Amtiri

GUIDE

Connectivity

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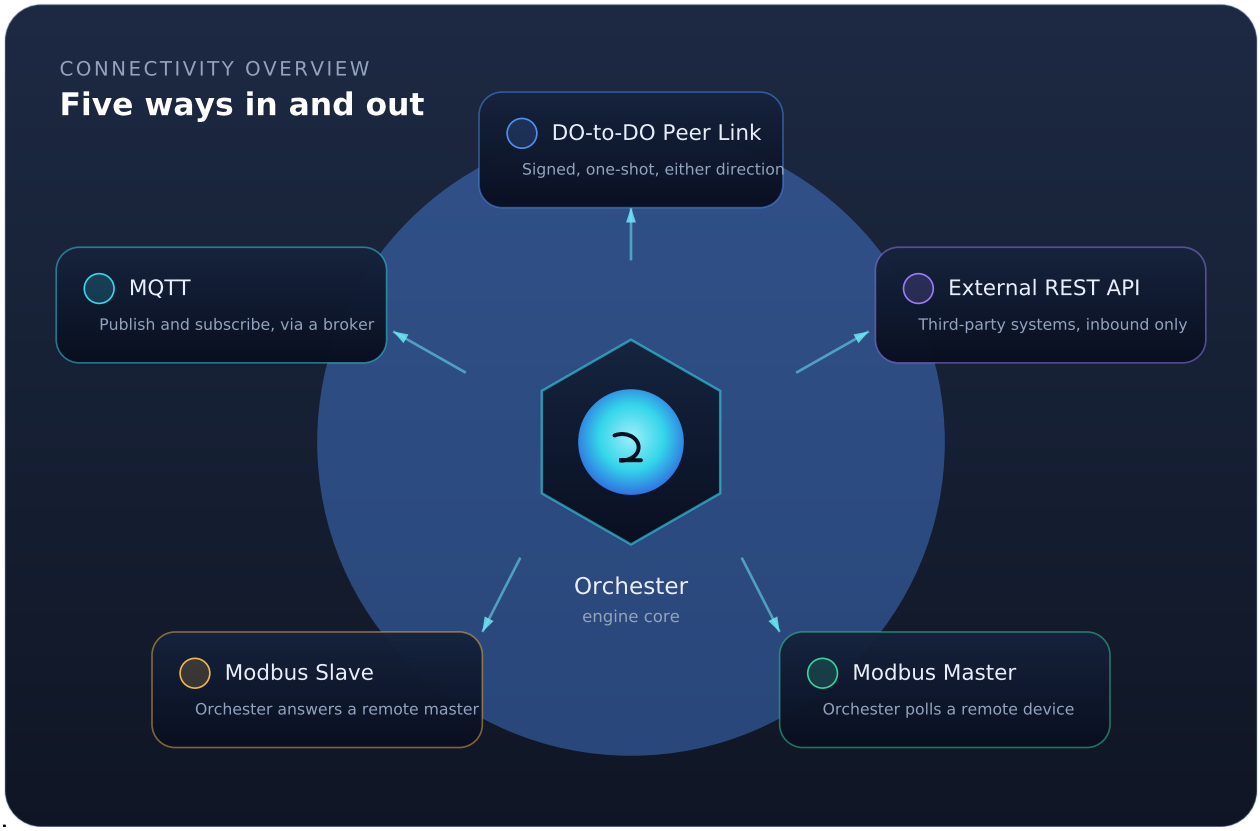
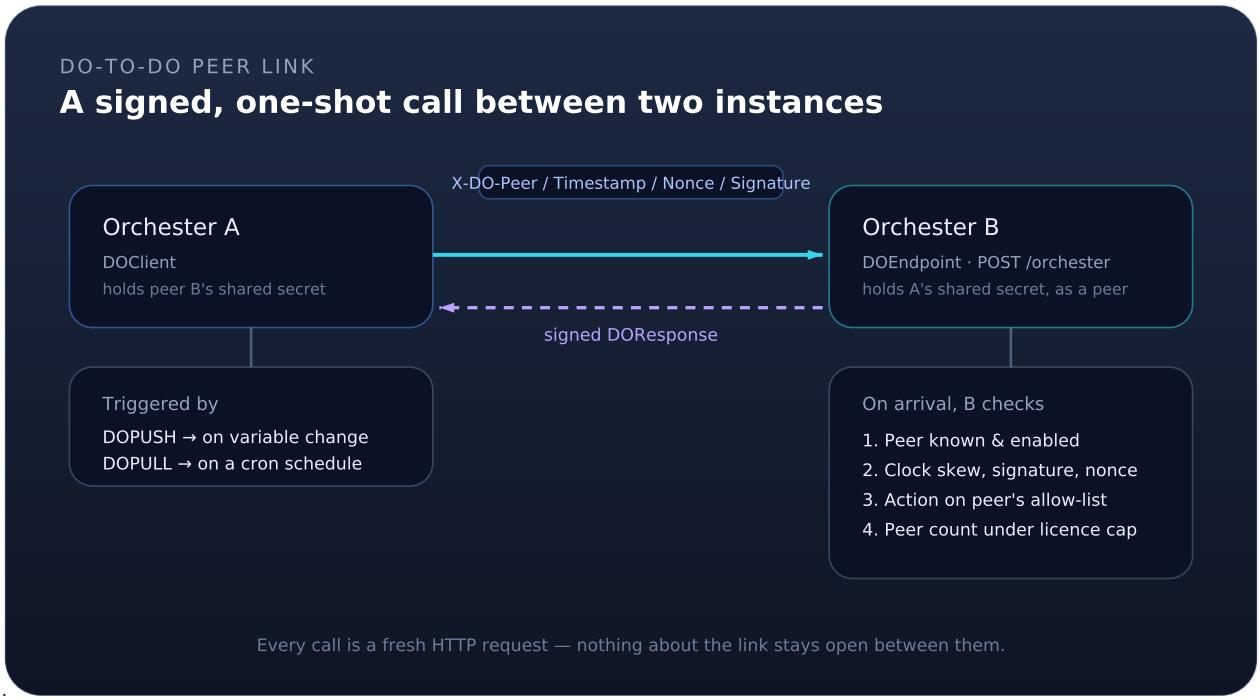


An Orchester instance rarely runs alone. It replicates to and from other instances, accepts data from third-party systems, and polls or answers industrial field devices. Five mechanisms cover all of it, and this guide walks through each: what it's for, how to configure it, and what to watch out for.

Method	Who calls whom	Typical use
DO-to-DO Peer Link	Either side, signed, one-shot	Replicating variables or history between two Orchester instances
External REST API	External system calls in	A third-party system pushing data into Orchester
Modbus Master	Orchester polls out	Reading from and writing to a PLC, meter or drive
Modbus Slave	A remote master calls in	Exposing Orchester's own variables to a SCADA/HMI
MQTT	Orchester dials a broker	Publishing telemetry and subscribing to commands

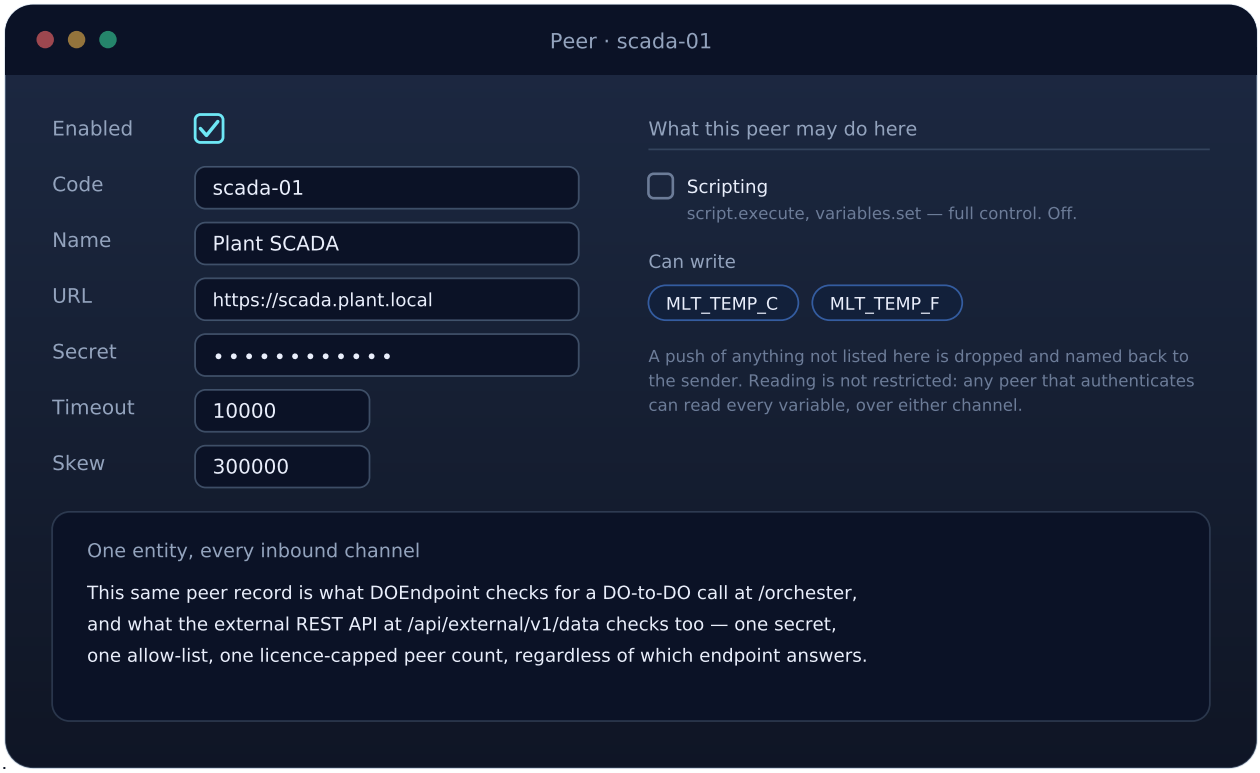
DO-to-DO Peer Link



Two Orchester instances talk to each other through a single, generic endpoint: `POST /orchester`. Every call carries one action — `variables.push`, `variables.get`, `variables.set`, `script.execute`, `logger.head`, `logger.append`, or a `ping` — in a signed envelope, and gets a signed reply. There is no persistent connection: each call opens a fresh HTTP request and closes it once the response arrives.

The request is authenticated with four headers — `X-DO-Peer`, `X-DO-Timestamp`, `X-DO-Nonce`, `X-DO-Signature` — built from an HMAC-SHA256 signature over the method, path, peer code, timestamp, nonce and a hash of the body, using a secret both sides already share. A nonce cache rejects any request replayed inside the clock-skew window, and repeated authentication failures from the same source trip a rate limit.

You don't configure this exchange directly — you configure the **peer** it runs against, and the modules that use it:



Field	Meaning
`enabled`	Whether this peer is usable at all
`code`	The identity the far side signs with
`url`	Where to reach the peer — only needed if this instance calls out to it
`secret`	The shared HMAC key, or `env:VAR_NAME` to read it from an environment variable instead
`timeout`	How long an outbound call waits before giving up (ms)
`skew`	Maximum allowed clock drift between the two sides (ms), default 5 minutes
`writables`	The variables this peer may write here with `variables.push`. Empty means none: a peer saved without a list is a misconfiguration, not a superuser
`scripting`	Whether this peer may run AScript here (`script.execute`, `variables.set`). That is full control of the instance — off by default, and granted only to a peer you trust completely

Two modules ride on top of a peer: `DOPUSH` sends `variables.push` whenever a watched variable changes; `DOPULL` calls `variables.get` on a cron schedule. Both point at the same peer entity, so the URL, secret and permissions only need to be set once no matter how many modules use that link.

> [!IMPORTANT] A peer's permissions cover **writing and scripting only**. Every other action is open to any peer that authenticates: it can read *any* variable with `variables.get`, and append history rows for any variable with `logger.append`. Registering a peer is therefore a decision about who may read your plant, not only who may change it — the secret is the boundary, so treat it as one.

Naming this instance

The `code` in a peer entity names the *far* side. This instance's own name is set separately, in the field at the top of the Orchester panel's left rail, and is stored in `entities/.instance`.

It has to match the `code` of the peer entity that represents this instance on the other machine — that name travels in the `X-DO-Peer` header and is how the far side knows which secret to verify your request with. An instance that has never been named calls itself `ORCHESTER` and says so in its log at every start.

> [!NOTE] The name does **not** travel in a configuration export. An archive taken from one plant and imported into another must not rename the instance that imported it — two installations answering to the same code collide replication cursors and replay caches. Set it once per installation, like the licence.

Example. Instance `plant-a` pushes two variable values to instance `plant-b`, which has granted it `variables.push`:

```
POST /orchester HTTP/1.1
X-DO-Peer: plant-a
X-DO-Timestamp: 1755000000000
X-DO-Nonce: 7c9e6679-7425-40de-944b-e07fc1f90ae7
X-DO-Signature: 3q2+7wYAAAA9CGFP...

{"v":1,"action":"variables.push","code":"plant-a","id":"7c9e6679-7425-40de-944b-e07fc1f90ae7",
 "data":{"values":{"TEMP_C":21.4,"PUMP_RUNNING":true}}}
```

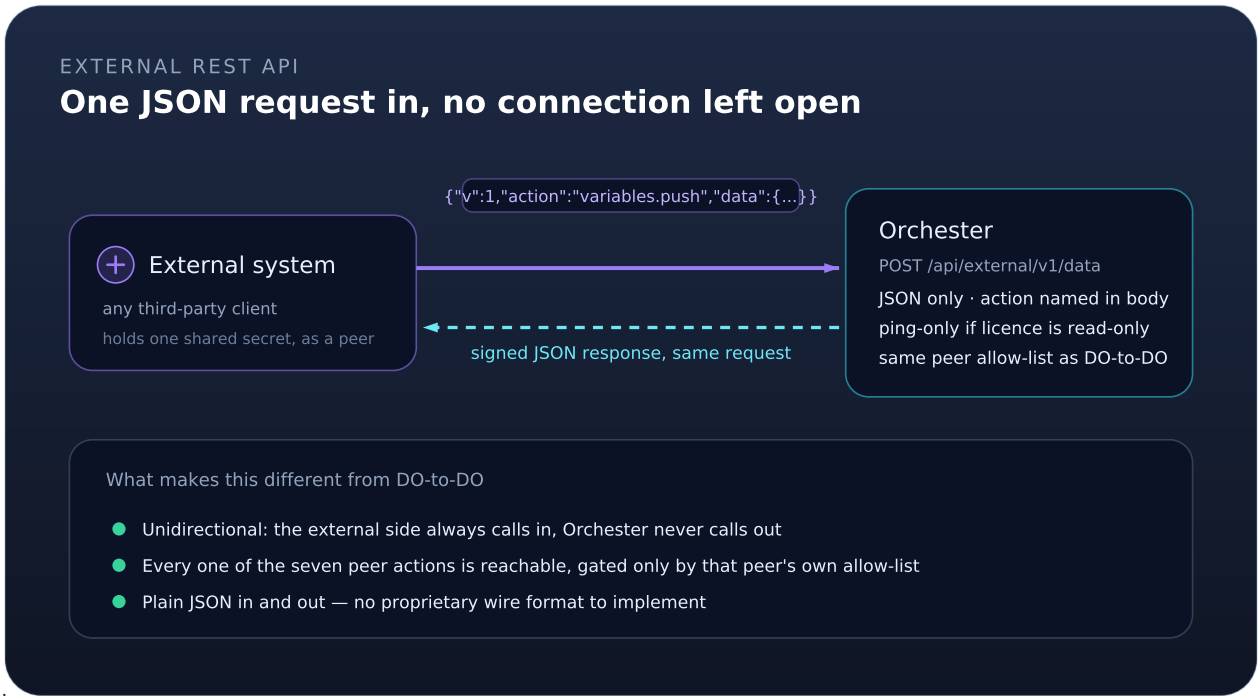
`plant-b` answers with a signed `{"status":"OK","data":{"applied":2,"rejected":0,"rejectedNames":[]}}`.

If `plant-a`'s peer entity on `plant-b` does not list one of those variables under `writables`, that value is dropped and the answer becomes `PARTIAL`, naming what was refused:

```
{"status":"PARTIAL","data":{"applied":1,"rejected":1,"rejectedNames":["PUMP_RUNNING"]}}
```

`PARTIAL` is a success, not a retry: the sender logs the refused names and does not send them again, because a variable the far side will not accept never becomes acceptable by being sent a second time.

External REST API



The DO-to-DO link assumes the far side is another Orchester instance, speaking the same internal wire format. For everything else — a customer's own backend, an integration platform, a script — there's a second endpoint, `POST /api/external/v1/data`, built on exactly the same peer, signing, permission and licence model, but JSON-only and reachable by any system that can compute an HMAC-SHA256 signature.

The request shape is the same one-action-per-call envelope: a JSON body naming the action and carrying its data, the same four `X-DO-*` signature headers, and the same peer permissions deciding what a given external system may write. It's unidirectional by design — the external system always calls in, and Orchester never calls back out to it, so there's nothing to keep open between requests.

One difference from the internal link: when this instance's licence is in a read-only state (expired, invalid, or a tampered clock), the external endpoint answers `ping` only, and refuses everything else. The internal peer-to-peer channel doesn't carry that restriction, so replication between your own instances keeps working even while a licence issue is being sorted out — only the door held open to outside systems narrows.

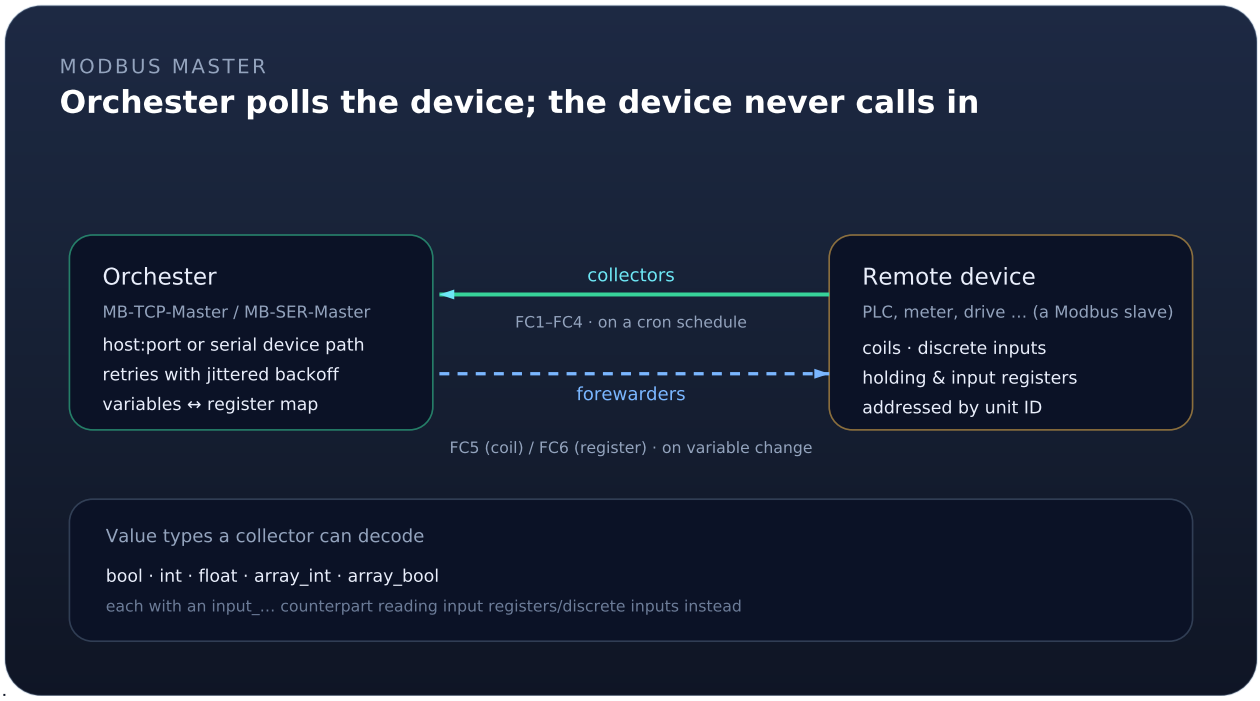
Set this up exactly like a DO-to-DO peer — the same editor, the same two permissions shown above — since it's the same entity either way. List only the variables that integration actually has to write, and leave **scripting off**: it hands the caller full control of the instance, so reserve it for peers you trust completely. Remember that reads are not scoped — an external system you register can query every variable in the plant.

Example. An ERP system, registered as peer `erp-integration` with `ORDERS_COMPLETED` as its only writable variable and no scripting, records a completed order count:

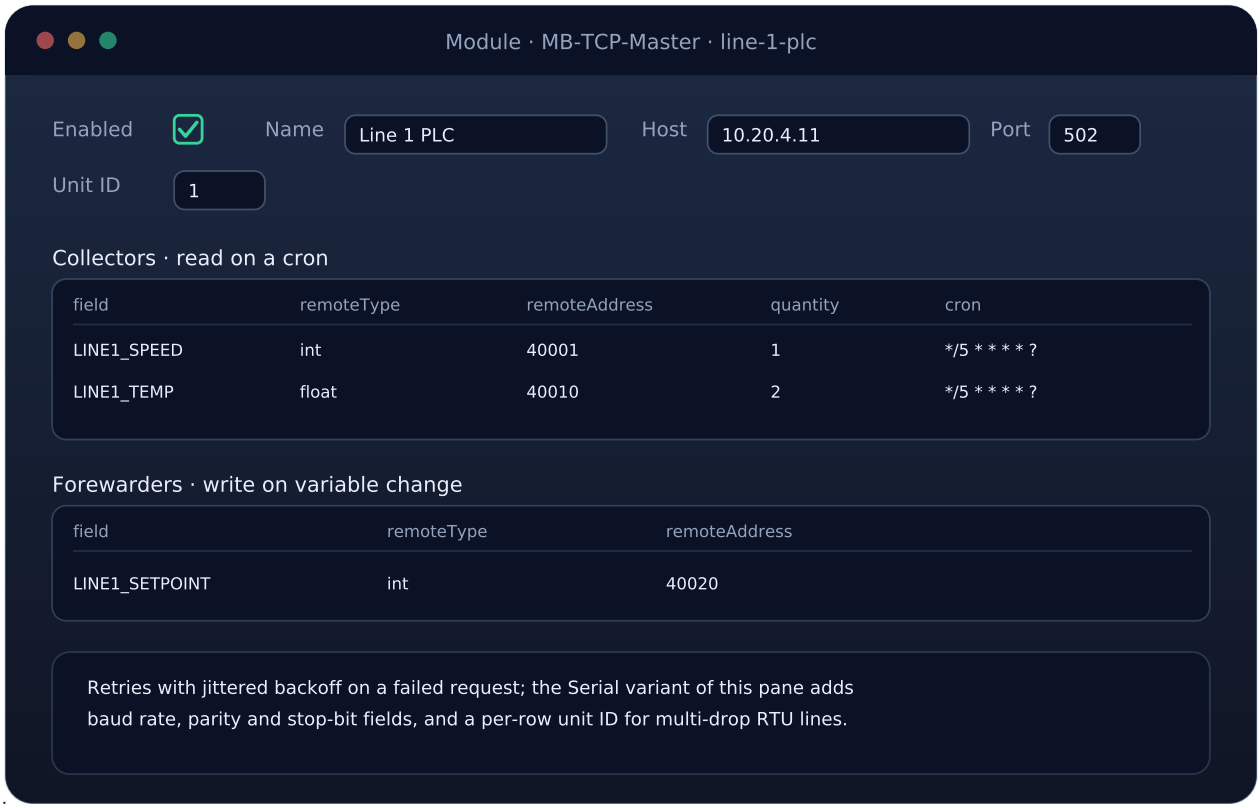
```
curl -X POST https://plant.example.com/api/external/v1/data \
  -H "Content-Type: application/json" \
  -H "X-DO-Peer: erp-integration" \
  -H "X-DO-Timestamp: 1755000000000" \
  -H "X-DO-Nonce: 3fa85f64-5717-4562-b3fc-2c963f66afa6" \
  -H "X-DO-Signature: <base64 HMAC-SHA256 over method, path, peer, timestamp, nonce and body>" \
  -d '{"v":1,"action":"variables.push","data":{"values":{"ORDER_COUNT":128}}}'
```

The signature is computed the same way on any platform: HMAC-SHA256 over `POST\n/api/external/v1/data\n<peer>\n<timestamp>\n<nonce>\n<sha256 of the body>`, using the peer's shared secret — there's no DataOrchester-specific SDK required, just a standard crypto library.

Modbus Master



As a Modbus master, Orchester is the one opening the connection — to a PLC, a power meter, a variable-speed drive, anything that answers Modbus requests. Two module types exist: `MB-TCP-Master` for Modbus TCP, and `MB-SER-Master` for serial RTU over an RS-485/RS-232 line, each configured with the reachability details for that transport (host/port for TCP; serial device, baud rate, parity and stop bits for RTU) plus a default unit ID.



Reading and writing are configured as two independent lists:

- **Collectors** read from the device on a cron schedule and land the result in a variable. Each row names the variable, the remote address, and a `remoteType` telling the module how to decode it: `bool` / `input_bool` (coil / discrete input, one bit), `int` / `input_float` and friends (one or two holding/input registers, reassembled into an integer or IEEE-754 float), or an `array_*` variant reading `quantity` words or coils at once.
- **Forewarders** write to the device whenever their variable changes. The write side is narrower than the read side — only `bool` (a single coil, function code 5) and `int` (a single register, function code 6) are supported.

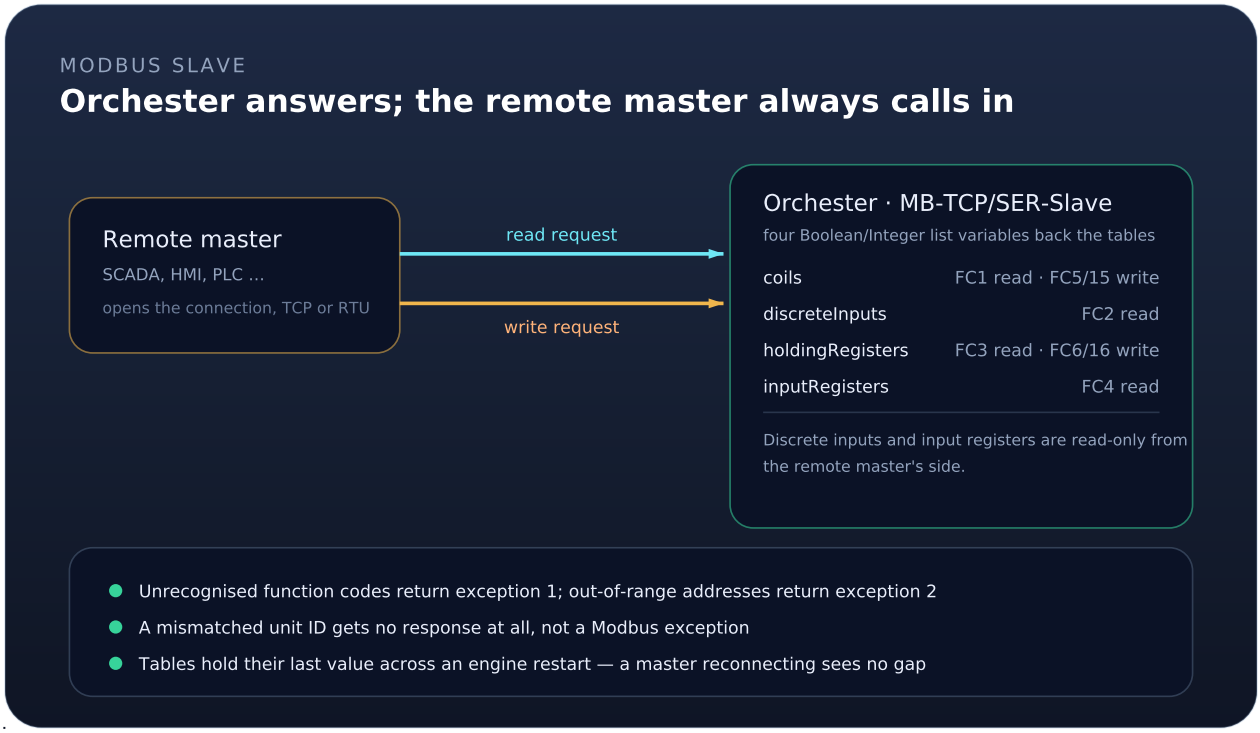
Every request retries with a jittered backoff on failure rather than giving up on the first dropped packet or timeout, which matters on a noisy serial line shared by several devices.

Example. Reading a line's temperature (a 32-bit float split across two holding registers) every ten seconds, and writing an operator-adjustable setpoint back when it changes:

```
Collector   field=LINE1_TEMP_C   remoteType=float  remoteAddress=40010  cron=*/10 * * * * ?
Forewarder  field=LINE1_SETPOINT remoteType=int    remoteAddress=40020
```

`LINE1_TEMP_C` now updates itself every ten seconds from the device; writing to `LINE1_SETPOINT` anywhere in Orchester — a dashboard, a formula, another peer — sends function code 6 to register 40020 on the PLC.

Modbus Slave



Flip the direction, and Orchester becomes the thing being polled: `MB-TCP-Slave` and `MB-SER-Slave` turn an instance into a Modbus server that a SCADA system, an HMI, or another PLC can read from and write to. Four list-valued variables back the four Modbus tables:

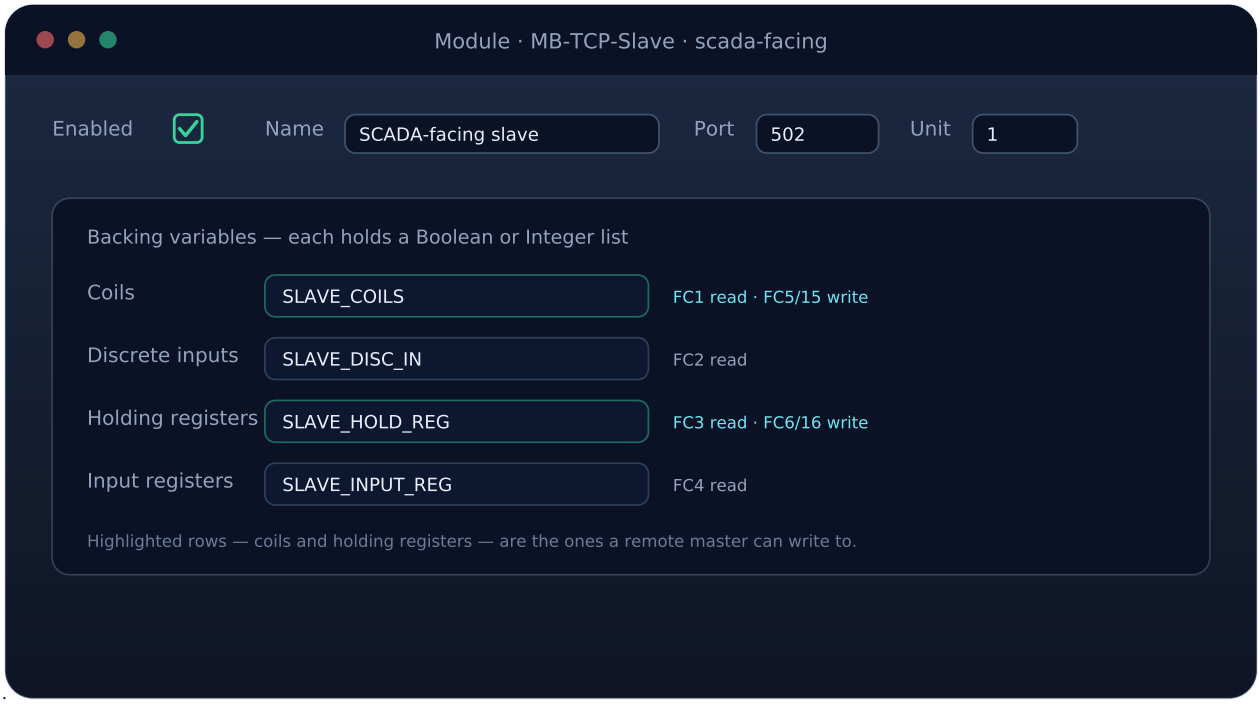


Table	Backing variable holds	Function codes
Coils	`List<Boolean>`	FC1 read, **FC5/FC15 write**
Discrete inputs	`List<Boolean>`	FC2 read
Holding registers	`List<Integer>`	FC3 read, **FC6/FC16 write**
Input registers	`List<Integer>`	FC4 read

Discrete inputs and input registers are read-only from the remote master's side — only coils and holding registers accept writes, matching their table names.

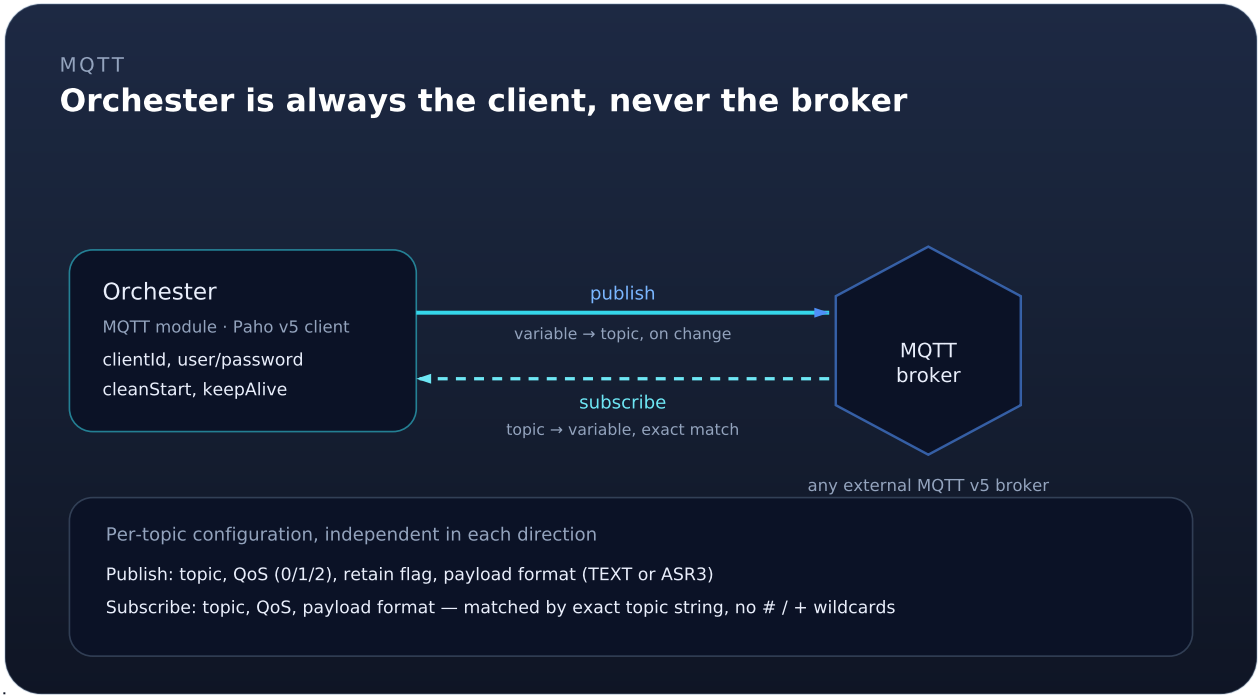
An unsupported function code comes back as Modbus exception 1; an out-of-range address or a request past the end of the backing list comes back as exception 2. A request tagged with a unit ID that doesn't match this slave's configured `unit` gets no response at all, rather than an exception — indistinguishable, on the wire, from the slave not existing. And because these are ordinary Orchester variables, they hold their last written value across an engine restart, so a master reconnecting after a deploy sees continuity, not a gap.

Example. Exposing eight alarm bits and four analog readings to a plant SCADA, unit ID 3:

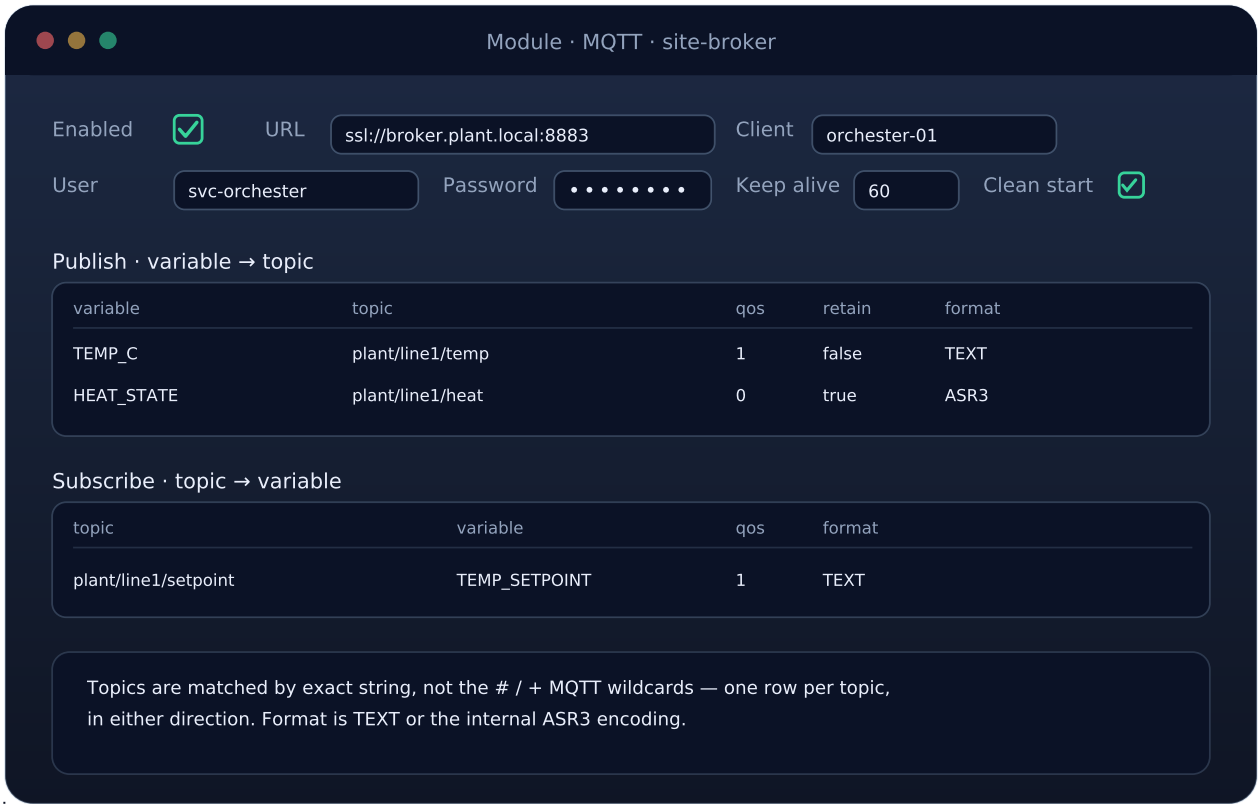
```
coils           -> SLAVE_COILS      (List<Boolean>, length 8)
holdingRegisters -> SLAVE_HOLD_REG   (List<Integer>, length 4)
```

The SCADA reads FC3 at address 2, quantity 1, and gets `SLAVE_HOLD_REG[2]`. If it writes FC5 to coil 3 to force an alarm, that write lands in `SLAVE_COILS[3]`, exactly as the table above suggests.

MQTT



The `MQTT` module makes Orchester an MQTT v5 client — never a broker. It opens one connection to an external broker and, independently in each direction, publishes variable values out to topics and subscribes to topics that update variables.



Field	Meaning
`url`	Broker address, including scheme (`tcp://` or `ssl://`) and port
`client`	The MQTT client ID this instance presents
`user` / `password`	Broker credentials, if required
`cleanStart`	Whether to start a fresh session on connect (default on)
`keepAlive`	Keep-alive interval in seconds (default 60)

Publish and subscribe are both configured as maps, one row per topic:

- **Publish**: variable to topic, with a QoS level, a retain flag, and a payload format — plain `TEXT` or the internal `ASR3` encoding, which round-trips richer types than a plain string can.
- **Subscribe**: topic to variable, with the same QoS and format choice.

Topic matching is an exact string comparison — there's no `#` / `+` wildcard support, so a subscription needs one row per concrete topic it should react to.

Example. A line records its power draw in the `POWER_KW` variable and needs it visible to a plant-wide dashboard subscribed to the site broker, while a remote setpoint arrives over the same broker:

```
Publish     POWER_KW -> plant/line1/power        QoS 1  retain=false  format=TEXT
Subscribe   plant/line1/setpoint -> TEMP_SETPOINT QoS 1  format=TEXT
```

Choosing between them

- Talking to **another Orchester instance**: use the DO-to-DO peer link — it's already there, and `DOPUSH` / `DOPULL` cover the common push/pull patterns without any custom code.
- Talking to **a third-party system that can call you**: use the external REST API. It reuses the same peer and licence model as DO-to-DO, so a customer's integration is one more peer entity, not a new trust boundary.
- Talking to **a field device that speaks Modbus**: use Modbus Master if Orchester should poll the device, or Modbus Slave if the device (or a SCADA layer above it) needs to poll Orchester instead. Both can run at once for the same device family, if some points are read there and others are written here.
- Talking to **a message broker**, or integrating with anything already built around publish/subscribe: use the MQTT module.

All five share the same underlying safety property: none of them can be configured into pulling more than a licensed instance is entitled to, and none of them de-energizes a running engine on their own — a licence issue narrows what a peer or the external API will answer, it never stops a module that's already driving a device.

Next steps

- Configuration reference
- Licence activation