Effectiveness of Bitswap Discovery Process

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Motivation

- Measure Bitswap content discovery efficiency
- Evaluate Bitswap `ProviderSearchDelay` magic value set to 1 second
- Optimize content routing efficiency

Bitswap Discovery Process

1. `go-bitswap` broadcasts a `WANT-HAVE` request to directly all connected peers
2. If the content is found, request is done
3. If after `1s` no positive answer is return from the broadcast, start a DHT lookup
4. When a Provider is found in the DHT, `go-bitswap` sends a `WANT-BLOCK` request

Measurements Setup

- Request CIDs collected by sniffing the Bitswap network
- Bitswap has 15 seconds to find and fetch 1 block
- Prevent DHT lookup inside Bitswap
- If Bitswap fails to discover content, verify if content is still available
- Prevent recursive content resolution
- Ran on a Google Cloud VM in Central Europe in Dec. 2022

Discovery Process Stats

- 98.37% discovery success rate (within 15 seconds)
- On average 856 distinct remote peers are solicited for each Bitswap request
- On average 1714 messages are sent for each Bitswap request

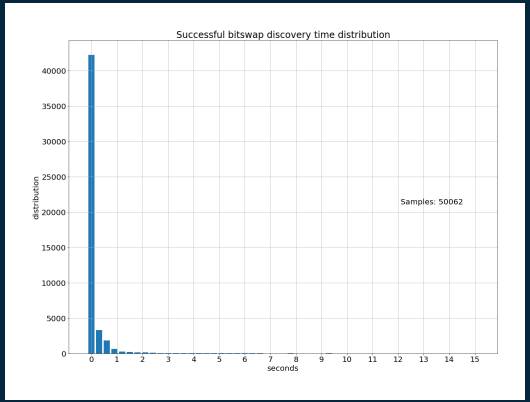
Content Providers Stats

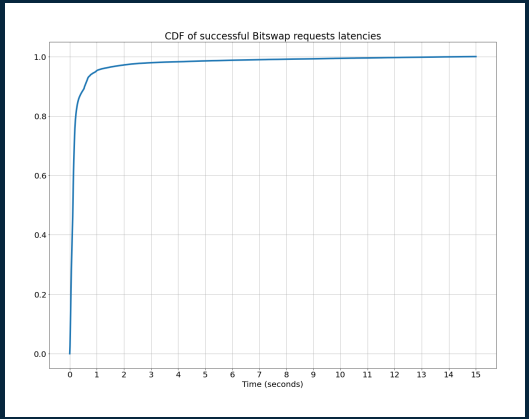
- Total requests: 50’062

Top N providers	Percentage of blocks served
Top 1	10.61%
Top 3	25.65%
Top 5	37.93%
Top 10	58.12%
Top 20	75.41%
Top 50	84.39%
Top 361	98.49%
Top 723	100.0%

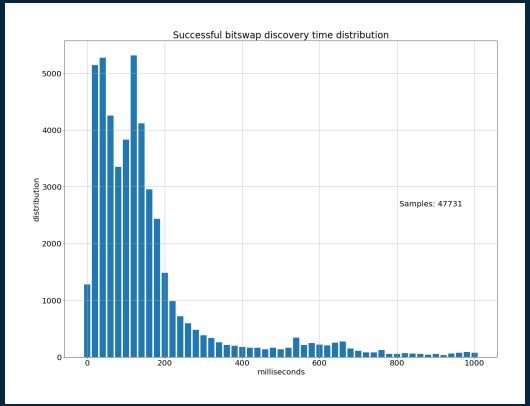
	PeerID	Number of blocks served	Operator
1.	12D3KooWGtRcWvihm4hX2gT6bQu3uyjb78rgyQR3hPhkxMwivscY	5398	
2.	12D3KooWLsSWaRsoCejZ6RMsGqdftpKbohczNqs3jvNfPgRwrMp2	4113	nft.storage
3.	12D3KooWGRJo1vLDBtfS8a4cVss2QVqvbCaPgtmwwgpUtW675QRa	3543	nft.storage
4.	12D3KooWAuBxG5uMBkeyFwHD9JyHaJGTqn7NhJbmmukNDPHSLKts	3167	nft.storage
5.	12D3KooWJc7GbwkjVg9voPNxdRnmEDS3i8NXNwRXD6kLattaMnE4	3085	nft.storage
6.	12D3KooWEGeZ19Q79NdzS6CJBoCwFZwujqi5hoK8BtRcLa48fJdu	2357	
7.	12D3KooWJ59N9z5CyLTtcUTnuTKnRTEVxiztjjiEAYbP16aZjQ3D	2287	nft.storage
8.	12D3KooWENiDwDCPnbEQKHHsDnSsE5Y3oLyXnxuyhjcCEBK9TvkU	2051	
9.	12D3KooWC9L4RjPGgqpzBUBkcVpKjJYofCkC5i5QdQftg1LdsFb2	1826	
10.	12D3KooWKd92H37a8gCDZPDAAGTYvEGAq7CNk1TcaCkcZedkTwFG	1750	nft.storage

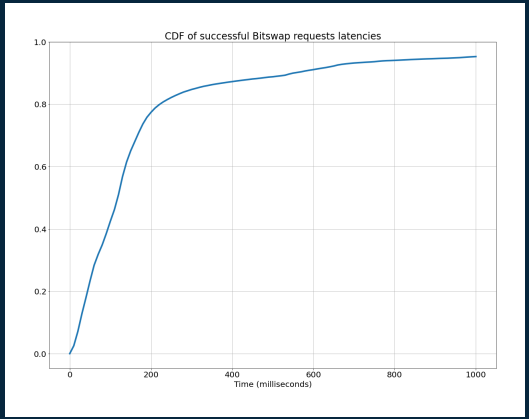
Bitswap Discovery + Fetch Latencies





Bitswap Discovery + Fetch Latencies Zoom





Recent Developments

- Connection manager now limits to 32/96 inbound connections (ipfs/kubo#9483)
- Worse TTFB when ProviderSearchDelay is set to 0 (ipfs/kubo#8807)
- Certainly caused by side effects/bugs in go-bitswap (ipfs/kubo#9530)

Takeaways

- Bitswap is currently **fast** (discovery+fetch $\leq$ 200ms in 80%) and **accurate** (98.37% of accessible content found)
- Bitswap is **inefficient** (856 peers solicited for each request)
- Bitswap content discovery **does NOT scale** (e.g if the network grows by 10x, the number of open connection must be 10x to keep the same discovery success rate)
- The top 20 peers serve 75% of the requested content

- Data transfer and content routing should probably NOT be bundled together

References

- Complete measurement methodology
- Additional data and plots
- Improvement recommendations

RFM-16 Report