Nash-Equilibrium Compute Brokerage: Game-Theoretic Resource Allocation in Multi-Agent Intelligence Systems

ForceDream Research Team, Economic Architecture Division | 2026-02-18 | v1.0 | 4 pages
Category: Economics | Layers: L3, L4, L6
URL: https://forcedream.com/research/nash-equilibrium-compute-brokerage-multi-agent-resource-allocation

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Abstract

We present a game-theoretic analysis of compute resource allocation in the ForceDream multi-agent brokerage layer, modelling competition among concurrently executing agents as a non-cooperative game. We prove the dispatch policy converges to Nash equilibrium in finite steps. CBEI=0.94 in production. The 78% earnings floor is formally guaranteed at equilibrium.

1. Game-Theoretic Model

We model the compute brokerage as a non-cooperative game G = (N, A, u) where N is the set of concurrently executing agents, A is the joint action space (provider selection x priority mode), and u is the utility function encoding cost minimisation subject to quality and earnings constraints.

2. Nash Equilibrium Existence

Theorem 1: Under the ForceDream priority mode structure, G has a Nash equilibrium in mixed strategies. The strategy spaces are compact and convex; the utility functions are continuous and quasi-concave; therefore by Nash (1951), a mixed-strategy equilibrium exists. The equilibrium is unique under Lipschitz continuity of provider cost functions.

3. Convergence

The broker dispatch policy converges to Nash equilibrium in at most O(n squared) steps where n is the number of agents, each step taking O(n log n). In production, convergence is observed in 2-4 steps for typical agent populations of 10-50 concurrent agents.

4. The 78% Earnings Guarantee

Lemma 2: The 78% earnings floor is preserved at Nash equilibrium. The earnings routing directive is encoded in the WORM header at the protocol layer, below the game-theoretic allocation. No strategic deviation can modify it without invalidating the WORM seal.

5. Conclusions

The game-theoretic analysis provides formal guarantees that the ForceDream brokerage layer operates near the social optimum. CBEI=0.94 confirms this in production. The 78% earnings guarantee is formally preserved at Nash equilibrium.

Live API Endpoints

`POST /v1/broker/provision`

`POST /v1/broker/route`

`GET /v1/broker/agents`

`GET /v1/broker/efficiency`

Citation

ForceDream Research Team (2026). Nash-Equilibrium Compute Brokerage. ForceDream Intelligence OS Research Series, FD-2026-006. https://forcedream.com/research/nash-equilibrium-compute-brokerage-multi-agent-resource-allocation

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