Computation and (Today's) Internet Services

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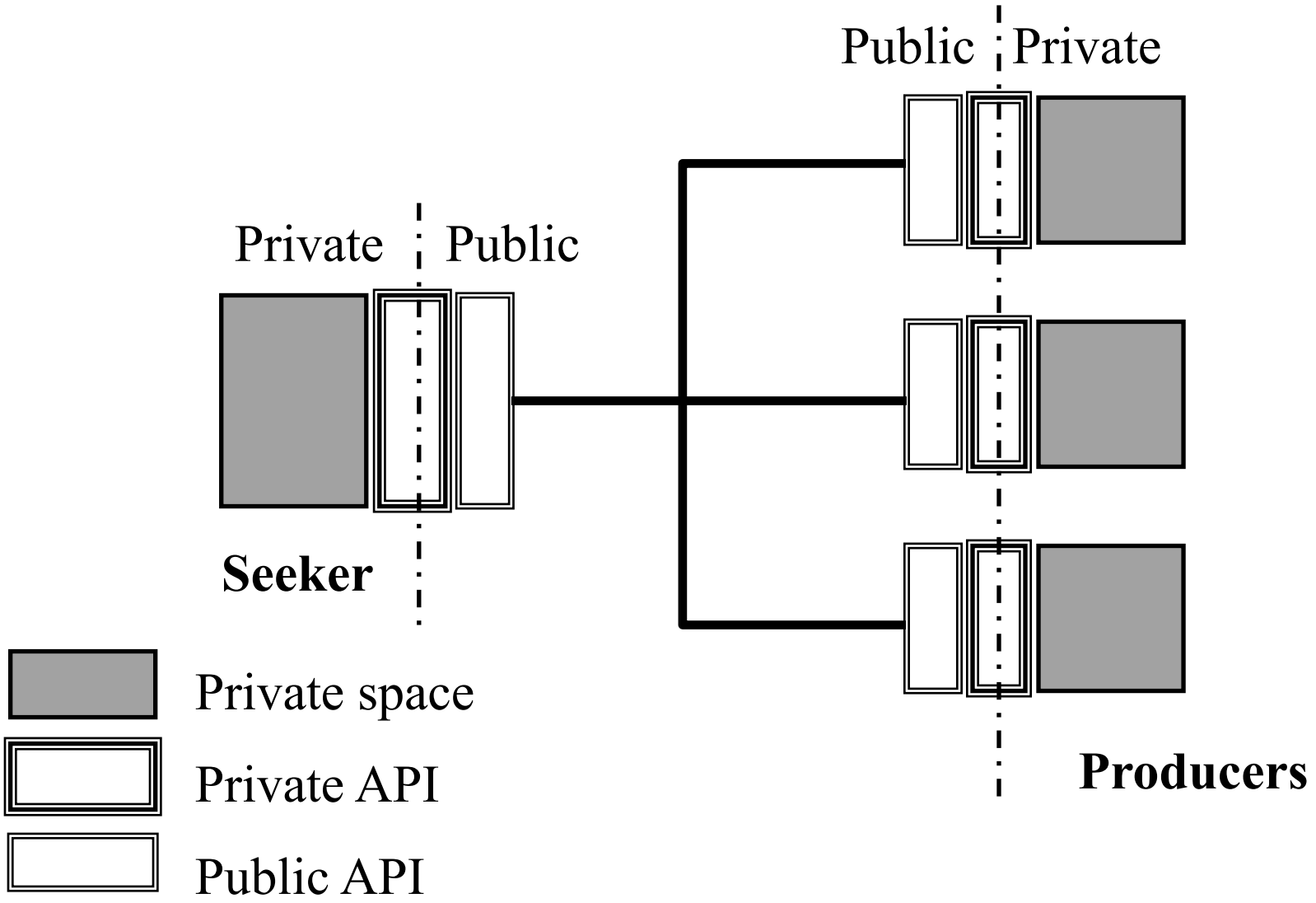
Remember that we have...

- ...different **owners** of
  - Source
  - Metadata
  - Index
  - Query
  - Client's knowledge

Who are the owners?

- Producer
  - Owner of information
- Indexer
  - Mediator or “middle man”
- Consumer
  - Seeker of information

Privacy



The Consumer's Eye-View

- How do I find the stuff I want?
- How do I know if I've found all available resources?
- How do I limit the number of "hits" I get?
- How can I express my needs in the language of the search tools?

The Producer's Perspective

- Once I have produced electronic information, how do I advertise it?
- How do I ensure that the right people find it?
- How can I limit the range of people who find it (security)?

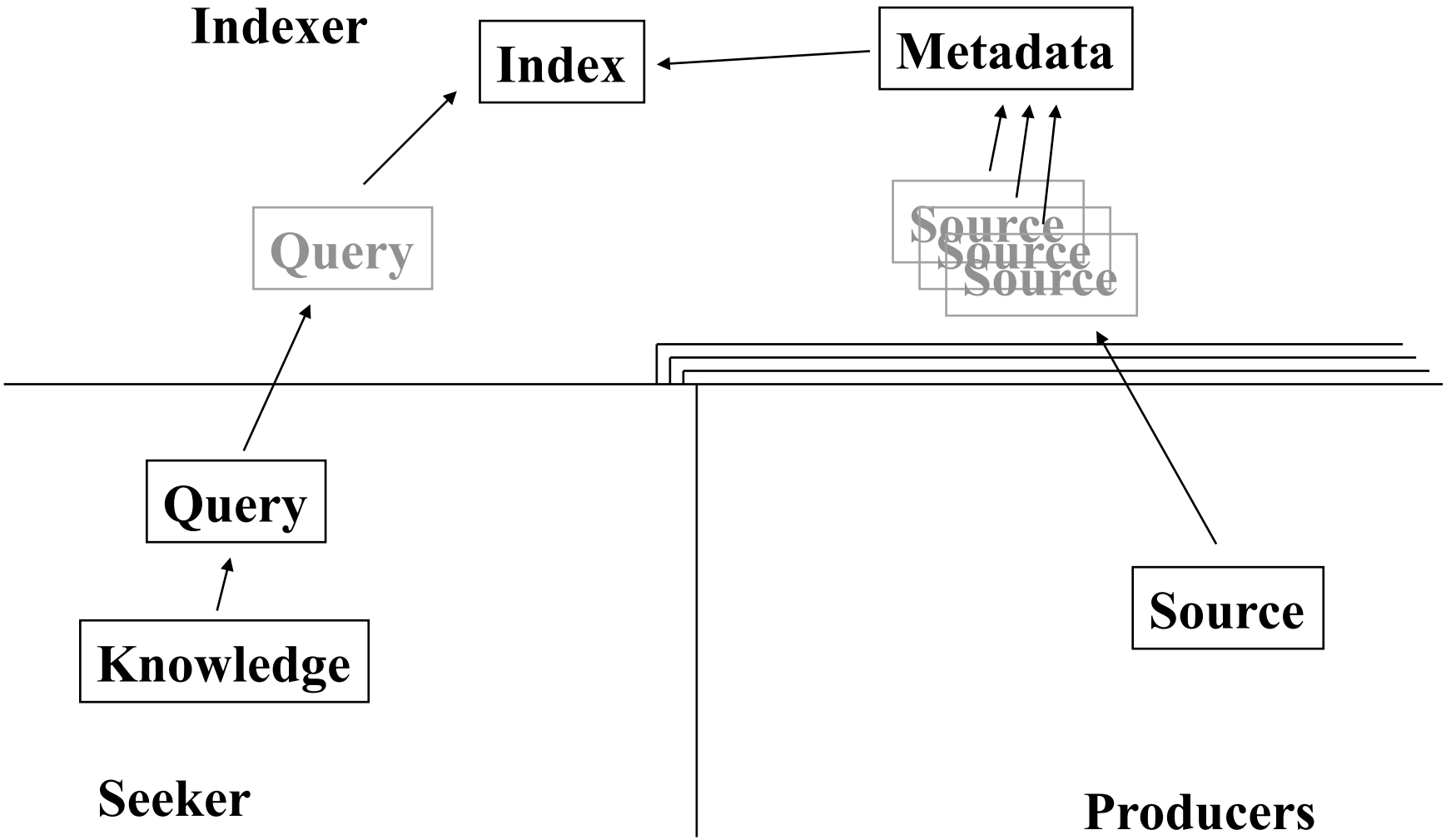
Models of Distributed Internet Computing - 1996

- Common
  - Full-sweep “pull” indexing
  - Cooperative (distributed) “pull” indexing
- New
  - Forward knowledge “push”
- On the horizon...
  - New paradigms (URAs, URNs)

Full-Sweep “pull”

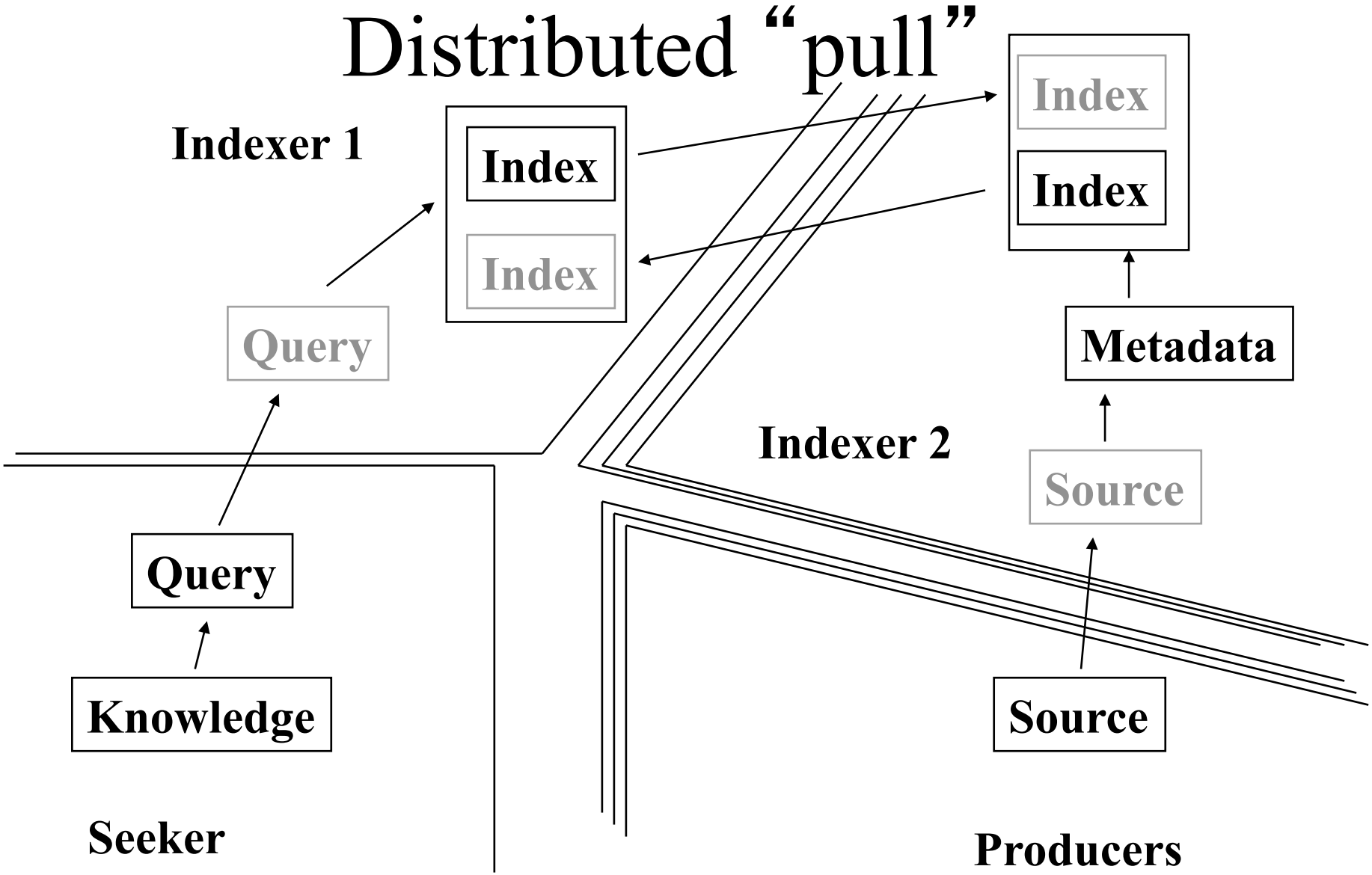
- Lycos, Alta-Vista et.al.
  - *Pro* - proprietary indexing format
  - *Pro* - uniformity and consistency of index data
  - *Con* - huge undertaking to fully map the space

Full-Sweep “pull”



Distributed “pull”

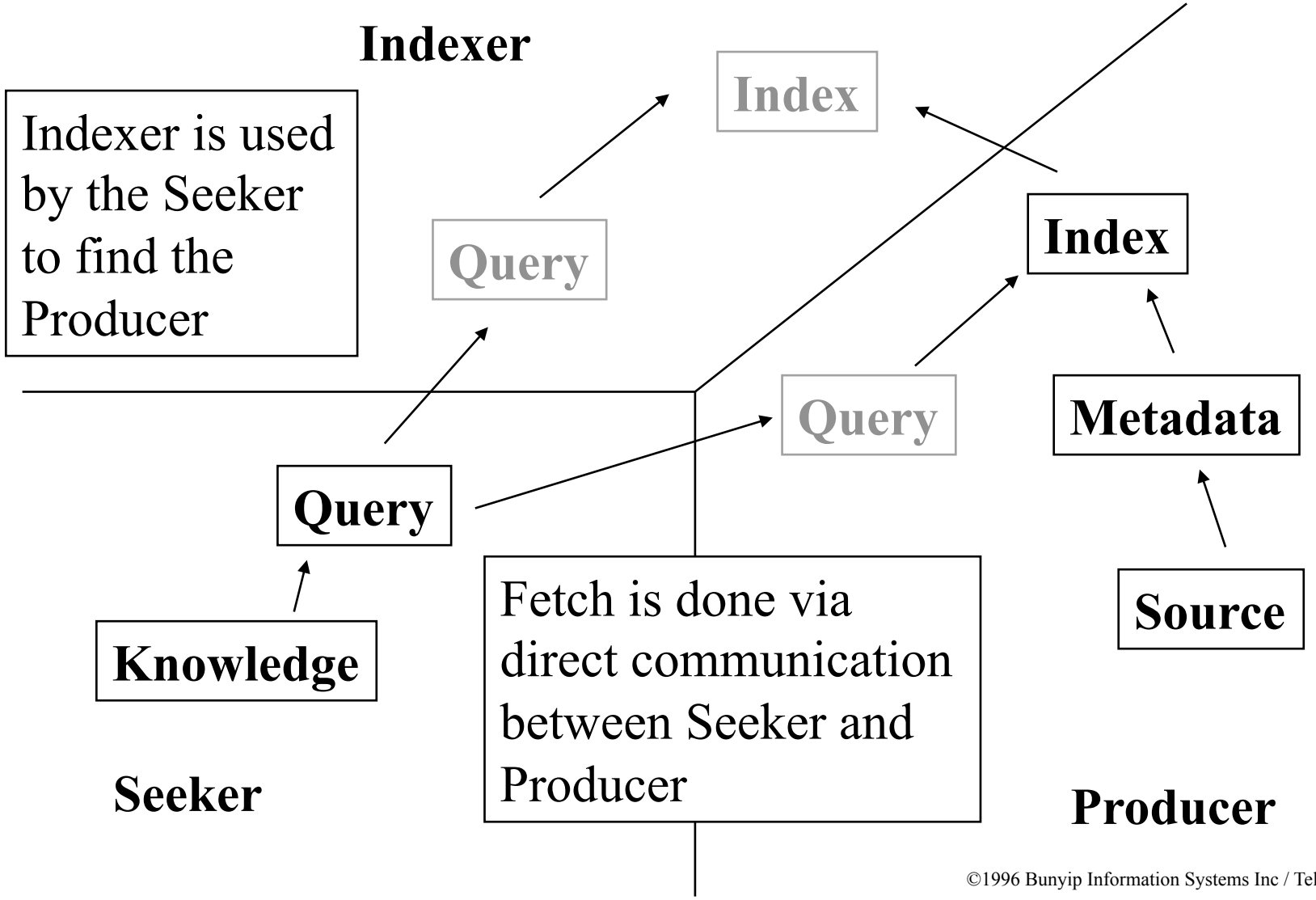
- Archie et.al.
  - *Pro* - maintain proprietary data format
  - *Pro* - maintain uniformity and consistency of index data
  - *Pro* - multiple parts of the space can be mapped independently
  - *Con* - integrating and coordinating results from different participating sources



Forward Knowledge “push”

- Whois++, Common Indexing Protocol et.al.
  - *Pro* - update is in the hands of the information producer
  - *Pro* - searches are done close to the source
  - *Pro* - specialized index hierarchies can be built
  - *Con* - update is in the hands of the information producer

Forward Knowledge “push”



Fetch and Search

- Fetch
  - You know what you are looking for
  - You have the path to the file in a filesystem
  - You have the domainname to lookup in DNS
  - You have the Distinguished Name in X.500
- Search
  - You do not know what you are looking for
  - You know some words in the file
  - You have the name of the host (not domain) in DNS
  - You have the name of a person to find in X.500

Fetch and Search

- Whats the point?
  - Fetching things is simple
  - Searching locally in a controlled environment is easy
  - Searching globally, in a heterogenous environments is very hard
- Indexing is needed!

Distributing knowledge

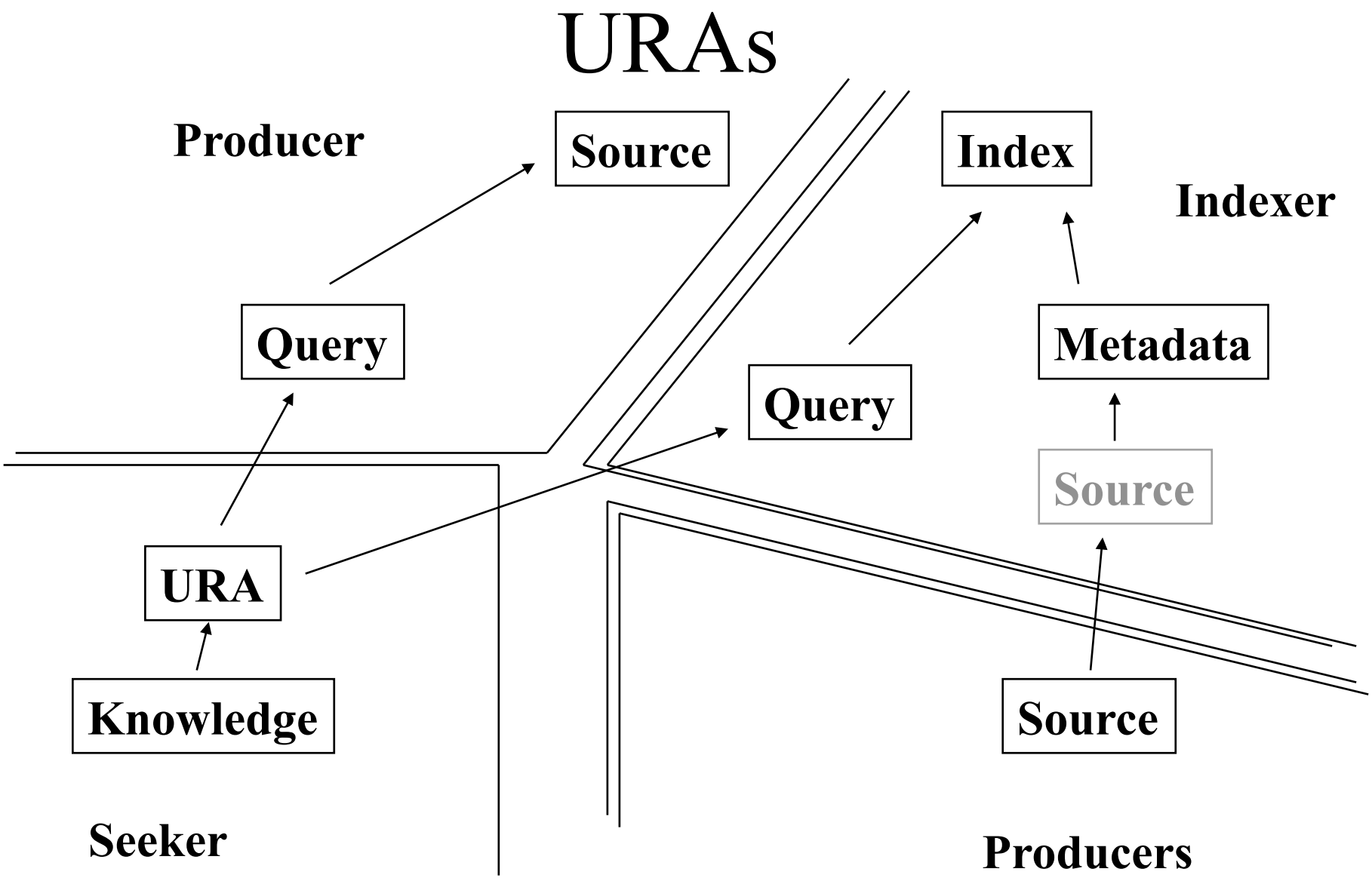
- Passing (pushing) index information is a way of announcing the knowledge you have
- A Seeker can use that information to find a Producer
- This is called Query-Routing
  - See Common Indexing Protocol, the FIND working group in the IETF and Whois++

Future Paradigms

- More client-side computation
- Longevity through indirection

Uniform Resource Agents

- Client-side information representation
- Provide a formalized structure for encapsulating composite Internet activities
  - URA header
  - Activation data
  - Targets
  - Experience information
  - Activity
  - Response filter



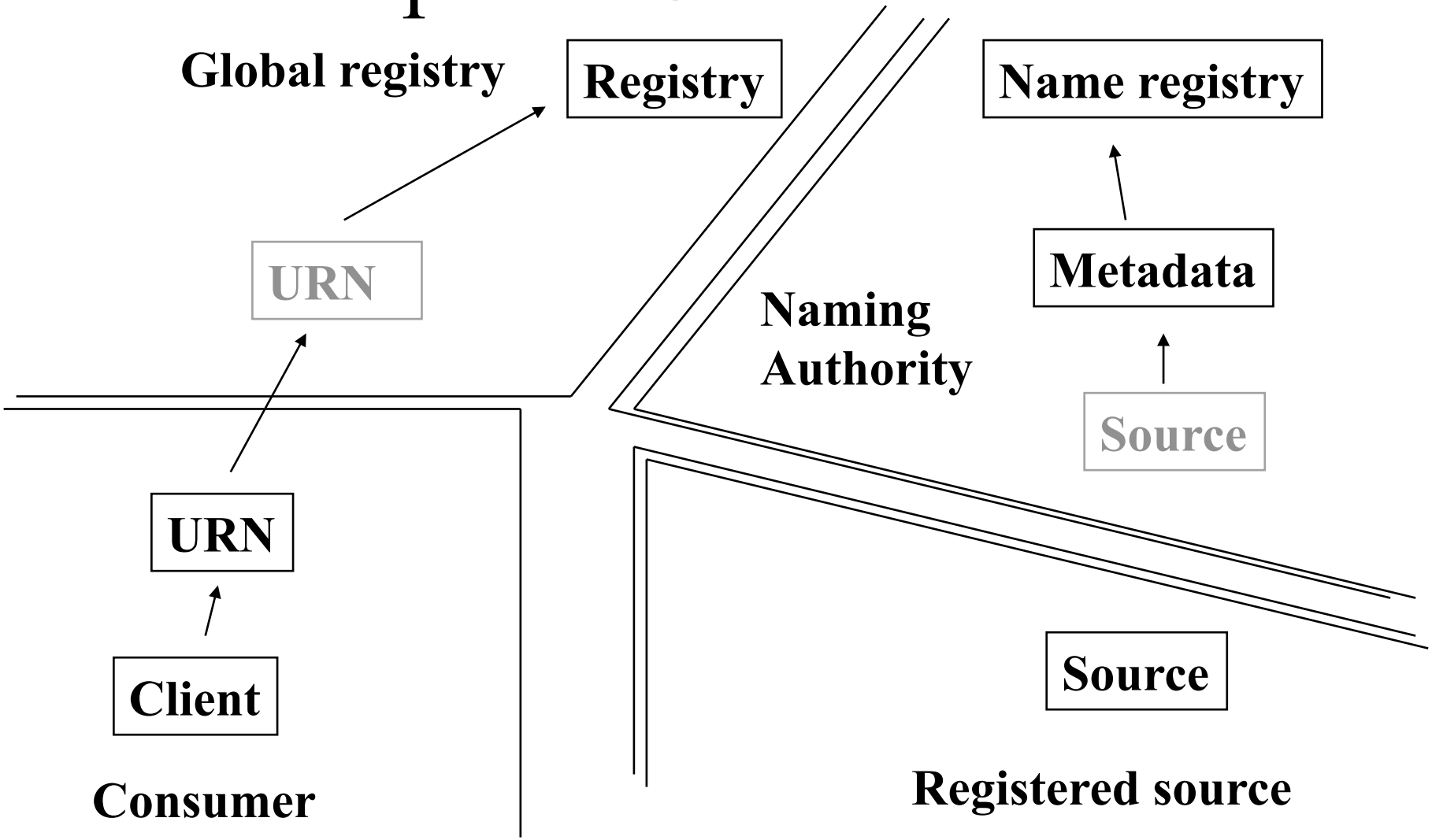
Uniform Resource Names

- A rose, by any other name... would be hard to find on the Internet
- URL - resource location
  - 3rd item from the left, 4th shelf down
- URN - resource name
  - Moby Dick

UR{L|N} Computational Distinctions

- URL
  - specify location & protocol to access desired resource
  - resource may move, disappear, change
- URN
  - mapping from identifier to content must persist across changes in ownership, etc
  - therefore, require computation outside the space of the resource owner

The Proposed URN Framework



NAPTR - An Expermental URN Implementation

- A longlived name of the content of a resource
  - `urn:inet:acme.se:information`
- Lookup rules for “inet” (NAPTR for inet.urn.net)
- Lookup rules for acme.se (NAPTR for acme.se)
- Lookup rules for http in the domain acme.se (SRV for http.tcp.acme.se)
- Connect to www.acme.se port 80 and fetch
  - `http://www.acme.se:80/N2R/urn:inet:acme.se:information`

SRV Resource Record

- Pointing out an access point for a service in a domain
- Arguments are
  - –Order number
  - –Priority
  - –Portnumber
  - –Name of computer
- Example for http/tcp

```
http.tcp.acme.se.       IN SRV 10 10 80   server.acme.se.
http.tcp.sales.acme.se. IN SRV 10 10 1024 server.acme.se.
```

NAPTR Resource Record

- Naming authority pointer record
- Arguments are
  - Order number
  - Priority
  - Flags
  - Service
  - Regular expression
  - Replacement string

```
inet.urn.net. IN NAPTR 10 10 "" "" "/^[^:]*:inet:([^:]*):.*$/\1/i" ""
acme.se. IN NAPTR 10 10 "http+n2r" "s" "" http.tcp.acme.se.
```

Conclusion

- The Internet information space is characterized by a distribution of knowledge necessary for carrying out information (retrieval) tasks
- Different computational models exist and are being explored to deal with/make use of that distribution