measurement agents at voluntary subscriber points
- Measure speed, uplink, latency and outages by address
- Check critical points separately: school, health point, community centre
- Publish a map with four parameters

### Step 3. Inventory of flows (2–3 months)

- Passengers: origin, destination, time — from carrier data and aggregated mobility
- Freight: what leaves, moved by whom, in what consignments, how often
- Empty running: share and directions
- Dedicated services: school, medical, postal — routes and loading

### Step 4. One clock-face interchange (6–9 months)

- Select the L1 centre with the greatest number of converging routes
- Bring timetables into a clock-face pattern with slack built into arrivals
- Equip the transfer: canopy, heat, toilet, displays, wayfinding
- Measure before and after: achieved chains, median cycle time, passenger numbers

### Step 5. One micro-hub (6–12 months)

- Place it in the existing community building: acceptance, scales, cold store, packaging, pickup
- Connect it to a district-level backhaul exchange
- Measure empty running and small-consignment delivery cost before and after
- Measure separately the share of consignments with a temperature breach

**WHY THIS ORDER**

The first three steps cost orders of magnitude less than any construction and are useful in themselves: they show exactly where connectivity is lost, and they do so before the money is allocated. Steps four and five deliver a measurable result within a year — that is, within a single political cycle, which for programmes of this kind is a condition of survival.

## 14. What is unverified, and where knowledge ends

The section without which this document would read as a finished programme. What follows are open questions, not implementation details.

| Question | The uncertainty | How to remove it |
|---|---|---|
| **Economics of demand-responsive transport** | Below some density of bookings, possibly no form of public transport works | A pilot in two or three settlements of differing density, with honest publication of a negative result |
| **Willingness to relocate** | The size of "city → village" migration is unmeasured, and the whole demographic case rests on it | Survey plus pre-booking plus analysis of actual transactions |
| **Willingness of connectivity providers** | Disclosing actual parameters and working to measured KPIs is a matter of negotiating position, not technology | Begin with voluntary measurement and publication; regulate on the evidence |
| **Cold chain losses** | The quantity is not systematically measured; the author's estimate is unconfirmed | Temperature loggers in consignments at the pilot hub, first season |
| **Threshold values** | 30 / 60 / 120 minutes are working values, not a research finding | Calibration against the first measurements across different district types |
| **Institutional feasibility** | The weakest point of the document | See below |

### 14.1. The principal risk: connectivity has no owner

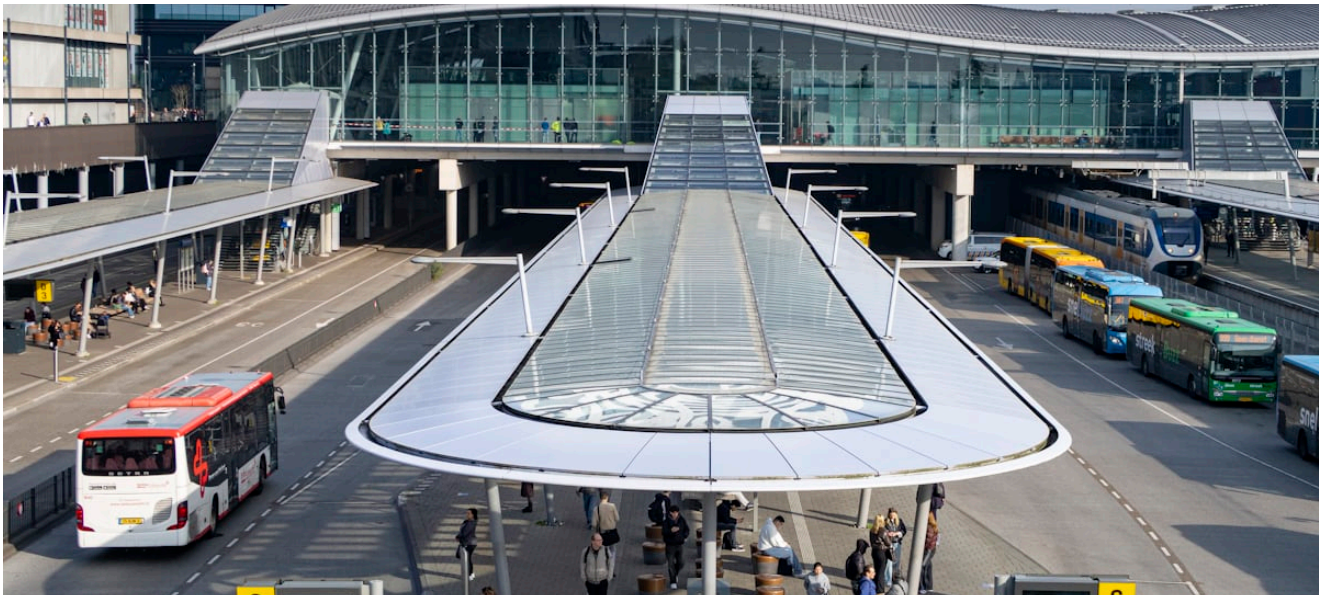
Technically, everything described is straightforward. What is hard is that the road, the bus, the fibre, the health point, the school and the electricity network today belong to different authorities, with different planning cycles, different funding sources and different definitions of success. Each of them can deliver its own programme in good faith while connectivity does not change at all.

> *Connectivity cannot be designed if nobody owns it. Until a specific organisation is answerable for it, with a budget and an indicator, it remains the sum of other people's side effects.*

Hence the single institutional conclusion of this document: a regional-level body is required that answers specifically for connectivity — holding the model, empowered to synchronise the timetables of different carriers, and judged on an indicator. In the SELO 2.0 memorandum this role is described as the territorial development corporation; here a transport and logistics function is added to it.

## 15. Conclusion

The platform's three memoranda describe one system from three sides. SELO 2.0 answers what to do with a territory. Biophilic Cities answers what the environment should be. This document answers what connects those territories to one another.



An interchange. The place where connectivity is either created or lost — and which costs incomparably less than the kilometres of road leading to it.

> Not to build more, but to connect better.
> Not to report volume, but to measure the time achieved.

Three things to do before anything else: convert timetables into machine-readable form, measure the same-day accessibility index, and appoint an owner of connectivity. None of the three requires capital investment. Every other decision in this document derives from them.

---

This document has been prepared as an analytical memorandum. Threshold values are proposed for discussion rather than in force, and are subject to calibration against actual measurement. The current version and the related SELO 2.0 and Biophilic Cities memoranda are available on the analytical platform gosplan2.ru.

# Appendix A. Method for measuring the same-day accessibility index

## A.1. Input data

- Machine-readable timetables for every route in the district, including seasonal variants
- The road network with seasonal passability noted
- A list of L1 and L2 services with addresses and actual opening hours
- Population by settlement
- Sunrise and sunset times for the calculation period

## A.2. Algorithm

```
for each settlement L0:
    for each service at level L1 (and separately L2):
        find the earliest run arriving at the service
            no later than the start of opening hours
        find the latest run departing back
            no earlier than the end of opening hours
        if both exist and fit within daylight:
            the cycle closes
    share of closed cycles x population = contribution to the index

district index = sum of contributions / total population
```allow at least 10 minutes for a transfer```
```compute seasonal timetables separately: the winter index is usually lower```
```

## A.3. What must not be missed

- **Opening hours.** A run delivering a passenger to a closed office does not close the cycle — the most frequent error in the calculation
- **Transfers.** Count the real walking time between platforms, not only the difference in the timetable
- **Seasonality.** Winter and summer indices are computed separately; mud season and flooding are separate scenarios
- **The last mile.** The distance from the housing group to the stop is part of the cycle
- **Days of the week.** The weekday and weekend indices differ fundamentally

# Appendix B. Interchange checklist

## B.1. Timetable

- All routes arrive within an agreed window and depart after it
- Minimum transfer time of at least 10 minutes, allowing for the real walk
- Slack built into the schedule for late arrival
- The clock-face pattern is preserved in seasonal variants
- The timetable is published in machine-readable form

## B.2. Physical environment

- Canopy and a heated waiting room
- A toilet open during service hours
- Real-time displays and clear wayfinding between platforms
- Movement between platforms without crossing the carriageway
- Lighting and winter maintenance across the whole transfer area
- Cycle parking and a drop-off point for private cars
- A parcel pickup point — as a reason for an additional trip

## B.3. Organisation

- A through ticket or through fare for the whole chain
- Dispatch control recording actual arrivals
- A defined procedure when a connection fails
- A named party responsible for the interchange and a funding source for its upkeep

# Appendix C. Micro-hub checklist (level Lo)

### C.1. Premises

- Placed in an existing heated building; no separate construction required
- Access for goods vehicles and a turning area
- A separate entrance, not shared with the public functions of the centre

### C.2. Equipment

- Calibrated scales, shelving, standard packaging on a deposit-return basis
- A cold store with a temperature logger and backup power
- An operator workstation with a reliable connection
- Labelling and document printing
- Parcel lockers for pickup

### C.3. Processes

- An electronic waybill for every consignment
- Temperature checks at acceptance and despatch
- Publication of free return-run capacity on the district exchange
- A regime for keeping food and non-food consignments separate
- A named operator and a funding source for three years

# Appendix D. Connectivity passport of a settlement

```
SETTLEMENT _____                level: L0 / L1 / L2

ACCESSIBILITY
  L1 centre: _____   travel time ____   transfers ____
  Cycle to L1 closes:      yes / no   (weekday / weekend)
  Cycle to L2 closes:      yes / no
  First run ____   last run ____
  Winter index ____ %      summer index ____ %

LAST MILE
  Distance to the stop, max ____ m
  Pavement: yes / no       lighting: yes / no
  Winter maintenance: yes / no

CONNECTIVITY
  Speed down ____ / up ____ Mbit/s   (measured, not the tariff)
  Latency ____ ms          jitter ____ ms
  Outages per year ____    mean time to restore ____ h
  Backup channel: yes / no   medium: _____
  Critical points with redundancy: school / health point / centre

LOGISTICS
  Micro-hub: yes / no       cold store: yes / no
  Regular collection of produce: ____ times a week
  Parcel pickup point: yes / no
  Empty running on this direction ____ %

UTILITIES
  Free capacity at the connection point ____ kW
  Time to connection ____ months
  Water network losses ____ %
```

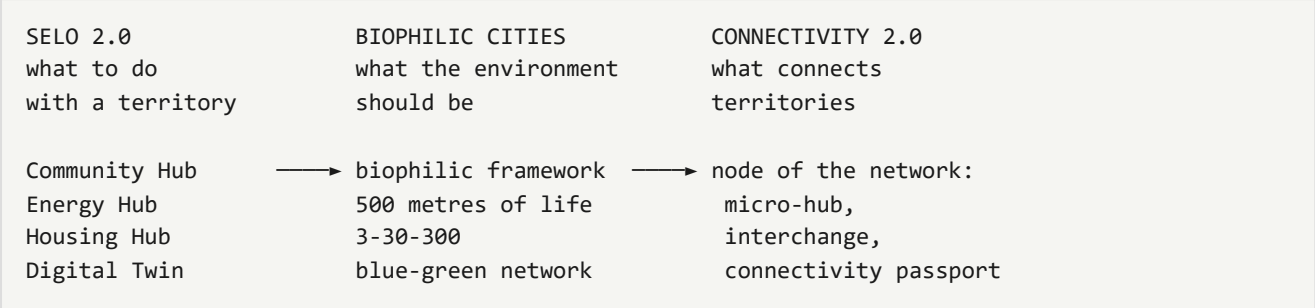
The passport is completed from the results of steps 1–3 of the roadmap and is the minimum dataset for admitting a territory to the programme. Blank fields are not a defect of the form but a list of what has not been measured.

# Appendix E. Glossary

| | |
|---|---|
| **Connectivity** | The capacity of a network to move a person or a consignment between nodes within acceptable time; a non-additive quantity — not equal to the sum of its elements |
| **Daily cycle** | The unit of planning: “home → service → home” for a person, “production → consolidation → market” for freight |
| **Same-day accessibility index** | The share of residents for whom the cycle to the centre of the relevant level closes within daylight under the timetable in force |
| **Clock-face timetable** | Synchronising arrivals and departures at a node to fixed minutes of the hour so that transfers are guaranteed |
| **L0 / L1 / L2 / L3** | Levels of the settlement framework, defined by function and access time rather than population |
| **DRT** | Demand-responsive transport: the trip is formed on request and the route is built dynamically |
| **Micro-hub** | Acceptance, packing, cooling and pickup functions placed inside an existing public building at level L0 |
| **Backhaul** | Using an otherwise empty return run for a matched load |
| **Cold chain** | An unbroken temperature regime from production to consumer; its value is set by the weakest link |
| **Uplink** | Outbound channel speed; determines suitability for video, telemedicine and remote work |
| **INFRA FIRST** | The order of works: metering and losses → capacity → reserve → connection → development |
| **Digital twin of settlement** | A network model linking layers of population, services, transport, freight and utility constraints with automatic recalculation |

## Appendix F. Relation to the two other memoranda

The platform's three documents form one contour and are written to be read independently without contradicting one another.




| Shared principle | How it appears in each document |
|---|---|
| **Function instead of volume** | SELO: functional utilisation instead of m². BIO: access instead of green area. CONNECTIVITY: cycle time instead of kilometres |
| **Order of works** | ENERGY FIRST → INFRA FIRST: capacity and networks confirmed before development |
| **Connectivity over size** | BIO: eco-corridors matter more than park area. CONNECTIVITY: the node matters more than the kilometres. SELO: 500 metres matter more than hectares |
| **Public metrics** | In all three: an indicator nobody can check has no reason to stay honest |
| **Measurement before money** | In all three the first step is a baseline that cannot be reconstructed later |
| **An owner of the result** | SELO: the territory operator. CONNECTIVITY: the same body plus a transport and logistics function. BIO: a maintenance budget with a named holder |

**WHERE THE DOCUMENTS OVERLAP PHYSICALLY**

The community centre from SELO 2.0 is simultaneously the logistics micro-hub and the last-mile point of this document, while its square is an element of the biophilic framework. That is not a coincidence but a consequence of the founding argument of all three texts: on a small territory only combined functions are viable, because separate ones do not pay for themselves.