@ecobridge.xyz/devicemanager

Documentation for @ecobridge.xyz/devicemanager

- readme.md for @ecobridge.xyz/devicemanager
- changelog.md for @ecobridge.xyz/devicemanager

readme.md for @ecobridge.xyz/devicemanager

A comprehensive, TypeScript-first device manager for discovering and communicating with network devices. □□

npm version License: MIT

□□ Overview

`@ecobridge.xyz/devicemanager` provides a unified, object-oriented API for discovering and controlling network devices. Whether you're building a document scanning workflow, managing printers, controlling smart home devices, or monitoring UPS systems — this library has you covered.

Supported Device Types:

- □□ **Scanners** — eSCL (AirScan), SANE protocols
- □□ **Printers** — IPP, JetDirect protocols
- □□ **Speakers** — Sonos, AirPlay, Chromecast, DLNA
- □□ **UPS Systems** — NUT, SNMP protocols
- □□ **SNMP Devices** — Generic SNMP v1/v2c/v3 support
- □□ **Smart Home** — Home Assistant integration (lights, switches, sensors, climate, locks, fans, cameras, covers)

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□□ Installation

```
# Using pnpm (recommended)
pnpm add @ecobridge.xyz/devicemanager

# Using npm
npm install @ecobridge.xyz/devicemanager

# Using yarn
yarn add @ecobridge.xyz/devicemanager
```

□□ Quick Start

The OOP Pattern: Discovery → Selection → Feature → Operation

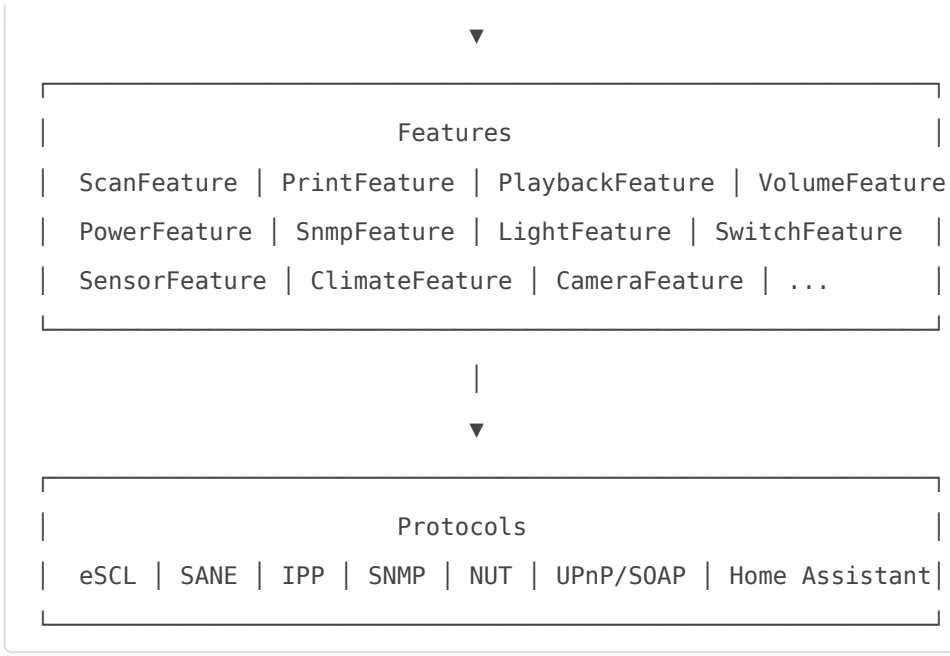
```
import { DeviceManager, ScanFeature } from '@ecobridge.xyz/devicemanager';
import * as fs from 'fs/promises';

async function scanDocument() {
  const manager = new DeviceManager();

  // 1□□ DISCOVERY - Find scanners in your network
  await manager.discoverScanners('192.168.1.0/24');

  // 2□□ INSPECTION - See what's available
  const scanners = manager.getDevices({ hasFeature: 'scan' });
  console.log('Found scanners:', scanners.map(s => `${s.name} at ${s.address}`));

  // 3□□ SELECTION - Choose your device (explicit, no magic!)
  const device = manager.selectDevice({ address: '192.168.1.100' });

  // 4□□ FEATURE ACCESS - Get the capability you need
  const scanFeature = device.selectFeature<ScanFeature>('scan');
```

```
  // 5□□ OPERATION - Do the thing!
  await scanFeature.connect();
  const result = await scanFeature.scan({
    source: 'flatbed',
    resolution: 300,
    colorMode: 'color',
    format: 'jpeg',
  });

  await fs.writeFile('scan.jpg', result.data);
  console.log(`Saved: scan.jpg (${result.data.length} bytes)`);

  await manager.shutdown();
}

scanDocument();
```

□□ Architecture

The library follows a clean, composable architecture:

```
┌─────────────────────────────────────────────────────────┐
│                      DeviceManager                      │
│  • Discovery (mDNS, SSDP, Network Scanning)             │
│  • Device Registry (by IP, deduplication)               │
│  • Device Selection (query & assert patterns)           │
└─────────────────────────────────────────────────────────┘
                            │
                            ▼
┌─────────────────────────────────────────────────────────┐
│                    UniversalDevice                      │
│  • Represents any network device                        │
│  • Composable features (scan, print, volume, etc.)      │
│  • Connection lifecycle management                      │
└─────────────────────────────────────────────────────────┘
                            │
```



API Reference

DeviceManager

The central orchestrator for device discovery and management.

```
const manager = new DeviceManager({
  autoDiscovery: true,      // Enable mDNS/SSDP auto-discovery
  discoveryTimeout: 10000,  // Discovery timeout in ms
  enableRetry: true,        // Enable retry with exponential backoff
  maxRetries: 5,            // Maximum retry attempts
});
```

Discovery Methods

```
// Focused scanner discovery
const scanners = await manager.discoverScanners('192.168.1.0/24', {
  timeout: 3000,
  concurrency: 50,
});

// Focused printer discovery
const printers = await manager.discoverPrinters('192.168.1.0/24');
```

```
// General network scan (all device types)
const devices = await manager.scanNetwork({
  ipRange: '192.168.1.0/24',
  probeEscl: true,
  probeIpp: true,
  probeSane: true,
  probeAirplay: true,
  probeSonos: true,
  probeChromecast: true,
});

// mDNS/SSDP continuous discovery
await manager.startDiscovery();
manager.on('device:found', ({ device, featureType }) => {
  console.log(`Found: ${device.name}`);
});
await manager.stopDiscovery();
```

Device Selection

```
// Query pattern (returns array, may be empty)
const allDevices = manager.getDevices();
const scanners = manager.getDevices({ hasFeature: 'scan' });
const brotherDevices = manager.getDevices({ name: 'Brother' });

// Assert pattern (returns single device, throws if not found)
const device = manager.selectDevice({ address: '192.168.1.100' });
const scanner = manager.selectDevice({ name: 'Brother', hasFeature: 'scan' });
```

IDeviceSelector Interface

```
interface IDeviceSelector {
  id?: string;               // Exact match on device ID
  address?: string;          // Exact match on IP address
  name?: string;             // Partial match (case-insensitive)
  model?: string;            // Partial match (case-insensitive)
  manufacturer?: string;     // Partial match (case-insensitive)
  hasFeature?: TFeatureType; // Must have this feature
```

```
  hasFeatures?: TFeatureType[];   // Must have ALL features
  hasAnyFeature?: TFeatureType[]; // Must have ANY feature
}
```

UniversalDevice

Represents any network device with composable features.

```
const device = manager.selectDevice({ address: '192.168.1.100' });

// Device properties
console.log(device.name);         // "Brother MFC-J5730DW"
console.log(device.address);      // "192.168.1.100"
console.log(device.manufacturer); // "Brother"
console.log(device.model);        // "MFC-J5730DW"
console.log(device.status);       // 'online' | 'offline' | 'busy' | 'error'

// Feature access (safe query - returns undefined)
const maybeScan = device.getFeature<ScanFeature>('scan');

// Feature access (assert - throws if not available)
const scanFeature = device.selectFeature<ScanFeature>('scan');

// Check capabilities
device.hasFeature('scan');           // true/false
device.hasFeatures(['scan', 'print']); // must have ALL
device.hasAnyFeature(['scan', 'print']); // must have ANY
device.getFeatureTypes();            // ['scan', 'print', ...]
```

Features

□□ ScanFeature

```
const scanFeature = device.selectFeature<ScanFeature>('scan');
await scanFeature.connect();

// Get capabilities
const caps = await scanFeature.getCapabilities();
```

```
// { resolutions: [100, 200, 300, 600], formats: ['jpeg', 'png', 'pdf'], ... }

// Scan a document
const result = await scanFeature.scan({
  source: 'flatbed',       // 'flatbed' | 'adf' | 'adf-duplex'
  resolution: 300,         // DPI
  colorMode: 'color',      // 'color' | 'grayscale' | 'blackwhite'
  format: 'jpeg',          // 'jpeg' | 'png' | 'pdf' | 'tiff'
  quality: 85,             // JPEG quality (1-100)
  area: { x: 0, y: 0, width: 210, height: 297 }, // mm
});

// result.data is a Buffer containing the scanned image
await fs.writeFile('scan.jpg', result.data);
```

□□ PrintFeature

```
const printFeature = device.selectFeature<PrintFeature>('print');
await printFeature.connect();

// Get printer capabilities
const caps = await printFeature.getCapabilities();

// Print a document
const job = await printFeature.print(pdfBuffer, {
  copies: 2,
  mediaSize: 'iso_a4_210x297mm',
  sides: 'two-sided-long-edge',
  quality: 'high',
  colorMode: 'color',
  jobName: 'My Document',
});

// Check job status
const status = await printFeature.getJobStatus(job.id);
```

□□ PlaybackFeature & VolumeFeature

```
const playback = device.selectFeature<PlaybackFeature>('playback');
const volume = device.selectFeature<VolumeFeature>('volume');
```

```
await playback.connect();

// Control playback
await playback.play('http://example.com/audio.mp3');
await playback.pause();
await playback.stop();
await playback.seek(120); // seconds

// Get playback status
const status = await playback.getStatus();
// { state: 'playing', position: 45, duration: 180, track: { title: '...' } }

// Control volume
await volume.setVolume(50);    // 0-100
await volume.mute();
await volume.unmute();
const level = await volume.getVolume();
```

□□ PowerFeature (UPS)

```
const power = device.selectFeature<PowerFeature>('power');
await power.connect();

// Get UPS status
const status = await power.getStatus();
// { status: 'online', battery: { charge: 100, runtime: 1800, voltage: 13.8 }, ... }

// Get battery info
const battery = await power.getBatteryInfo();
// { charge: 95, runtime: 1500, health: 'good' }

// Run self-test
await power.runTest();
```

□□ Smart Home Features

```
// Light control
const light = device.selectFeature<LightFeature>('light');
await light.turnOn();
```

```
await light.setBrightness(80);
await light.setColor({ r: 255, g: 100, b: 50 });
await light.setColorTemperature(4000); // Kelvin

// Switch control
const switch_ = device.selectFeature<SwitchFeature>('switch');
await switch_.turnOn();
await switch_.turnOff();
await switch_.toggle();

// Climate control
const climate = device.selectFeature<ClimateFeature>('climate');
await climate.setTargetTemperature(22);
await climate.setMode('heat'); // 'heat' | 'cool' | 'auto' | 'off'

// Sensor reading
const sensor = device.selectFeature<SensorFeature>('sensor');
const reading = await sensor.getState();
// { temperature: 22.5, humidity: 45, battery: 85 }
```

Protocol Direct Access

For advanced use cases, you can access protocols directly:

```
import { EsclProtocol, IppProtocol, SnmpProtocol } from '@ecobridge.xyz/devicemanager';

// Direct eSCL (AirScan) access
const escl = new EsclProtocol('192.168.1.100', 80, false);
const caps = await escl.getCapabilities();
const result = await escl.scan({ source: 'flatbed', resolution: 300 });

// Direct IPP access
const ipp = new IppProtocol('ipp://192.168.1.100:631/ipp/print');
const printerAttrs = await ipp.getPrinterAttributes();

// Direct SNMP access
const snmp = new SnmpProtocol('192.168.1.100', { community: 'public' });
const sysDescr = await snmp.get('1.3.6.1.2.1.1.1.0');
```

Home Assistant Integration

```
import { HomeAssistantProtocol, HomeAssistantDiscovery } from '@ecobridge.xyz/devicemanager';

// Connect to Home Assistant
const ha = new HomeAssistantProtocol({
  host: 'homeassistant.local',
  port: 8123,
  accessToken: 'your_long_lived_access_token',
});

await ha.connect();

// Get all entities
const entities = await ha.getStates();

// Control a light
await ha.callService('light', 'turn_on', {
  entity_id: 'light.living_room',
  brightness: 200,
});

// Subscribe to state changes
ha.on('state_changed', (event) => {
  console.log(`${event.entity_id}: ${event.new_state.state}`);
});

// Auto-discover Home Assistant instances via mDNS
const discovery = new HomeAssistantDiscovery();
discovery.on('found', (instance) => {
  console.log(`Found HA at ${instance.address}:${instance.port}`);
});
await discovery.start();
```

Helper Utilities

```
import {
  withRetry,
  isValidIp,
  cidrToIps,
  getLocalSubnet,
} from '@ecobridge.xyz/devicemanager';

// Retry with exponential backoff
const result = await withRetry(
  () => someFlakeyOperation(),
  { maxRetries: 3, baseDelay: 1000, multiplier: 2 }
);

// IP utilities
isValidIp('192.168.1.1');           // true
cidrToIps('192.168.1.0/30');        // ['192.168.1.0', '192.168.1.1', ...]
getLocalSubnet();                    // '192.168.1.0/24'
```

□□ Discovery Methods

The library supports multiple discovery mechanisms:

Method	Protocol	Use Case
`discoverScanners()`	eSCL, SANE	Find network scanners
`discoverPrinters()`	IPP	Find network printers
`scanNetwork()`	All	Comprehensive subnet scan
`startDiscovery()`	mDNS, SSDP	Continuous auto-discovery

mDNS Service Types

```
import { SERVICE_TYPES } from '@ecobridge.xyz/devicemanager';

// Available: escl, ipp, ipp-tls, airplay, raop,
// googlecast, sonos, sane, http, https, printer
```

SSDP Service Types

```
import { SSDP_SERVICE_TYPES } from '@ecobridge.xyz/devicemanager';

// Available: all, rootdevice, mediaRenderer, mediaServer,
// contentDirectory, avtransport, renderingControl,
// connectionManager, zonePlayer
```

□□ Feature Types

```
type TFeatureType =
  | 'scan'       // Document scanning
  | 'print'      // Document printing
  | 'fax'        // Fax send/receive
  | 'copy'       // Copy (scan + print)
  | 'playback'   // Media playback
  | 'volume'     // Volume control
  | 'power'      // Power/UPS status
  | 'snmp'       // SNMP queries
  | 'dlna-render'// DLNA renderer
  | 'dlna-serve' // DLNA server
  | 'light'      // Smart lights
  | 'climate'    // HVAC/thermostats
  | 'sensor'     // Sensors
  | 'camera'     // Cameras
  | 'cover'      // Blinds, garage doors
  | 'switch'     // Smart switches
  | 'lock'       // Smart locks
  | 'fan'        // Fans
  ;
```

□□ Advanced Usage

Custom Device Creation

Use the factory functions for creating devices with specific features:

```
import { createScanner, createPrinter, createSpeaker } from '@ecobridge.xyz/devicemanager';

// Create a scanner device manually
const scanner = createScanner({
  id: 'my-scanner',
  name: 'Office Scanner',
  address: '192.168.1.50',
  port: 80,
  protocol: 'escl',
  txtRecords: {},
});

// Create a printer device
const printer = createPrinter({
  id: 'my-printer',
  name: 'Office Printer',
  address: '192.168.1.51',
  port: 631,
  txtRecords: { rp: '/ipp/print' },
});

// Create a Sonos speaker
const speaker = createSpeaker({
  id: 'living-room-sonos',
  name: 'Living Room',
  address: '192.168.1.52',
  port: 1400,
  protocol: 'sonos',
});
```

Smart Home Factory Functions

```
import {
  createSmartLight,
  createSmartSwitch,
  createSmartSensor,
  createSmartClimate,
```

```
  createSmartCover,
  createSmartLock,
  createSmartFan,
  createSmartCamera,
} from '@ecobridge.xyz/devicemanager';

// Create devices with Home Assistant integration
const light = createSmartLight({
  id: 'living-room-light',
  name: 'Living Room Light',
  address: 'homeassistant.local',
  port: 8123,
  entityId: 'light.living_room',
  protocol: 'home-assistant',
  protocolClient: haClient,  // Your HomeAssistantProtocol instance
  capabilities: {
    supportsBrightness: true,
    supportsColorTemp: true,
    supportsRgb: true,
  },
});
```

Event Handling

```
const manager = new DeviceManager();

// Discovery events
manager.on('device:found', ({ device, featureType }) => {
  console.log(`Found ${device.name} with ${featureType} capability`);
});

manager.on('device:lost', (address) => {
  console.log(`Device at ${address} went offline`);
});

// Network scan progress
manager.on('network:progress', (progress) => {
  console.log(`Scanning: ${progress.percentage}% - Found ${progress.devicesFound} devices`);
```

```
});

// Device events
const device = manager.selectDevice({ address: '192.168.1.100' });
device.on('status:changed', ({ oldStatus, newStatus }) => {
  console.log(`Status: ${oldStatus} → ${newStatus}`);
});
device.on('feature:connected', (featureType) => {
  console.log(`Feature ${featureType} connected`);
});
```

Error Handling

The library uses a fail-fast approach with clear error messages:

```
try {
  // Throws if no device matches
  const device = manager.selectDevice({ address: '192.168.1.999' });
} catch (err) {
  // "No device found matching: {\"address\":\"192.168.1.999\"}"
}

try {
  // Throws if device doesn't have the feature
  const printFeature = device.selectFeature<PrintFeature>('print');
} catch (err) {
  // "Device 'Brother Scanner' does not have feature 'print'"
}

// Safe alternatives that don't throw
const devices = manager.getDevices({ address: '192.168.1.999' }); // []
const maybePrint = device.getFeature<PrintFeature>('print'); // undefined
```

□□ Requirements

- **Node.js** 18+ (native `fetch` support required)
- **TypeScript** 5.0+ (recommended)

- **Network access** to target devices

□□ Credits

Built with ❤ using:

- bonjour-service - mDNS discovery
- node-ssdp - SSDP/UPnP discovery
- net-snmp - SNMP protocol
- ipp - IPP printing protocol
- sonos - Sonos control
- castv2-client - Chromecast protocol

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changelog.md for @ecobridge.xyz/devicemanager

2026-01-13 - 3.1.0 - feat(print)

use IPP smartPrint and normalize IPP capabilities and job mapping

- Use IppProtocol.smartPrint for automatic format detection/conversion when submitting print jobs.
- Normalize and map IIppJob -> IPrintJob via mapIppJobToInternal, collapsing extended IPP job states into internal states.
- Parse IIppPrinterCapabilities fields (mediaSizeSupported, mediaTypeSupported, sidesSupported, printQualitySupported, copiesSupported) and derive supportsDuplex from sidesSupported and maxCopies from copiesSupported range with a fallback.
- Map numeric IPP printQuality values (3,4,5) to internal quality strings (draft, normal, high).
- Switched calls to getPrinterAttributes/getJobAttributes and adjusted job listing to map returned IIppJob objects.
- Export new IPP types from protocols index: IIppPrinterCapabilities, IIppJob, IIppPrintOptions.

2026-01-12 - 3.0.2 - fix(devicemanager)

no changes detected - nothing to commit

- git diff indicates no modifications, additions, or deletions
- no files were changed in the provided diff

2026-01-12 - 3.0.1 - fix(release)

add npm registries to release config and expand documentation for UniversalDevice architecture and smart-home features

- npmextra.json: add "registries" to release configuration to publish to both Verdaccio (https://verdaccio.lossless.digital) and the npm registry
- readme.hints.md: rewritten/expanded implementation notes to describe the UniversalDevice architecture, composable features (including smart-home types like light, switch, sensor, climate, cover, lock, fan, camera), protocols, discovery, factories, interfaces, and testing guidance
- readme.md: add factory usage examples including smart-home factory functions, update txtRecords usage (rp) in examples, and small copy/emoji edits

2026-01-10 - 3.0.0 - BREAKING CHANGE(devicemanager)

migrate tests to new UniversalDevice/feature-based API, add device factories, SNMP protocol/feature and IP helper utilities

- Replace protocol-specific device classes (Scanner, Printer) with UniversalDevice and feature objects (ScanFeature, PrintFeature, PlaybackFeature, VolumeFeature, PowerFeature, SnmpFeature)
- Add device factory functions: createScanner, createPrinter, createSpeaker, createUpsDevice
- Add DeviceManager.getDevices selector and updated selectDevice behavior (throws when no match)
- Expose SnmpProtocol and other protocol implementations
- Introduce IP helper utilities: isValidIp, cidrToIps, getLocalSubnet
- Update tests and logging to use feature-based APIs and factories (selectFeature/getFeature, hasFeature, featureCount)

2026-01-09 - 2.3.1 - fix(readme)

update README to comprehensive, TypeScript-first documentation covering installation, quick start, examples, API usage, events, error handling, requirements, credits, and legal/company information

- Rewrote readme.md with ~590 additional lines to provide a full usage guide and examples
- Added installation instructions for pnpm, npm, and yarn and badges for npm and license
- Documented OOP usage pattern (Discovery → Selection → Feature → Operation), event handling, and error handling examples
- Clarified requirements (Node.js 18+, TypeScript 5.0+), credits, license, trademark and company contact information
- Docs-only change — no code or API modifications

2026-01-09 - 2.3.0 - feat(devicemanager)

add selector-based device APIs, selectFeature helper, convenience discovery methods, and ESCL scan completion fallback

- Introduce IDeviceSelector and add selector support to getDevices(selector) to filter devices by id,address,name,model,manufacturer and feature capabilities.
- Add selectDevice(selector) which returns exactly one device (throws if none) and logs a warning if multiple matches are returned without a unique identifier.
- Deprecate getDevice(id) and getDeviceByAddress(address) in favor of selector-based retrieval methods.
- Add private matchesSelector(...) implementing exact identity checks (id,address), case-insensitive partial attribute matching (name, model, manufacturer), and feature availability checks (hasFeature, hasFeatures, hasAnyFeature).
- Add selectFeature(type) on devices to provide fail-fast access to a required feature (throws if missing).
- Add discoverScanners(subnet, options) and discoverPrinters(subnet, options) convenience methods that run targeted network scans and return discovered scanners or printers respectively.
- Improve ESCL protocol waitForScanComplete to attempt a direct download first (which triggers/blocks on many scanners) and fall back to polling if direct download fails or returns empty data.

2026-01-09 - 2.2.0 - feat(smarthome)

add smart home features and Home Assistant integration (WebSocket protocol, discovery, factories, interfaces)

- Add concrete smart home feature implementations: light, climate, sensor, switch, cover, lock, fan, camera.
- Introduce Home Assistant WebSocket protocol handler (protocol.homeassistant) and Home Assistant discovery via mDNS (discovery.classes.homeassistant).
- Add generic smart home interfaces and Home Assistant-specific interfaces (smarthome.interfaces, homeassistant.interfaces) and export them.
- Add smart home factories to create devices for discovered/declared smart home entities and export factory helpers.
- Update plugins to include WebSocket (ws) and add ws dependency and @types/ws in package.json.

2026-01-09 - 2.1.0 - feat(devicemanager)

prefer higher-priority discovery source when resolving device names and track per-device name source

- Add TNameSource type and NAME_SOURCE_PRIORITY to rank name sources (generic, manual, airplay, chromecast, mdns, dlna, sonos).
- Replace chooseBestName with shouldUpdateName that validates 'real' names and uses source priority when deciding to update a device name.
- Add nameSourceByIp map to track which discovery source provided the current name and persist updates during registration.
- Register devices with an explicit nameSource (e.g. 'mdns', 'dlna', 'sonos', 'manual') and map speaker protocols to appropriate name sources.
- Ensure manual additions use 'manual' source and non-real names default to 'generic'.
- Clear nameSourceByIp entries when devices are removed/disconnected and on shutdown.

2026-01-09 - 2.0.0 - BREAKING CHANGE(core)

rework core device architecture: consolidate protocols into a protocols/ module, introduce UniversalDevice + factories, and remove many legacy device-specific classes (breaking API changes)

- Consolidated protocol implementations into ts/protocols and added protocols/index.ts for unified exports.

- Added device factory layer at ts/factories/index.ts to create UniversalDevice instances with appropriate features.
- Introduced protocols/protocol.upssnmp.ts (UPS SNMP handler) and other protocol reorganizations.
- Removed legacy concrete device classes and related files (Device abstract, Scanner, Printer, SnmpDevice, UpsDevice, DlnaRenderer/Server, Speaker and Sonos/AirPlay/Chromecast implementations).
- Updated top-level ts/index.ts exports to prefer UniversalDevice, factories and the new protocols module.
- Updated feature and discovery modules to import protocols from the new protocols index (import path changes).
- BREAKING: Consumers must update imports and device creation flows to use the new factories/UniversalDevice and protocols exports instead of the removed legacy classes.

2026-01-09 - 1.1.0 - feat(devicemanager)

Introduce a UniversalDevice architecture with composable Feature system; add extensive new device/protocol support and discovery/refactors

- Add UniversalDevice class and Feature abstraction with concrete features: scan, print, playback, volume, power, snmp, dlna-render/serve.
- Add SSDP discovery and DLNA implementations (renderer + server) and integrate SSDP into DeviceManager.
- Add speaker subsystem and concrete speaker implementations: Sonos, AirPlay, Chromecast, plus generic Speaker API and Volume/Playback features.
- Add SNMP feature and SNMP device handling plus UPS support (NUT and UPS SNMP handlers and UpsDevice).
- Refactor protocol implementations: move/replace scanner/printer protocol code into protocols/ (eSCL, SANE, IPP) and update network scanner to probe additional ports (AirPlay, Sonos, Chromecast) and device types.
- Update exports (ts/index.ts) to expose new modules, types and helpers; update plugins import handling (node-ssdp default export compatibility).
- Add developer docs readme.hints.md describing new architecture and feature APIs, and various helper fixes (iprange/os import, typed socket handlers).

2026-01-09 - 1.0.1 - initial

Initial project release.

- Project initialized (initial commit).

- Duplicate initial commits consolidated into this release.