ATOMBEAM

NEURPAC DATA SHEET FOR OIL AND GAS TRANSPORT

Pipeline companies and midstream operators are the vital link for transporting, storing, and processing oil and gas. Reliable connectivity is essential for ensuring delivery and meeting regulatory and safety requirements through real-time transmission.

Optimizing Oil and Gas Transport with Neurpac

Oil and gas operations increasingly depend on transmitting real-time data across critical use cases:

- **Leak Detection & Compliance** - Advanced leak detection monitoring required by PHMSA and Canadian regulations.
- **Compressor & Pump Station Monitoring** - Mechanical, electrical, and environmental data: RPM, vibration, motor current/voltage, gas detection, air quality, and emissions..
- **Security & Cyber Monitoring** - Tracking security event logs, intrusion attempts, and asset integrity.
- **Field Crew Logs** - Collection of sensor logs, geotags, and work orders from remote crews.

75% Message Size Reduction

Individual messages as small as 4 bytes are compacted and transmitted in real time, making it ideal for frequent smart metering data updates.

4x Effective Bandwidth

Ultra-fast encode/decode with Neurpac translates to 4X more bandwidth.

Cost Reduction

Extend the usefulness of existing infrastructure and reduce congestion on contended networks such as SATCOM or LPWANs, supporting large-scale smart metering rollouts.

Data as Codewords

Uses machine learning and AI to automatically build/deploy codewords at the edge, which replaces data with a more efficient, searchable, and randomly accessible representation.

The Challenge

Pipeline providers rely on Supervisory Control and Data (SCADA) systems to monitor pressures, flows, and valve status across thousands of miles, requiring real-time transmission.

- Data consists of continuous telemetry in small packets that must be sent instantly.
- Connectivity is often limited to private microwave, cellular, or satellite links.
- Bandwidth constraints and congestion can impede performance.

The Solution

A reliable, scalable, and accessible solution is needed to transport real-time data seamlessly across pipeline infrastructure.

Key Requirements:

- Seamless integration with existing equipment and infrastructure
- Efficient operation in low-bandwidth environments
- Scalability for growing operational demands and data complexity
- Timely diagnostics and decision-making at both the edge and enterprise levels

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Oil & Gas transport Use Cases

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Neurpac Advantages

75% Message Size Reduction

Enables faster transmission of SCADA data, sensor readings, and operational metrics.

4x Effective Bandwidth

Ultra-fast encode/decode with Neurpac delivers 4× bandwidth. Messages as small as 4 bytes are compacted and sent in real time, ideal for pipelines, compressor stations, and storage facilities with limited or costly bandwidth.

Cost Reduction

Extends the life of existing infrastructure and reduces congestion on networks such as SATCOM, cellular, or dedicated connections, supporting large-scale small-data payload transport.

Data as Codewords

AI/ML automatically builds and deploys codewords at the edge, replacing data with a more efficient, searchable, and randomly accessible representation.

Key Requirements:

✓ Seamless integration with existing equipment and infrastructure

✓ Efficient operation in low-bandwidth environments

✓ Scalability for growing operational demands and data complexity

✓ Timely diagnostics and decision-making at both the edge and enterprise levels

Neurpac

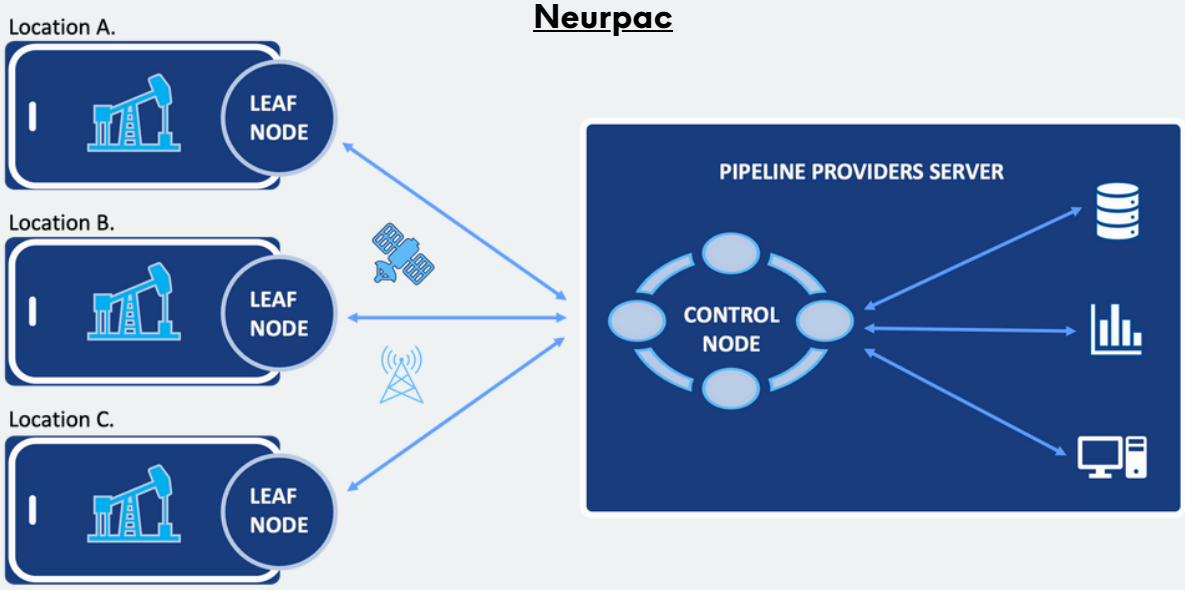
The Atombeam Neurpac solution introduces a more cost-effective, real-time method for Smart City applications by increasing throughput from diverse locations up to 4X.

Neurpac Overview

Neurpac is a data compaction software solution with a small device footprint requiring very little power and very little memory. It runs transparently in line in a network data path where it transparently compacts the data transmission, making it extremely beneficial in the case of WAN transmission within contended networks.

Software Components	Decoder	Encoder	Configurator	Trainer
Leaf Node	✓	✓		
Control Node	✓	✓	✓	✓

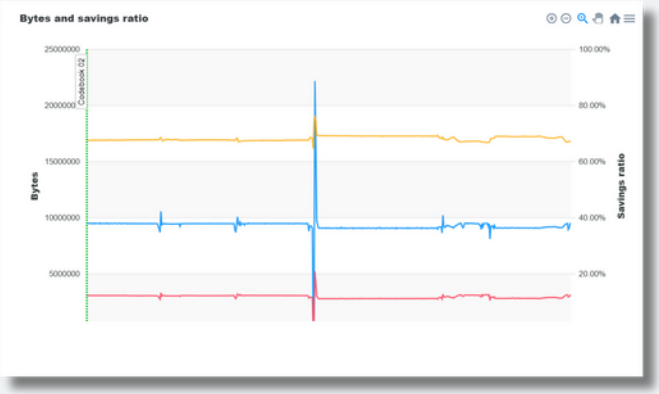
Neurpac



Control Nodes manage and coordinate the operation of connected **Leaf Nodes**. Each Leaf Node is deployed as a software-defined VPN on a server or virtual machine. They contain an **encode**r, a **decoder**, **a trainer**, and a **configurator**.

Leaf Nodes contain an encoder, decoder, and optionally a trainer and configurator. They automatically adjust the local machine's networking configuration and operate under the supervision of their associated Control Node.

- The **trainer** analyzes telemetry data to generate codewords, which form the basis for data efficiency.
- The **encoder** converts raw data into codewords for compact transmission.
- The **decoder** reconstructs the original data from codewords with no loss of fidelity.



Original Data Bytes

Compaction Ratio

Encoded Bytes

Neurpac for Oil and Gas Transport Key Benefits:

Cost-Effective Infrastructure

- Neurpac helps Oil & Gas transport operations reduce both upfront investment and ongoing maintenance costs. By compressing data up to 75%, it lowers bandwidth consumption, storage needs, and transmission expenses—especially valuable when managing high-frequency or large-volume data streams.

Real-Time Data Processing and Analytics

- With real-time data processing, Neurpac enhances operational awareness and speeds response times. It enables instant detection of anomalies such as pressure drops, flow rate shifts, or temperature fluctuations, while accelerating leak detection for faster containment and improved safety.

Scalability and IoT Integration

- Neurpac allows operators to expand pipeline monitoring without costly new infrastructure. Providers can add segments or connections, extend coverage into remote areas with poor connectivity, and confidently manage peak data demands thanks to 75% bandwidth efficiency.

Operational Benefits

- Neurpac integrates and aggregates data seamlessly across diverse sensors and systems. Operators can deploy more sensors on existing infrastructure, stream data at higher frequencies, and enable predictive maintenance strategies. This reduces unplanned downtime, minimizes costly emergency repairs, and improves long-term asset reliability.

Get in touch!

Schedule your proof-of-concept today and discover how Atombeam can cut your data and costs by up to 75%.

System Requirements: Neurpac Point to Point VPN - Overview

Hardware Requirements

Leaf Node	Control Node
Minimum Requirements • **CPU:** 1 core, 1 GHz • **RAM:** 100 MB • **Storage:** 100 MB free space • **Network:** 1 Mbps bandwidth	**Minimum Requirements** • **CPU:** 2 core, 2 GHz • **RAM:** 1 GB • **Storage:** 1 GB free space • **Network:** 10 Mbps bandwidth
Recommended Requirements • **CPU:** 1+ cores, 2 GHz • **Ram:** 1 GB • **Storage:** 1 GB free space • **Network**: 1 Mbps Bandwidth	**Recommended Requirements** **CPU:** 4+ cores, 2 GHz **RAM**: 16 GB **Storage:** 5 GB free space **Network:** 100 Mbps Bandwidth

Operating System Support

Linux (Primary Support)
- Ubuntu: 22.04 LTS, 24.04 LTS

Architecture Support
- x86_64 (AMD64)
- ARM64 (aarch64)

Network Requirements

Ports
- Server: TCP 443 (configurable)
- Client Metrics: TCP 9090 (optional, configurable)

Protocols
- WebSocket over TLS (WSS)
- Mutual TLS authentication
- TUN interface (Layer 3 tunneling)

Memory Usage
- Base: ~50 MB per process
- Compaction: +20-100 MB (depends on codebook size)
- Per Session: +10-50 MB (server only)

Privilege Requirements

Linux Capabilities
- CAP_NET_ADMIN: TUN interface creation/configuration
- Root privileges: Required for network operations

Memory Usage
- Base: ~50 MB per process
- Compaction: 20-100 MB (depends on codebook size)
- Per Session: 10-50 MB (server only)

CPU Usage
- Idle: <1% CPU
- Active Compression: 5-15% CPU per 100 M
- Training: Up to 50% CPU during codebook generation

Storage Requirements
- Binaries: ~20 MB (statically linked)
- Codebooks: 1-2 MB per code book set
- Logs: Variable (configurable retention)
- Temporary Files: Up to 1 GB during training