Distributed Algorithms & Protocols Cheat Sheet

Algorithm / Protocol	What It Does	Best Case	Worst Case
Rumor Mongering	Probabilistic gossip protocol spreading updates.	O(log n) rounds	Some nodes may not get update
Anti-Entropy (Push/Pull)	Nodes exchange data to reach consistency.	O(log n) time	O(n) redundant messages
Napster	Centralized P2P with central index.	Fast lookup	Single point of failure
Gnutella	Fully decentralized P2P using flooding.	Simple, resilient	High traffic, not scalable
Pastry DHT	Prefix-based structured routing overlay.	O(log n) hops	O(n) on failure
Freenet	Anonymous distributed datastore.	Fast for local keys	Slow for unpopular data
BitTorrent	File sharing with tit-for-tat piece exchange.	Parallel fast download	Slow if few seeders
Chord DHT	Consistent hashing for lookup.	O(log n) hops	O(n) under churn
Lamport Clock	Logical timestamps for event ordering.	Constant	O(n) sync overhead
Vector Clock	Tracks causality among events precisely.	O(n) vector size	High memory usage
Cristian's Algorithm	Synchronizes client clock with server.	Low drift	Large drift on network delay
Chang-Roberts Election	Ring-based leader election using IDs.	O(n)	O(n²) messages
Ricart–Agrawala	Request-reply mutual exclusion.	O(n)	O(n) messages per entry
Maekawa's Algorithm	Quorum-based mutual exclusion.	O(√n) messages	Deadlock risk
Suzuki–Kasami	Token-based mutual exclusion.	O(1) entry delay	O(n) to find token
Raymond's Tree Algorithm	Tree-based token passing mutual exclusion.	O(log n)	O(n) delay
GHS MST	Builds distributed minimum spanning tree.	O(n log n)	O(n²) messages
FLP Impossibility	Consensus impossible in async system w/1 crash.	-	-
Raft Consensus	Leader-based replicated log agreement.	O(1) commit	Delayed elections
Paxos	Fault-tolerant consensus protocol.	O(1) after quorum	O(n) retries
Byzantine Agreement	Achieves agreement despite malicious faults.	3f+1 nodes	O(n²) messages
2-Phase Commit	Atomic commit using coordinator.	Fast commit	Blocking on crash
3-Phase Commit	Adds pre-commit to avoid blocking.	Reliable → commit	Abort on failures
AFS	Distributed file system w/ whole-file caching.	Local access	Invalidation overhead
Coda FS	AFS extension w/ replication + offline ops.	Fault tolerant	Manual conflict fix
Amazon Dynamo	Eventually consistent key-value store.	High availability	Temporary inconsistency
Bigtable	Google's distributed storage system.	O(1) lookup	O(log n) w/ compaction
Percolator	Incremental ACID processing over Bigtable.	Fast incremental update	High write contention
Corona	Pastry-based cluster monitoring system.	Balanced load	Slower under churn
PageRank	Ranks pages via incoming links.	Fast on sparse graphs	O(n²) dense graphs