

@push.rocks/smarts tream

A library to simplify the creation and manipulation of Node.js streams, providing utilities for handling transform, duplex, and readable/writable streams effectively in TypeScript.

- [readme.md for @push.rocks/smartsream](#)
- [changelog.md for @push.rocks/smartsream](#)

readme.md for @push.rocks/smartstream

A TypeScript-first library for creating and manipulating Node.js and Web streams with built-in backpressure handling, async transformations, and seamless Node.js ↔ Web stream interoperability.

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Install

```
pnpm install @push.rocks/smartstream
```

The package ships with two entry points:

Entry Point	Import Path	Environment
Node.js (default)	<code>@push.rocks/smartstream</code>	Node.js — full stream utilities, duplex, intake, wrappers, and Node↔Web helpers
Web	<code>@push.rocks/smartstream/web</code>	Browser & Node.js — pure Web Streams API (<code>WebDuplexStream</code>)

Usage

All examples use ESM / TypeScript syntax.

Importing

```
// Node.js – full API
import {
  SmartDuplex,
  StreamWrapper,
  StreamIntake,
  createTransformFunction,
  createPassThrough,
  nodewebhelpers,
} from '@push.rocks/smartstream';

// Web – browser-safe, zero Node.js dependencies
import { WebDuplexStream } from '@push.rocks/smartstream/web';
```

SmartDuplex — The Core Stream Primitive

`SmartDuplex` extends Node.js `Duplex` with first-class async support, built-in backpressure management, and a clean functional API. Instead of overriding `_transform` or `_write` manually, you pass a `writeFunction` that receives each chunk along with a `tools` object.

Basic Transform

```
import { SmartDuplex } from '@push.rocks/smartstream';

const upperCaser = new SmartDuplex<Buffer, Buffer>({
  writeFunction: async (chunk, tools) => {
    // Return a value to push it downstream
    return Buffer.from(chunk.toString().toUpperCase());
  },
});

readableStream.pipe(upperCaser).pipe(writableStream);
```

Using `tools.push()` for Multiple Outputs

The `writeFunction` can emit multiple chunks per input via `tools.push()`:

```
const splitter = new SmartDuplex<string, string>({
  objectMode: true,
  writeFunction: async (chunk, tools) => {
    const words = chunk.split(' ');
    for (const word of words) {
      await tools.push(word);
    }
    // Returning nothing – output was already pushed
  },
});
```

Final Function

Run cleanup or emit final data when the writable side ends:

```
const aggregator = new SmartDuplex<number, number>({
  objectMode: true,
  writeFunction: async (chunk, tools) => {
    runningTotal += chunk;
    // Don't emit anything per-chunk
  },
  finalFunction: async (tools) => {
    return runningTotal; // Emitted as the last chunk
  },
});
```

Truncating a Stream Early

Call `tools.truncate()` inside `writeFunction` to signal that no more data should be read:

```
const limiter = new SmartDuplex<string, string>({
  objectMode: true,
  writeFunction: async (chunk, tools) => {
    if (chunk === 'STOP') {
      tools.truncate();
      return;
    }
    return chunk;
  },
});
```

```
});
```

Creating from a Buffer

```
const stream = SmartDuplex.fromBuffer(Buffer.from('hello world'));
stream.on('data', (chunk) => console.log(chunk.toString())); // "hello world"
```

Creating from a Web ReadableStream

Bridge the Web Streams API into a Node.js Duplex:

```
const response = await fetch('https://example.com/data');
const nodeDuplex = SmartDuplex.fromWebReadableStream(response.body);

nodeDuplex.pipe(processTransform).pipe(outputStream);
```

Getting Web Streams from SmartDuplex

Convert a `SmartDuplex` into Web `ReadableStream` + `WritableStream` pair:

```
const duplex = new SmartDuplex({
  writeFunction: async (chunk, tools) => {
    return transform(chunk);
  },
});

const { readable, writable } = await duplex.getWebStreams();
```

Debug Mode

Pass `debug: true` and `name` to get detailed internal logs:

```
const stream = new SmartDuplex({
  name: 'MyStream',
  debug: true,
  writeFunction: async (chunk, tools) => chunk,
});
```

StreamWrapper — Pipeline Composition

`StreamWrapper` takes an array of streams, pipes them together, attaches error listeners on all of them, and returns a `Promise` that resolves when the pipeline finishes:

```
import { StreamWrapper } from '@push.rocks/smartstream';
import fs from 'fs';

const pipeline = new StreamWrapper([
  fs.createReadStream('./input.txt'),
  new SmartDuplex({
    writeFunction: async (chunk) => Buffer.from(chunk.toString().toUpperCase()),
  }),
  fs.createWriteStream('./output.txt'),
]);

await pipeline.run();
console.log('Pipeline complete!');
```

Error handling is automatic — if any stream in the array errors, the returned promise rejects:

```
pipeline.run()
  .then(() => console.log('Done'))
  .catch((err) => console.error('Pipeline failed:', err));
```

You can also listen for custom events across all streams:

```
pipeline.onCustomEvent('progress', () => {
  console.log('Progress event fired');
});
```

☐☐ StreamIntake — Dynamic Data Injection

`StreamIntake` is a `Readable` stream that lets you programmatically push data into a pipeline. It operates in object mode by default and provides a reactive observable (`pushNextObservable`) for demand-driven data production.

```
import { StreamIntake, SmartDuplex } from '@push.rocks/smartstream';

const intake = new StreamIntake<string>();
```

```

// Pipe through a transform
intake
  .pipe(new SmartDuplex({
    objectMode: true,
    writeFunction: async (chunk) => {
      console.log('Processing:', chunk);
      return chunk;
    },
  }))
  .on('data', (data) => console.log('Output:', data));

// Push data whenever it's ready
intake.pushData('Hello');
intake.pushData('World');
intake.signalEnd(); // Signal end-of-stream

```

Demand-driven Production with Observable

`pushNextObservable` emits whenever the stream is ready for more data — perfect for throttled or event-driven producers:

```

const intake = new StreamIntake<number>();

let counter = 0;
intake.pushNextObservable.subscribe(() => {
  if (counter < 100) {
    intake.pushData(counter++);
  } else {
    intake.signalEnd();
  }
});

intake.pipe(consumer);

```

Creating from Existing Streams

Wrap a Node.js `Readable` or a Web `ReadableStream`:

```

// From Node.js Readable
const intake = await StreamIntake.fromStream<Buffer>(fs.createReadStream('./data.bin'));

```

```
// From Web ReadableStream
const response = await fetch('https://example.com/stream');
const intake = await StreamIntake.fromStream<Uint8Array>(response.body);
```

⚡ Utility Functions

createTransformFunction

Quickly create a `SmartDuplex` from a simple async mapping function:

```
import { createTransformFunction } from '@push.rocks/smartstream';

const doubler = createTransformFunction<number, number>(async (n) => n * 2);

intakeStream.pipe(doubler).pipe(outputStream);
```

createPassThrough

Create an object-mode passthrough stream (useful as an intermediary or tee point):

```
import { createPassThrough } from '@push.rocks/smartstream';

const passThrough = createPassThrough();
source.pipe(passThrough).pipe(destination);
```

📄 WebDuplexStream — Pure Web Streams API

`WebDuplexStream` extends `TransformStream` and works in both browsers and Node.js. Import it from the `/web` subpath for zero Node.js dependencies.

```
import { WebDuplexStream } from '@push.rocks/smartstream/web';

const stream = new WebDuplexStream<number, number>({
  writeFunction: async (chunk, { push }) => {
    push(chunk * 2); // Push transformed data
  },
});
```

```

});

const writer = stream.writable.getWriter();
const reader = stream.readable.getReader();

// Write
await writer.write(5);
await writer.write(10);
await writer.close();

// Read
const { value } = await reader.read(); // 10
const { value: v2 } = await reader.read(); // 20

```

From a Uint8Array

```

const stream = WebDuplexStream.fromUInt8Array(new Uint8Array([1, 2, 3]));
const reader = stream.readable.getReader();
const { value } = await reader.read(); // Uint8Array [1, 2, 3]

```

Data Production with `readFunction`

Supply data into the stream from any async source:

```

const stream = new WebDuplexStream<string, string>({
  readFunction: async (tools) => {
    await tools.write('chunk 1');
    await tools.write('chunk 2');
    tools.done(); // Signal end
  },
  writeFunction: async (chunk, { push }) => {
    push(chunk.toUpperCase());
  },
});

const reader = stream.readable.getReader();
// reads "CHUNK 1", "CHUNK 2"

```

Node ↔ Web Stream Converters

The `nodewebhelpers` namespace provides bidirectional converters between Node.js and Web Streams:

```
import { nodewebhelpers } from '@push.rocks/smartstream';
```

Function	From	To
<code>createWebReadableStreamFromFile(path)</code>	File path	Web <code>ReadableStream<Uint8Array></code>
<code>convertWebReadableToNodeReadable(webStream)</code>	Web <code>ReadableStream</code>	Node.js <code>Readable</code>
<code>convertNodeReadableToWebReadable(nodeStream)</code>	Node.js <code>Readable</code>	Web <code>ReadableStream</code>
<code>convertWebWritableToNodeWritable(webWritable)</code>	Web <code>WritableStream</code>	Node.js <code>Writable</code>
<code>convertNodeWritableToWebWritable(nodeWritable)</code>	Node.js <code>Writable</code>	Web <code>WritableStream</code>

Example: Serve a File as a Web ReadableStream

```
const webStream = nodewebhelpers.createWebReadableStreamFromFile('./video.mp4');  
  
// Use with fetch Response, service workers, etc.  
return new Response(webStream, {  
  headers: { 'Content-Type': 'video/mp4' },  
});
```

Example: Convert Between Stream Types

```
import fs from 'fs';  
import { nodewebhelpers } from '@push.rocks/smartstream';  
  
// Node → Web  
const nodeReadable = fs.createReadStream('./data.bin');  
const webReadable = nodewebhelpers.convertNodeReadableToWebReadable(nodeReadable);  
  
// Web → Node  
const nodeReadable2 = nodewebhelpers.convertWebReadableToNodeReadable(webReadable);  
nodeReadable2.pipe(fs.createWriteStream('./copy.bin'));
```

□□ Backpressure Handling

`SmartDuplex` uses a `BackpressuredArray` internally, bounded by `highWaterMark` (default: 1). When the downstream consumer is slow, the stream automatically pauses the upstream producer until space is available — no manual bookkeeping required.

```
const slow = new SmartDuplex({
  name: 'SlowConsumer',
  objectMode: true,
  highWaterMark: 1,
  writeFunction: async (chunk, tools) => {
    await new Promise((resolve) => setTimeout(resolve, 200));
    return chunk;
  },
});

const fast = new SmartDuplex({
  name: 'FastProducer',
  objectMode: true,
  writeFunction: async (chunk, tools) => {
    return chunk; // Instant processing
  },
});

// Backpressure is handled automatically between fast → slow
fast.pipe(slow).on('data', (d) => console.log(d));

for (let i = 0; i < 100; i++) {
  fast.write(`chunk-${i}`);
}
fast.end();
```

□□ Real-World Example: Processing Pipeline

```
import fs from 'fs';
import { SmartDuplex, StreamWrapper } from '@push.rocks/smartstream';

// Read → Transform → Filter → Write
const pipeline = new StreamWrapper([
  fs.createReadStream('./access.log'),
  new SmartDuplex({
    writeFunction: async (chunk) => {
      // Parse each line
      return chunk.toString().split('\n');
    },
  }),
  new SmartDuplex({
    objectMode: true,
    writeFunction: async (lines: string[], tools) => {
      // Filter and push matching lines
      for (const line of lines) {
        if (line.includes('ERROR')) {
          await tools.push(line + '\n');
        }
      }
    },
  }),
  fs.createWriteStream('./errors.log'),
]);

await pipeline.run();
console.log('Error extraction complete');
```

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changelog.md for @push.rocks/smartstream

2026-03-02 - 3.4.0 - feat(smartduplex)

improve backpressure handling and web/node stream interoperability

- Refactored SmartDuplex to use synchronous `_read/_write/_final` (avoids async pitfalls), added internal backpressured buffer draining and consumer signaling
- Implemented pull-based backpressure for Node <-> Web stream conversions (nodewebhelpers and `convertNodeReadableToWebReadable/convertWebReadableToNodeReadable`)
- `StreamIntake.fromStream` now reads from 'readable' and drains properly; `StreamWrapper` resolves safely on end/close/finish
- Improved `getWebStreams / WebDuplexStream` behavior (safer enqueue/close/abort handling, final/readFunction improvements)
- Added many new unit tests covering backpressure, web/node helpers, `StreamIntake`, `StreamWrapper`, `WebDuplexStream`; bumped `@push.rocks/lik` and `@types/node` versions

2026-02-28 - 3.3.0 - feat(smartstream)

bump dependencies, update build/publish config, refactor tests, and overhaul documentation

- Upgrade devDependencies (e.g. `@git.zone/tsbuild` -> `^4.1.2`, `@git.zone/tsrun` -> `^2.0.1`, `@git.zone/tstest` -> `^3.1.8`, `@types/node` -> `^25.3.2`) and runtime deps (e.g. `@push.rocks/lik` -> `^6.2.2`, `@push.rocks/smartenv` -> `^6.0.0`, `@push.rocks/smartpromise` -> `^4.2.3`, `@push.rocks/smartrx` -> `^3.0.10`).
- Refactor tests to use Node's native fs streams instead of `@push.rocks/smartfile.fsStream` and export default `tap.start()` to support ESM test runner patterns.

- Adjust build/publish: remove --web flag from build script, add pnpm override for agentkeepalive, add tspublish.json files for publish order, and add release registries/access in npmextra.json (verdaccio + npm).
- Rework project metadata in npmextra.json (namespaced @git.zone keys, tsdoc entry changes) and minor TypeScript/web fix: cast stream/web constructors to any in ts_web/plugins.ts.
- Large README rewrite: improved installation (pnpm), clearer Node vs Web entrypoints, expanded examples, and updated legal/license wording.

2024-11-19 - 3.2.5 - fix(nodewebhelpers)

Fix import and use correct module structure for Node.js streams in smartstream.nodewebhelpers.ts

- Corrected the import statement for the fs module.
- Updated the use of the fs.createReadStream method.

2024-10-16 - 3.2.4 - fix(SmartDuplex)

Fix stream termination when reading from a web readable stream

- Resolved an issue in SmartDuplex where the stream did not properly terminate after reaching the end of a web readable stream.

2024-10-16 - 3.2.3 - fix(smartduplex)

Enhance documentation for read function in SmartDuplex

- Added inline comments to clarify the behavior and importance of unlocking the reader in the readFunction of SmartDuplex.fromWebReadableStream.

2024-10-16 - 3.2.2 - fix(SmartDuplex)

Fix issue with SmartDuplex fromWebReadableStream method

- Resolved a potential unhandled promise rejection in fromWebReadableStream method
- Ensured proper release of stream reader lock in case of read completion

2024-10-16 - 3.2.1 - fix(core)

Fix the order of operations in SmartDuplex _read method to ensure proper waiting for items.

- Adjusted the order of reading function execution and waiting for items in the SmartDuplex _read method.
- Fixed potential issues with stream data processing timing.

2024-10-16 - 3.2.0 - feat(SmartDuplex)

Added method to create SmartDuplex from a WebReadableStream.

- Implemented a static method in SmartDuplex to allow creating an instance from a WebReadableStream.
- This addition enhances the capability of SmartDuplex to integrate with web streams, facilitating seamless stream manipulation across environments.

2024-10-14 - 3.1.2 - fix(WebDuplexStream)

Fix variable naming inconsistency in WebDuplexStream test

- Changed variable names from 'transformStream' to 'webDuplexStream' for consistency.

- Renamed 'writableStream' and 'readableStream' to 'writer' and 'reader' respectively.

2024-10-13 - 3.1.1 - fix(WebDuplexStream)

Improved read/write interface and error handling in WebDuplexStream

- Enhanced the IStreamToolsRead and IStreamToolsWrite interfaces for better Promise handling
- Refined readFunction and writeFunction handling to accommodate asynchronous data processing and error propagation
- Added internal _startReading method to facilitate initial data handling if readFunction is present
- Maintained backward compatibility while ensuring data continuity when no writeFunction is specified

2024-10-13 - 3.1.0 - feat(core)

Add support for creating Web ReadableStream from a file

- Introduced a new helper function `createWebReadableStreamFromFile` that allows for creating a Web ReadableStream from a file path.
- Updated exports in `ts/index.ts` to include `nodewebhelpers` which provides the new web stream feature.

2024-10-13 - 3.0.46 - fix(WebDuplexStream)

Fix errors in WebDuplexStream transformation and test logic

- Corrected async handling in WebDuplexStream write function
- Fixed `WebDuplexStream` tests to properly handle asynchronous reading and writing

2024-10-13 - 3.0.45 - fix(ts)

Fixed formatting issues in SmartDuplex class

- Resolved inconsistent spacing in SmartDuplex class methods and constructor.
- Ensured consistent formatting in the getWebStreams method.

2024-06-02 - 3.0.39 - smartduplex

Add .getWebStreams method

- Introduced a new `.getWebStreams` method in the smartduplex module, providing compatibility with the web streams API.

2024-03-16 - 3.0.34 - configuration

Update project configuration files

- Updated `tsconfig` for optimization.
- Modified `npmextra.json` to set the `githost` attribute.

2023-11-03 - 3.0.0 to 3.0.8 - core

Transition to major version 3.x

- Implemented breaking changes in the core system for better performance and feature set.
- Continuous core updates to improve stability and performance across minor version increments.

2023-11-02 - 2.0.4 to 2.0.8 - core

Core updates and a major fix

- Implemented core updates addressing minor bugs and enhancements.

- A significant breaking change update transitioning from 2.0.x to 3.0.0.

2022-03-31 - 2.0.0 - core

Major esm transition

- Implemented a breaking change by switching the core to ESM (ECMAScript Module) format for modernized module handling.