Crossfire Protocol Reference

Crossplay · https://namazustudios.com/docs/add-ons/crossplay-gaming-backend/crossfire-protocol-reference/

This page documents the wire protocol used by Namazu Crossfire: the connection state machine, the JSON message envelope, the four handshake flows, the signaling model (direct vs. broadcast signals, backlog/replay, and signal lifecycles), control messages, error handling, and the ping/pong keepalive. It is intended for anyone implementing a Crossfire client from scratch, or extending the server with a custom matchmaking algorithm.

If you are integrating an existing client (Unity, JVM, or browser), see Crossfire Client Libraries instead — this page is for protocol implementers.

Connection lifecycle

Every WebSocket connection to the Crossfire endpoint progresses through a single, one-way state machine:

```
WAITING → READY → HANDSHAKE → SIGNALING → TERMINATED
```

[Crossfire connection state machine: WAITING to READY to HANDSHAKE to SIGNALING to TERMINATED, with error transitions to TERMINATED from READY and HANDSHAKE]

- **WAITING** — the socket has not yet been accepted by the server.
- **READY** — the connection is open. The client must send a handshake message (`FIND`, `JOIN`, `CREATE`, or `JOIN_CODE`) as its first message. Any signaling or direct-signaling messages sent this early are buffered rather than rejected, and are replayed once the connection reaches `SIGNALING`.
- **HANDSHAKE** — entered as soon as a handshake message is accepted. A second handshake attempt is not allowed; the connection may only enter this phase once. Signaling messages received while still in this phase are also buffered.

- **SIGNALING** — entered once authentication succeeds *and* a match has been assigned. From here the client exchanges signals and control messages until the socket closes.
- **TERMINATED** — absorbing. Once terminated, further inbound messages are logged and dropped rather than causing further errors.

Any message whose category is not valid for the current phase closes the connection with a policy-violation close code and a `ProtocolStateException`.

Message envelope and wire format

Every message is a single JSON object with a `type` discriminator field. The server resolves `type` against `ProtocolMessageType` and deserializes the rest of the object into the matching Java class. There is no separate envelope wrapper — the payload fields sit alongside `type` at the top level. Unknown fields are ignored (the shared Jackson mapper has `FAIL_ON_UNKNOWN_PROPERTIES` disabled), which keeps the wire format forwards-compatible across minor versions.

```
{
  "type": "STRING_BROADCAST",
  "profileId": "abc123",
  "lifecycle": "SESSION",
  "payload": "hello"
}
```

Binary payloads (`BINARY_BROADCAST`, `BINARY_RELAY`) are base64-encoded strings on the wire, per standard Jackson `byte[]` handling.

Each `ProtocolMessageType` belongs to exactly one **category** (`ProtocolMessageCategory`), and the connection phase determines which categories are legal to receive:

Category	Used for	Valid phase
`HANDSHAKE`	`FIND`, `JOIN`, `CREATE`, `JOIN_CODE`, `CREATED`, `MATCHED`	`READY`
`SIGNALING`	Broadcast signals delivered to every other participant	`SIGNALING`
`SIGNALING_DIRECT`	Signals addressed to one specific recipient (SDP/ICE exchange, relays)	`SIGNALING`
`CONTROL`	`OPEN`, `CLOSE`, `END`, `LEAVE`	`SIGNALING`

Category	Used for	Valid phase
`ERROR`	`ERROR` (server → client only)	any phase

Some message types are **server-only** (`ProtocolMessage.isServerOnly()` returns `true`) — for example `MATCHED` and all server-driven presence signals (`CONNECT` , `DISCONNECT` , `HOST` , `SIGNAL_JOIN` , `SIGNAL_LEAVE`). If a client sends one of these, the server rejects it with an `INVALID_MESSAGE` error and closes the connection.

Protocol versions

Crossfire currently defines two protocol versions, negotiated per-connection by the `version` field of the handshake request:

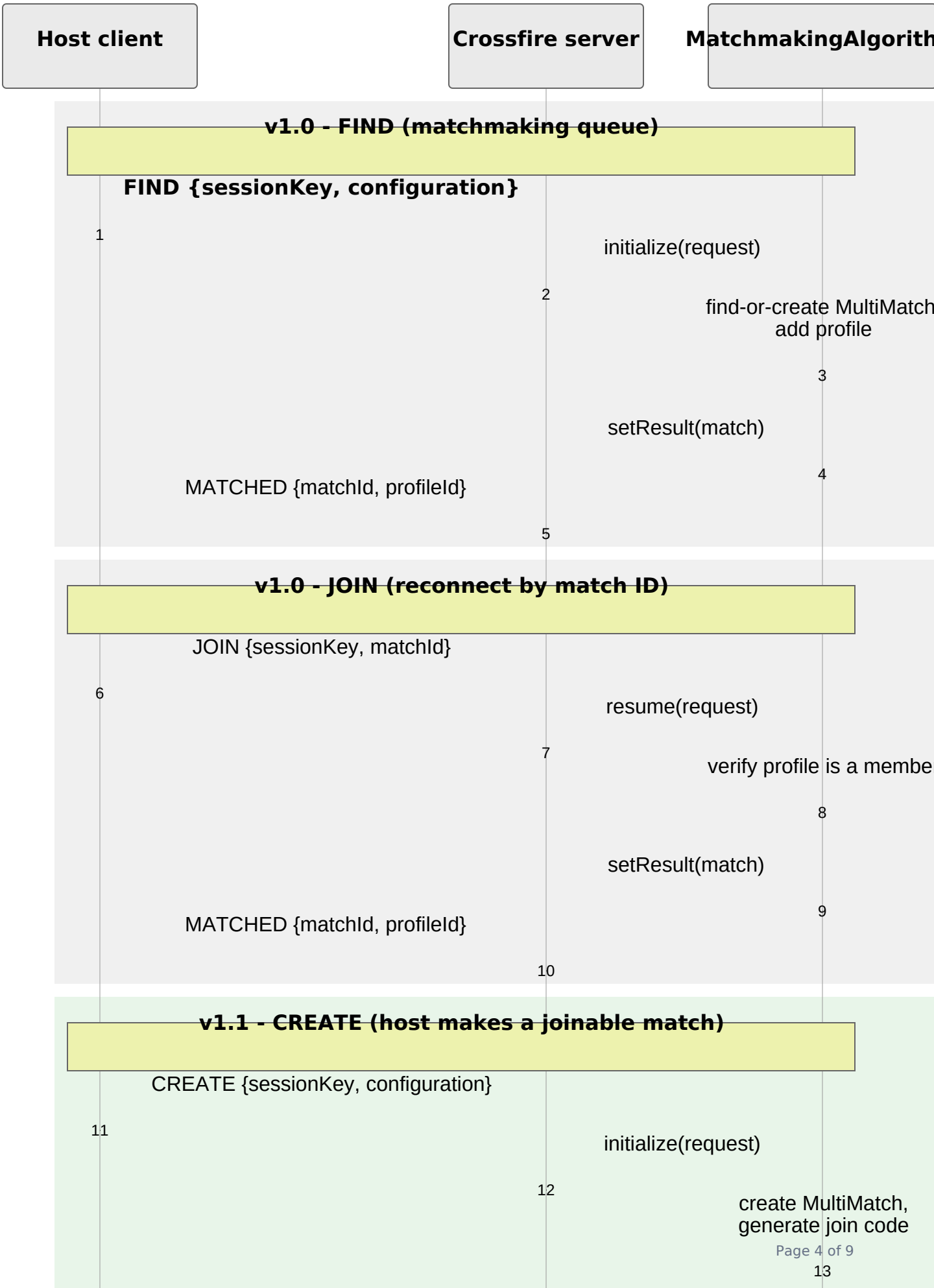
- **`V_1_0`** — the original handshake flows: `FIND` (matchmaking queue) and `JOIN` (join/resume by match ID). All signaling, control, and error message types are also `V_1_0` .
- **`V_1_1`** — adds the create/join-code flow: `CREATE` and `JOIN_CODE` , plus the `CREATED` response.

A version is compatible with a request if the major versions match and the server/session version's minor is greater than or equal to the requested minor (`Version.isCompatibleWithRequestedVersion`). The server routes each handshake request to a dedicated handler based on the version: `V10HandshakeHandler` only understands `FIND` / `JOIN` , while `V11HandshakeHandler` only understands `CREATE` / `JOIN_CODE` . Both extend the shared `V1HandshakeHandler` base, which manages authentication and the handshake-internal state machine (`READY → AUTHENTICATING → AUTHENTICATED → MATCHING → TERMINATED`) common to all four flows.

The four handshake flows

Every flow follows the same shape: client sends a handshake request → server authenticates the session/profile → server resolves a `MatchmakingAlgorithm` (default, or named via the application's `MatchmakingApplicationConfiguration.matchmaker`) → the algorithm asynchronously matches or creates → server sends a handshake response → connection transitions to `SIGNALING` .

[Sequence diagrams for the four Crossfire handshake flows: FIND, JOIN, CREATE, and JOIN_CODE]


Host client
Crossfire server
MatchmakingAlgorith
v1.0 - FIND (matchmaking queue)
FIND {sessionKey, configuration}
1
initialize(request)
2
find-or-create MultiMatch
add profile
3
setResult(match)
4
MATCHED {matchId, profileId}
5
v1.0 - JOIN (reconnect by match ID)
JOIN {sessionKey, matchId}
6
resume(request)
7
verify profile is a membe
8
setResult(match)
9
MATCHED {matchId, profileId}
10
v1.1 - CREATE (host makes a joinable match)
CREATE {sessionKey, configuration}
11
initialize(request)
12
create MultiMatch,
generate join code
13

FIND (v1.0) — join the matchmaking queue

Request (`FindHandshakeRequest`): `type: "FIND"` , `version` , `sessionKey` (required), `profileId` (optional — falls back to the profile attached to the session), `configuration` (required — the name of the `MatchmakingApplicationConfiguration` to use).

The server resolves the named `FindMatchmakingAlgorithm` and calls `initialize(request)` , which is expected to find-or-create a `MultiMatch` and add the profile to it. Response: `MatchedResponse` (`type: "MATCHED"` , `matchId` , `profileId`).

JOIN (v1.0) — rejoin a known match

Request (`JoinHandshakeRequest`): `type: "JOIN"` , `version` , `sessionKey` , `matchId` (required), `profileId` (optional). Used to reconnect after a disconnection or network interruption — the client already knows its match ID.

The server looks up the match's own `MatchmakingApplicationConfiguration` (so the join uses the same algorithm the match was created under), then calls the algorithm's `resume(request)` , which verifies the requesting profile is actually a member of the match before returning a handle. Response: `MatchedResponse` .

CREATE (v1.1) — create a joinable match

Request (`CreateHandshakeRequest`): `type: "CREATE"` , `version` (defaults to `V_1_1`), `sessionKey` , `profileId` , `configuration` (required).

Resolves a `JoinCodeMatchmakingAlgorithm` and calls `initialize(request)` , which creates the match and generates a join code. Response: `CreatedHandshakeResponse` (`type: "CREATED"` , `matchId` , `joinCode` , `profileId`) — the join code is the piece of data a game would show the host to share with other players.

JOIN_CODE (v1.1) — join by code

Request (`JoinCodeHandshakeRequest`): `type: "JOIN_CODE"` , `version` , `sessionKey` , `joinCode` (required), `profileId` .

The server looks the match up by join code, resolves the same `JoinCodeMatchmakingAlgorithm` the match was created with, and calls `resume(request)` , which adds the joining profile to the match if it

isn't already a member. Response: `MatchedResponse` (not `CreatedHandshakeResponse` — only the creator receives the join code back; subsequent joiners already know it).

All four flows are pluggable — see Custom Matchmaking Algorithms for how to replace the default FIFO/join-code implementations with your own matching, rating, or lobby logic.

Signaling phase

Once a connection enters `SIGNALING`, the server sends the handshake response and then joins the connection to the match's in-memory mailbox. From this point, three kinds of traffic flow over the socket: **broadcast signals**, **direct signals**, and **control messages**.

Broadcast vs. direct signals

A **broadcast signal** (`BroadcastSignal`) is delivered to every other participant in the match except the sender. Client-originated broadcast types are `STRING_BROADCAST` and `BINARY_BROADCAST` (arbitrary game data). Server-originated ("server-only") broadcast types report match presence: `CONNECT`, `DISCONNECT`, `HOST`, `SIGNAL_JOIN`, `SIGNAL_LEAVE`.

A **direct signal** (`DirectSignal`) is addressed to exactly one recipient profile via `recipientProfileId`, and it is a protocol error (`UnexpectedMessageException`) to address one to yourself. This is the category used for WebRTC negotiation: `SDP_OFFER`, `SDP_ANSWER`, and `CANDIDATE` (ICE candidates, carrying `mid` / `midIndex` / `candidate`). It's also used for point-to-point application data that shouldn't go to the whole match: `STRING_RELAY`, `BINARY_RELAY`.

The server validates both sender and recipient (for direct signals) are actual members of the match before delivering; an unknown profile ID results in a `ForbiddenException`.

Signal lifecycle: ONCE, SESSION, MATCH

Every signal declares a `SignalLifecycle` that controls whether — and for how long — the server buffers it for replay to clients that connect or reconnect later:

- **`ONCE`** — fire-and-forget. Delivered only to currently-connected recipients; never buffered. If nobody is listening at the moment it's sent, it's lost. Default lifecycle for `STRING_BROADCAST`, `BINARY_BROADCAST`, `STRING_RELAY`, `BINARY_RELAY`, and the server's `DISCONNECT` signal (a disconnect notice from five minutes ago isn't useful to a new joiner).

- **`SESSION`** — buffered for the lifetime of the sender's current connection; cleared as soon as that connection's subscription disconnects. Used for `CONNECT`, `HOST`, and the WebRTC negotiation signals `SDP_OFFER` / `SDP_ANSWER` / `CANDIDATE` — if a peer drops mid-negotiation, that negotiation state should not survive to a fresh connection; the spec notes a dropped peer should force a fresh SDP offer rather than replay the stale one.
- **`MATCH`** — buffered for the entire life of the match, replayed to every new joiner regardless of when they connect. Used for `SIGNAL_JOIN` / `SIGNAL_LEAVE` (so a late joiner sees the full roster history) and available as an option on `StringBroadcastSignal` / `BinaryBroadcastSignal` / `StringRelayDirectSignal` / `BinaryRelayDirectSignal` for game data a late joiner needs (e.g. authoritative game state snapshots).

When implementing a new signal type of your own (via a custom control flow or algorithm), choose `MATCH` if late-joining players need the information and `SESSION` if it's transient per-connection state; reach for `ONCE` only for data with no replay value.

Backlog and replay for late joiners

Each match keeps one bounded outbox per profile, split into a `match` list (holds `MATCH`-lifecycle signals) and a `session` list (holds `SESSION`-lifecycle signals). Outboxes are bounded (`elements.crossfire.match.signaling.max.backlog.size`, default **256** entries total across the match) — exceeding it raises a `MessageBufferOverrunException` and terminates the connection, so don't lean on `MATCH`-lifecycle broadcasts as an unbounded event log.

When a profile first joins a match, the server synthesizes and buffers a `SIGNAL_JOIN` for it. When a connection attaches (`connect()`), the server synthesizes and buffers a `CONNECT` signal, assigns that profile as host if no host currently exists (broadcasting `HOST`), and then replays *every* signal across *every* profile's outbox that `isFor()` the connecting profile — this is how a client that reconnects mid-match catches up on roster state and any in-flight game state without having missed it. If a second connection attempt comes in for a profile that's already connected, the existing subscription is force-disconnected with a `DuplicateConnectionException` before the new one takes over, guaranteeing at most one live connection per profile per match.

If the host's connection disconnects cleanly, the server automatically reassigns host to another currently-connected participant and re-broadcasts `HOST`. If every participant disconnects (but the match record itself isn't ended), or every participant formally leaves the match, the server ends and

removes the match automatically.

[Sequence diagram showing a late-joining profile receiving replayed backlog signals from the match mailbox]

Control messages

Control messages manage the match itself rather than carrying game data. All are client-originated (there is no server-originated control message):

Type	Host-only?	Effect	Connection result
`OPEN`	Yes	Re-opens the match to new participants	connection stays open
`CLOSE`	Yes	Closes the match to new participants (existing participants unaffected)	connection stays open
`END`	Yes	Ends the match entirely	connection stays open
`LEAVE`	No	Removes the sending profile from the match (and deletes the match if it was the last profile)	connection is closed by the server

"Host-only" messages are not currently rejected server-side based on sender identity in the base control service — enforcing that only the host profile may send `OPEN` / `CLOSE` / `END` is the responsibility of a `ControlService` implementation if you replace the default, or of the game client's own UI logic.

Error handling

Protocol-level errors are delivered as a single `ERROR` message (`StandardProtocolError`: `code` + human-readable `message`) immediately before the server closes the WebSocket. There is no error recovery within a connection — every error is terminal for that socket; the client must reconnect (typically via `JOIN` or `JOIN_CODE`) to resume.

Built-in error codes (`ProtocolError.Code`): `UNKNOWN`, `TIMEOUT`, `INVALID_MESSAGE`. Domain exceptions from the wider Elements SDK (`BaseException` subclasses — e.g. `ForbiddenException`, `MultiMatchNotFoundException`) are mapped through their own `getCode()` value instead. The WebSocket close code sent alongside the error depends on the exception type:

- `TimeoutException` → `GOING_AWAY`
- `ProtocolStateException`, `UnexpectedMessageException`, `MessageBufferOverrunException` → `VIOLATED_POLICY`
- Other `BaseException`s → `TRY_AGAIN_LATER` for an `OVERLOAD` code, `VIOLATED_POLICY` otherwise
- Anything else → `UNEXPECTED_CONDITION`

Ping/pong keepalive

The server drives keepalive, not the client. On connection start it sets the WebSocket session's max idle timeout and schedules a native WebSocket ping on a fixed delay:

- `dev.getelements.elements.ping.interval.seconds` — how often the server pings (default **30**s).
- `dev.getelements.elements.timeout.seconds` — the session's max idle timeout (default **90**s); if no traffic (including pong replies) is seen within this window, the container closes the socket.

A pong reply resets container-level idle tracking automatically; the server does not otherwise track missed pongs itself. If sending a ping fails outright (e.g. the socket is already broken), the server proactively closes the session with an `UNEXPECTED_CONDITION` close code rather than waiting for the idle timeout.

Implementation notes

The project's internal engineering notes flag a historical race condition in the handshake shutdown path — using `updateAndGet` where `getAndUpdate` was needed, which could miss cancelling in-flight matchmaking work. As of this writing, `V1HandshakeHandler.stop()` correctly uses `getAndUpdate(V1HandshakeStateRecord::terminate)` and inspects the *previous* phase to decide whether to cancel a still-`MATCHING` handle, so this particular path is implemented correctly. If you're implementing your own `MatchHandle` subclass, `AbstractMatchHandle.leaveMatch()` (in the `util` module) is the canonical example of this pattern: it uses `getAndUpdate` specifically so it can act on the match's state *before* the termination transition overwrote it.