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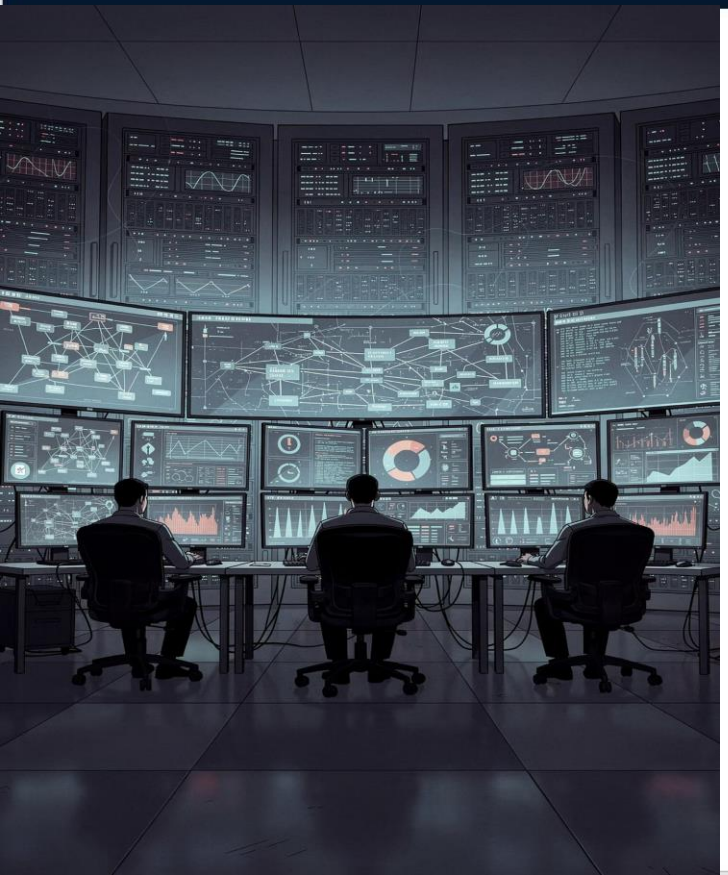

When MCP Meets Reality

Performance, Latency, and the Hidden Cost of AI Orchestration in Enterprises

Lessons from Network Troubleshooting and AI-Driven Remediation · MCP Dev Con

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THE PROBLEM

Why MCP Is Exciting

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Traditional Operations

1. Engineer
2. Telemetry + Logs
3. Config + Topology
4. Root Cause Analysis

AI-Driven Operations

1. Engineer
2. AI Agent
3. MCP
4. Enterprise Tools

MCP standardises access to enterprise capabilities — turning manual orchestration into automated intelligence.

USE CASE

The Network Troubleshooting Scenario

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"Investigate why interface ge-0/0/0 is down."

Engineer → NOC Portal → AI Agent

Single natural-language query triggers full investigation

Telemetry MCP Server

Interface stats, error counters, optical levels

Config MCP Server

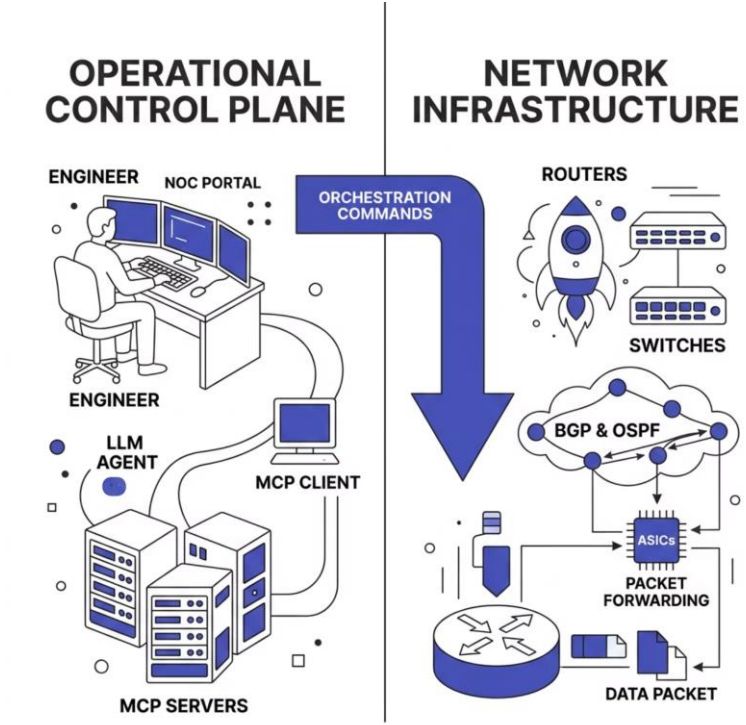
Recent config changes, rollback history

Topology + Incident Servers

Neighbour state, BGP sessions, open tickets

ARCHITECTURE

Understanding MCP Placement



MCP operates *above* the network

It is an orchestration layer — never an inline forwarding component.

> ⚠ **MCP does NOT run inside the router.** The control plane and execution plane are categorically separate.

- Control plane: orchestrate, diagnose, remediate
- Data plane: route, forward, switch — at line rate

PIPELINE

Formal MCP Execution Pipeline

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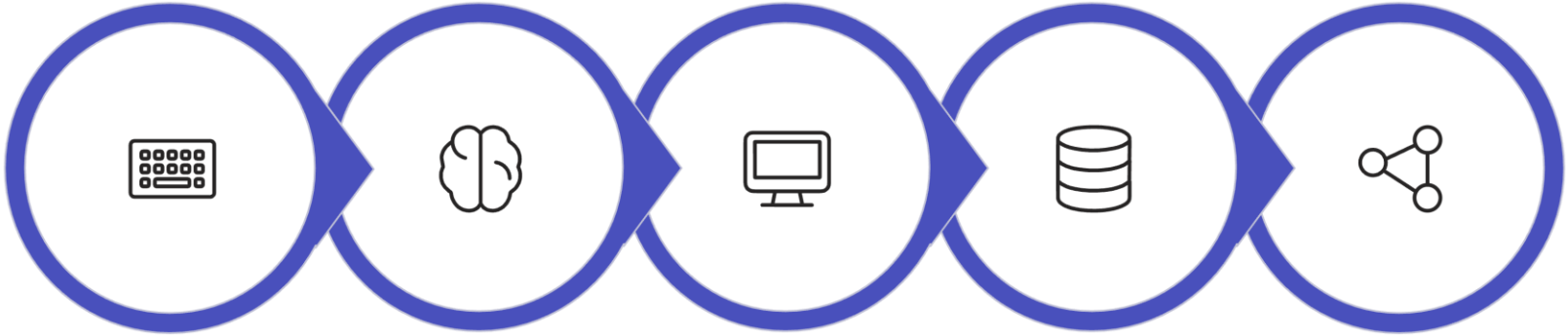
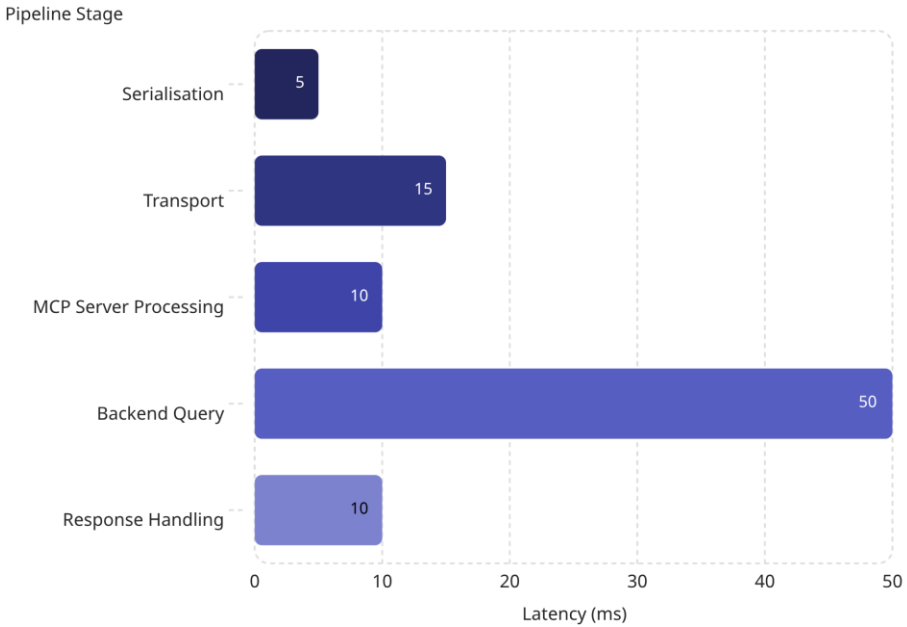


Every tool call has a measurable cost. Each hop in this pipeline contributes latency before the agent can reason on the result.

LATENCY

Where Latency Comes From



Single call: ~90 ms

Acceptable in isolation. Dangerous at scale.

×5 Sequential	×10 Sequential
450 ms	900 ms

⚠ Latency amplifies with every additional tool call in a sequential workflow.

OPTIMISATION

Sequential vs. Parallel Tool Invocation

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❌ Sequential — 450 ms

1. **Telemetry** ~90 ms
2. **Config** ~90 ms
3. **Topology** ~90 ms
4. **Incidents** ~90 ms

✅ Parallel — ~100 ms

All four tools execute concurrently via `asyncio.gather()`
4.5× latency reduction — architecture choice, not protocol tuning.

CRITICAL MISTAKE

MCP Must Never Enter the Data Plane

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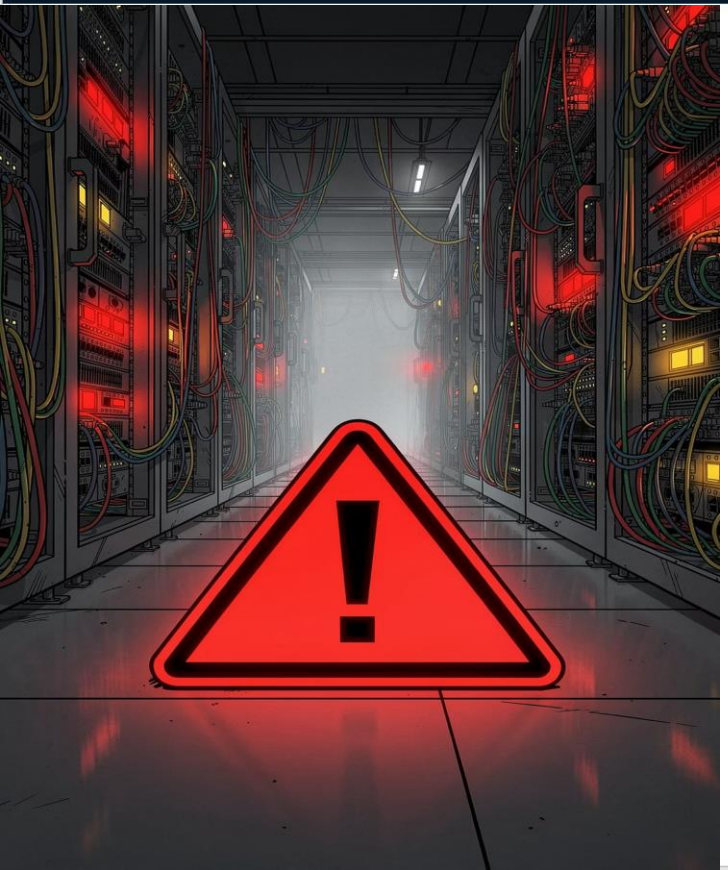

✅ MCP Belongs Here

- Investigation
- Diagnosis
- Recommendation
- Remediation

❌ Never This

1. Packet Arrives
2. MCP Tool Call
3. LLM Reasoning
4. Forward Packet

"Nobody would place an LLM in the packet forwarding path." MCP belongs in decision-making workflows, not forwarding loops.

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FAILURE MODES

Production Failure Taxonomy

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Latency Amplification

Sequential calls compound 90 ms into seconds

Data Movement Overhead

Large payloads serialised and deserialised per hop

Schema Drift

Tool contracts change; agents break silently

Observability Gaps

No tracing across LLM → MCP → backend hops

Boundary Violations

MCP invoked in latency-sensitive execution paths

REMEDIATION

Network Remediation Agent

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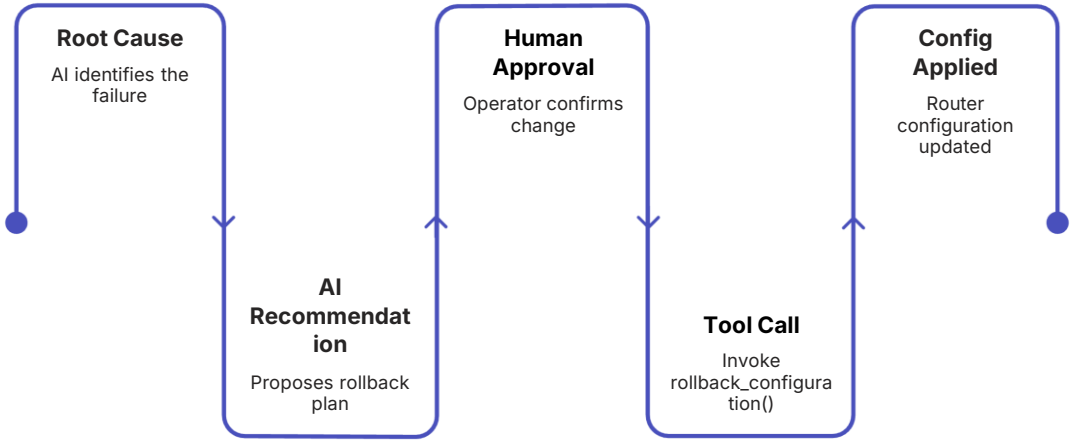

Human-in-the-loop by design

The agent **recommends**. The operator **approves**. Infrastructure **executes**.

AI Agent

Determines root cause, proposes rollback

Approval Gate

Human operator confirms before any change

MCP Tool

`rollback_configuration()` via NETCONF

DESIGN PRINCIPLE

The Control Plane Principle

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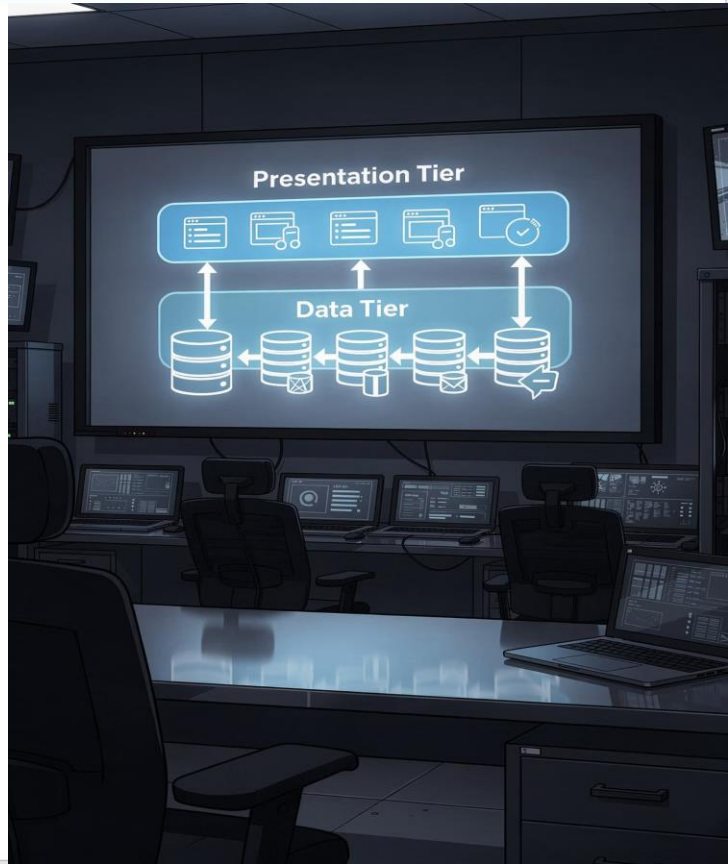
Operational Control Plane

- LLM Agent — reasoning
- MCP — orchestration
- Diagnostics — evidence
- Remediation — intent

Execution Plane

- Routing — BGP, OSPF
- Forwarding — ASICs, line rate
- Telemetry — gNMI, streaming
- Hardware — chips, optics

"BGP computes routes. ASICs forward packets. MCP orchestrates operational intelligence."



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TOOL REGISTRY

Network Troubleshooting MCP Tool Registry

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`get_interface_telemetry()`

Admin/oper status, error counters, optical power — sourced from gNMI / Prometheus

`get_recent_config_changes()`

Last N commits with diff and author — sourced from NETCONF / change management DB

`get_topology_neighbors()`

BGP/OSPF adjacency state, LLDP neighbours — sourced from topology service

`rollback_configuration()`

Revert to previous known-good config — requires human approval gate

MCP Servers expose capabilities. AI agents discover and compose them into investigative workflows.

PROTOCOL

MCP JSON-RPC Request

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```
{
  "jsonrpc": "2.0",
  "id": 101,
  "method": "tools/call",
  "params": {
    "name": "get_interface_telemetry",
    "arguments": {
      "device_id": "R1",
      "interface_name": "ge-0/0/0"
    }
  }
}
```

What's happening here

01

MCP Client serialises intent

JSON-RPC 2.0 envelope wraps the tool call

02

Transport delivers to server

HTTP / stdio / SSE depending on deployment

03

Server routes to handler

Tool name resolves to registered function

PROTOCOL

MCP JSON-RPC Response

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```
{
  "jsonrpc": "2.0",
  "id": 101,
  "result": {
    "device_id": "R1",
    "interface_name": "ge-0/0/0",
    "admin_status": "up",
    "oper_status": "down",
    "input_errors": 0,
    "output_errors": 0
  }
}
```

The server returns facts.

Not conclusions. Not remediation steps.

> The AI agent performs all reasoning. MCP Servers are **evidence providers**, not decision engines.

`oper_status: "down"` with zero errors signals a physical or upstream issue — the agent determines which.

IMPLEMENTATION

Troubleshooting Analyser Logic

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```
class TroubleshootingAnalyzer:

  async def investigate_interface(
    self, device_id, interface_name
  ):
    telemetry, config, topology = await asyncio.gather(
      self.telemetry_tool(device_id, interface_name),
      self.config_tool(device_id),
      self.topology_tool(device_id)
    )
    return self.determine_root_cause(
      telemetry, config, topology
    )
```

Key design decisions

→ Parallel execution

`asyncio.gather()` — all three tools fire simultaneously

→ Reasoning stays in the agent

`determine_root_cause()` — LLM synthesises evidence

→ MCP Servers stay dumb

Servers fetch and return — no analysis logic

IMPLEMENTATION

MCP Server Implementation

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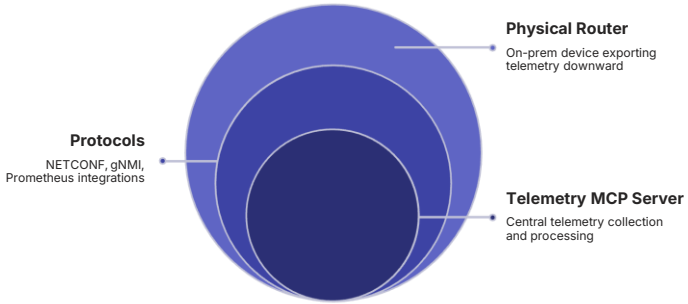
```
@mcp.tool()
async def get_interface_telemetry(
  device_id: str,
  interface_name: str
):
  data = telemetry_backend.query(
    device_id, interface_name
  )
  return {
    "admin_status": data.admin_status,
    "oper_status":  data.oper_status,
    "input_errors": data.input_errors,
    "output_errors": data.output_errors
  }
```

Thin adapter pattern



The MCP Server exposes enterprise capabilities over a standard protocol. Existing infrastructure is **unchanged**.

OBSERVABILITY

Design Observability from Day One

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Distributed Tracing

Correlate LLM reasoning spans → MCP tool calls → backend queries with a single trace ID

Per-Tool Latency Metrics

Instrument each tool invocation — identify which backend is the bottleneck

Schema Version Enforcement

Version every tool contract; alert on drift before agents break silently in production

Audit Trails

Every remediation action logged with agent reasoning, approval identity, and timestamp

KEY TAKEAWAYS

What to Carry Forward

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1 **MCP standardises enterprise capability access**

One protocol — telemetry, config, topology, remediation

2 **Every tool call has measurable cost**

90 ms per hop · sequential chains hit seconds fast

3 **Parallelise early, not after**

`asyncio.gather()` is your first performance lever

4 **MCP belongs in the control plane**

Orchestration, diagnosis, remediation — never forwarding

5 **Observability is not optional**

Trace every hop from intent to infrastructure change

Call to Action

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"Deploy MCP deliberately, not everywhere."

Match protocol scope to operational scope. The control plane is where MCP thrives.

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References

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4. **gNMI**

   https://github.com/openconfig/reference/blob/master/rpc/gnmi/gnmi-specification.md/

5. **Google's The Tail at Scale**

Questions?

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