Automatically Denormalizing Document Relationships

Will Thompson
O'Connor's

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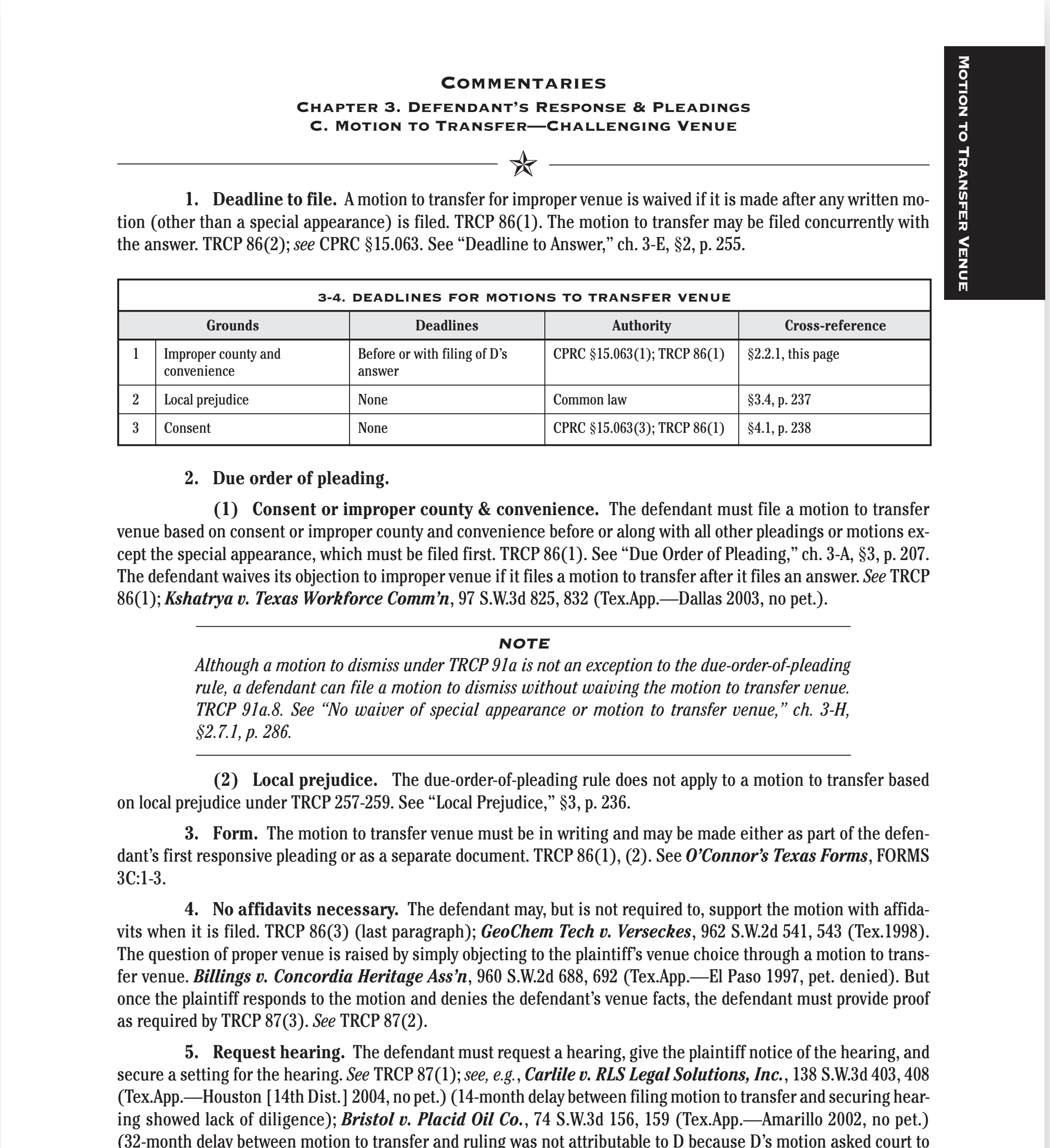
Print Books



1. Deadline to file. A motion to transfer for improper venue is waived if it is made after any written motion (other than a special appearance) is filed. TRCP 86(1). The motion to transfer may be filed concurrently with the answer. TRCP 86(2); *see* CPRC §15.063. See "Deadline to Answer," ch. 3-E, §2, p. 255.

3-4. DEADLINES FOR MOTIONS TO TRANSFER VENUE

	Grounds	Deadlines	Authority	Cross-reference
1	Improper county and convenience	Before or with filing of D's answer	CPRC §15.063(1); TRCP 86(1)	§2.2.1, this page
2	Local prejudice	None	Common law	§3.4, p. 237
3	Consent	None	CPRC §15.063(3); TRCP 86(1)	§4.1, p. 238

2. Due order of pleading.

(1) Consent or improper county & convenience. The defendant must file a motion to transfer venue based on consent or improper county and convenience before or along with all other pleadings or motions except the special appearance, which must be filed first. TRCP 86(1). See "Due Order of Pleading," ch. 3-A, §3, p. 207. The defendant waives its objection to improper venue if it files a motion to transfer after it files an answer. *See* TRCP 86(1); ***Kshatrya v. Texas Workforce Comm'n***, 97 S.W.3d 825, 832 (Tex.App.—Dallas 2003, no pet.).

NOTE

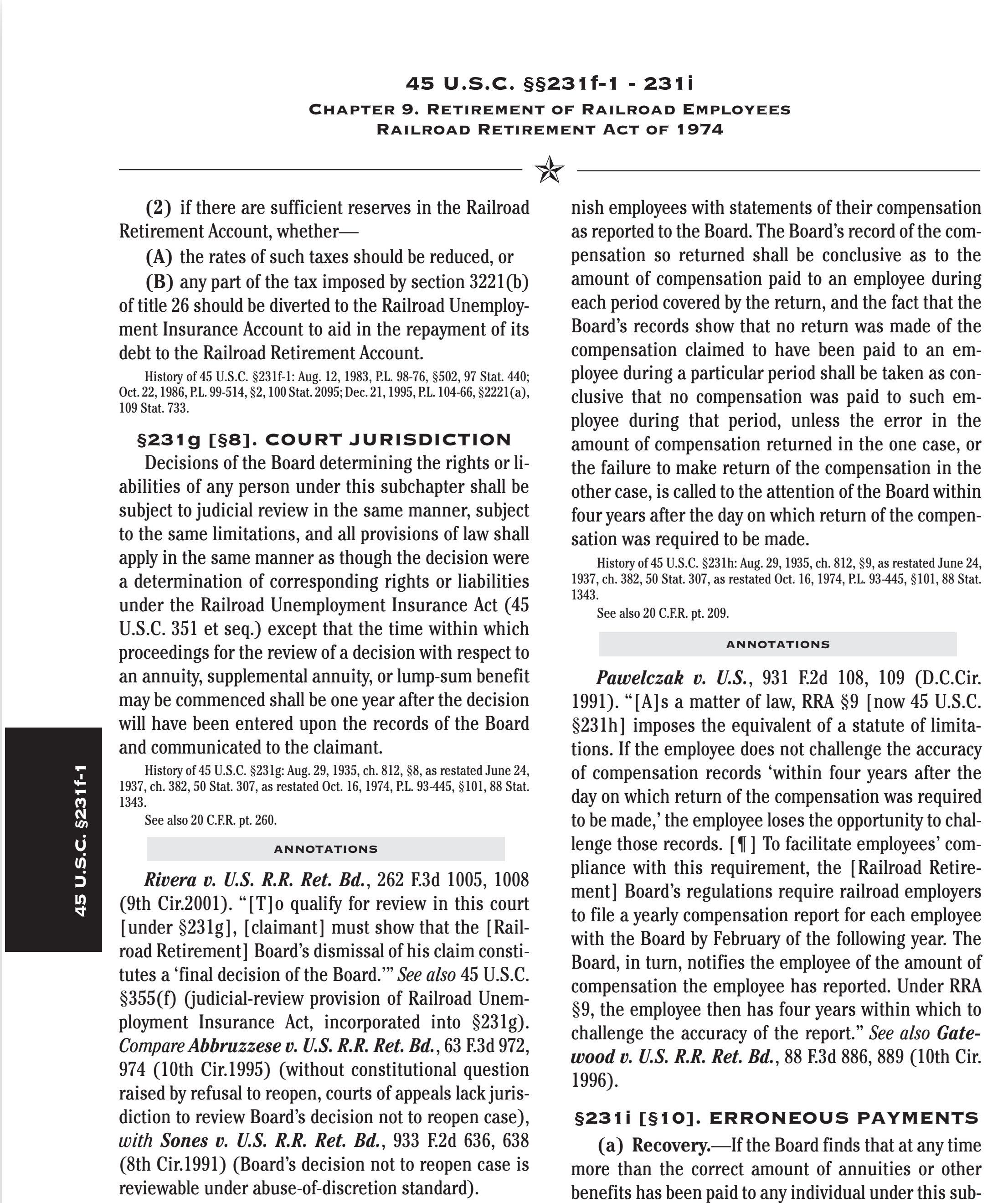
Although a motion to dismiss under TRCP 91a is not an exception to the due-order-of-pleading rule, a defendant can file a motion to dismiss without waiving the motion to transfer venue. TRCP 91a.8. See "No waiver of special appearance or motion to transfer venue," ch. 3-H, §2.7.1, p. 286.

(2) Local prejudice. The due-order-of-pleading rule does not apply to a motion to transfer based on local prejudice under TRCP 257-259. See "Local Prejudice," §3, p. 236.

3. Form. The motion to transfer venue must be in writing and may be made either as part of the defendant's first responsive pleading or as a separate document. TRCP 86(1), (2). See ***O'Connor's Texas Forms***, FORMS 3C:1-3.

4. No affidavits necessary. The defendant may, but is not required to, support the motion with affidavits when it is filed. TRCP 86(3) (last paragraph); ***GeoChem Tech v. Verseckes***, 962 S.W.2d 541, 543 (Tex.1998). The question of proper venue is raised by simply objecting to the plaintiff's venue choice through a motion to transfer venue. ***Billings v. Concordia Heritage Ass'n***, 960 S.W.2d 688, 692 (Tex.App.—El Paso 1997, pet. denied). But once the plaintiff responds to the motion and denies the defendant's venue facts, the defendant must provide proof as required by TRCP 87(3). *See* TRCP 87(2).

5. Request hearing. The defendant must request a hearing, give the plaintiff notice of the hearing, and secure a setting for the hearing. *See* TRCP 87(1); *see, e.g.*, ***Carlile v. RLS Legal Solutions, Inc.***, 138 S.W.3d 403, 408 (Tex.App.—Houston [14th Dist.] 2004, no pet.) (14-month delay between filing motion to transfer and securing hearing showed lack of diligence); ***Bristol v. Placid Oil Co.***, 74 S.W.3d 156, 159 (Tex.App.—Amarillo 2002, no pet.) (32-month delay between motion to transfer and ruling was not attributable to D because D's motion asked court to



(2) if there are sufficient reserves in the Railroad Retirement Account, whether—

(A) the rates of such taxes should be reduced, or

(B) any part of the tax imposed by section 3221(b) of title 26 should be diverted to the Railroad Unemployment Insurance Account to aid in the repayment of its debt to the Railroad Retirement Account.

History of 45 U.S.C. §231f-1: Aug. 12, 1983, P.L. 98-76, §502, 97 Stat. 440; Oct. 22, 1986, P.L. 99-514, §2, 100 Stat. 2095; Dec. 21, 1995, P.L. 104-66, §2221(a), 109 Stat. 733.

§231g [§8]. COURT JURISDICTION

Decisions of the Board determining the rights or liabilities of any person under this subchapter shall be subject to judicial review in the same manner, subject to the same limitations, and all provisions of law shall apply in the same manner as though the decision were a determination of corresponding rights or liabilities under the Railroad Unemployment Insurance Act (45 U.S.C. 351 et seq.) except that the time within which proceedings for the review of a decision with respect to an annuity, supplemental annuity, or lump-sum benefit may be commenced shall be one year after the decision will have been entered upon the records of the Board and communicated to the claimant.

History of 45 U.S.C. §231g: Aug. 29, 1935, ch. 812, §8, as restated June 24, 1937, ch. 382, 50 Stat. 307, as restated Oct. 16, 1974, P.L. 93-445, §101, 88 Stat. 1343.

See also 20 C.F.R. pt. 260.

ANNOTATIONS

Rivera v. U.S. R.R. Ret. Bd., 262 F.3d 1005, 1008 (9th Cir.2001). "[T]o qualify for review in this court [under §231g], [claimant] must show that the [Railroad Retirement] Board's dismissal of his claim constitutes a 'final decision of the Board.'" *See also* 45 U.S.C. §355(f) (judicial-review provision of Railroad Unemployment Insurance Act, incorporated into §231g). *Compare* ***Abbruzzese v. U.S. R.R. Ret. Bd.***, 63 F.3d 972, 974 (10th Cir.1995) (without constitutional question raised by refusal to reopen, courts of appeals lack jurisdiction to review Board's decision not to reopen case), *with* ***Sones v. U.S. R.R. Ret. Bd.***, 933 F.2d 636, 638 (8th Cir.1991) (Board's decision not to reopen case is reviewable under abuse-of-discretion standard).

nish employees with statements of their compensation as reported to the Board. The Board's record of the compensation so returned shall be conclusive as to the amount of compensation paid to an employee during each period covered by the return, and the fact that the Board's records show that no return was made of the compensation claimed to have been paid to an employee during a particular period shall be taken as conclusive that no compensation was paid to such employee during that period, unless the error in the amount of compensation returned in the one case, or the failure to make return of the compensation in the other case, is called to the attention of the Board within four years after the day on which return of the compensation was required to be made.

History of 45 U.S.C. §231h: Aug. 29, 1935, ch. 812, §9, as restated June 24, 1937, ch. 382, 50 Stat. 307, as restated Oct. 16, 1974, P.L. 93-445, §101, 88 Stat. 1343.

See also 20 C.F.R. pt. 209.

ANNOTATIONS

Pawelczak v. U.S., 931 F.2d 108, 109 (D.C.Cir. 1991). "[A]s a matter of law, RRA §9 [now 45 U.S.C. §231h] imposes the equivalent of a statute of limitations. If the employee does not challenge the accuracy of compensation records 'within four years after the day on which return of the compensation was required to be made,' the employee loses the opportunity to challenge those records. [¶] To facilitate employees' compliance with this requirement, the [Railroad Retirement] Board's regulations require railroad employers to file a yearly compensation report for each employee with the Board by February of the following year. The Board, in turn, notifies the employee of the amount of compensation the employee has reported. Under RRA §9, the employee then has four years within which to challenge the accuracy of the report." *See also* ***Gatewood v. U.S. R.R. Ret. Bd.***, 88 F.3d 886, 889 (10th Cir. 1996).

§231i [§10]. ERRONEOUS PAYMENTS

(a) Recovery.—If the Board finds that at any time more than the correct amount of annuities or other benefits has been paid to any individual under this sub-

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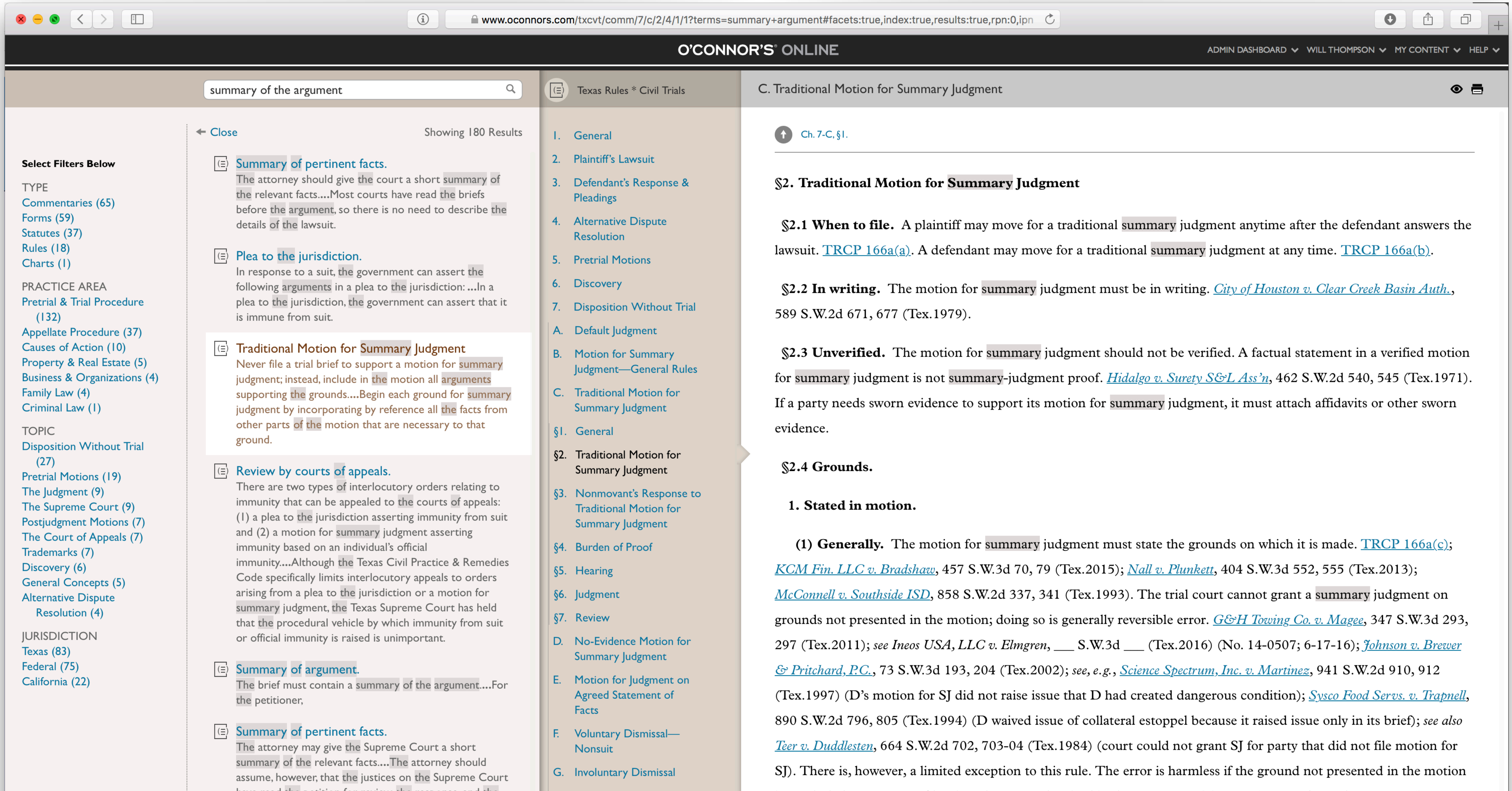
Web-based Service


www.oconnors.com/txcvt/comm/7/c/2/4/1/1?terms=summary+argument#facets:true,index:true,results:true,rpn:0,ipn
O'CONNOR'S ONLINE
ADMIN DASHBOARD
WILL THOMPSON
MY CONTENT
HELP
summary of the argument
Close
Texas Rules * Civil Trials
C. Traditional Motion for Summary Judgment
Ch. 7-C, §1.

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Summary of pertinent facts.
The attorney should give the court a short summary of the relevant facts....Most courts have read the briefs before the argument, so there is no need to describe the details of the lawsuit.

Plea to the jurisdiction.
In response to a suit, the government can assert the following arguments in a plea to the jurisdiction: ...In a plea to the jurisdiction, the government can assert that it is immune from suit.

Traditional Motion for Summary Judgment
Never file a trial brief to support a motion for summary judgment; instead, include in the motion all arguments supporting the grounds....Begin each ground for summary judgment by incorporating by reference all the facts from other parts of the motion that are necessary to that ground.

Review by courts of appeals.
There are two types of interlocutory orders relating to immunity that can be appealed to the courts of appeals: (1) a plea to the jurisdiction asserting immunity from suit and (2) a motion for summary judgment asserting immunity based on an individual's official immunity....Although the Texas Civil Practice & Remedies Code specifically limits interlocutory appeals to orders arising from a plea to the jurisdiction or a motion for summary judgment, the Texas Supreme Court has held that the procedural vehicle by which immunity from suit or official immunity is raised is unimportant.

Summary of argument.
The brief must contain a summary of the argument....For the petitioner,

Summary of pertinent facts.
The attorney may give the Supreme Court a short summary of the relevant facts....The attorney should assume, however, that the justices on the Supreme Court

1. General
2. Plaintiff's Lawsuit
3. Defendant's Response & Pleadings
4. Alternative Dispute Resolution
5. Pretrial Motions
6. Discovery
7. Disposition Without Trial
A. Default Judgment
B. Motion for Summary Judgment—General Rules
C. Traditional Motion for Summary Judgment
§1. General
§2. Traditional Motion for Summary Judgment
§3. Nonmovant's Response to Traditional Motion for Summary Judgment
§4. Burden of Proof
§5. Hearing
§6. Judgment
§7. Review
D. No-Evidence Motion for Summary Judgment
E. Motion for Judgment on Agreed Statement of Facts
F. Voluntary Dismissal—Nonsuit
G. Involuntary Dismissal

§2. Traditional Motion for Summary Judgment

§2.1 When to file. A plaintiff may move for a traditional summary judgment anytime after the defendant answers the lawsuit. TRCP 166a(a). A defendant may move for a traditional summary judgment at any time. TRCP 166a(b).

§2.2 In writing. The motion for summary judgment must be in writing. *City of Houston v. Clear Creek Basin Auth.*, 589 S.W.2d 671, 677 (Tex.1979).

§2.3 Unverified. The motion for summary judgment should not be verified. A factual statement in a verified motion for summary judgment is not summary-judgment proof. *Hidalgo v. Surety S&L Ass'n*, 462 S.W.2d 540, 545 (Tex.1971). If a party needs sworn evidence to support its motion for summary judgment, it must attach affidavits or other sworn evidence.

§2.4 Grounds.

1. Stated in motion.

(1) Generally. The motion for summary judgment must state the grounds on which it is made. TRCP 166a(c); *KCM Fin. LLC v. Bradshaw*, 457 S.W.3d 70, 79 (Tex.2015); *Nall v. Plunkett*, 404 S.W.3d 552, 555 (Tex.2013); *McConnell v. Southside ISD*, 858 S.W.2d 337, 341 (Tex.1993). The trial court cannot grant a summary judgment on grounds not presented in the motion; doing so is generally reversible error. *G&H Towing Co. v. Magee*, 347 S.W.3d 293, 297 (Tex.2011); *see Ineos USA, LLC v. Elmgren*, ___ S.W.3d ___ (Tex.2016) (No. 14-0507; 6-17-16); *Johnson v. Brewer & Pritchard, P.C.*, 73 S.W.3d 193, 204 (Tex.2002); *see, e.g.*, *Science Spectrum, Inc. v. Martinez*, 941 S.W.2d 910, 912 (Tex.1997) (D's motion for SJ did not raise issue that D had created dangerous condition); *Sysco Food Servs. v. Trapnell*, 890 S.W.2d 796, 805 (Tex.1994) (D waived issue of collateral estoppel because it raised issue only in its brief); *see also* *Teer v. Duddlesten*, 664 S.W.2d 702, 703-04 (Tex.1984) (court could not grant SJ for party that did not file motion for SJ). There is, however, a limited exception to this rule. The error is harmless if the ground not presented in the motion

Modeling relationships

One-to-one

Clients

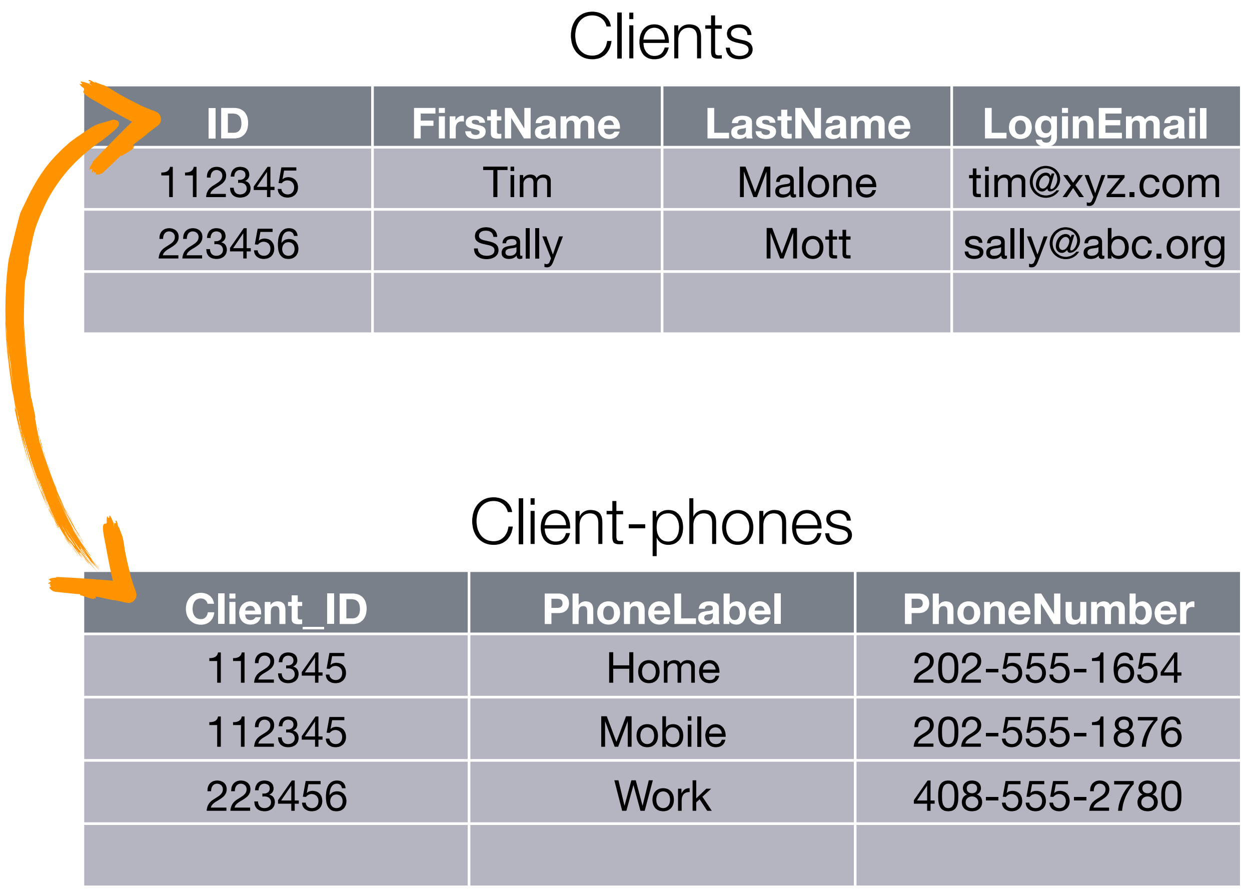
ID	FirstName	LastName	LogInEmail
112345	Tim	Malone	tim@xyz.com
223456	Sally	Mott	sally@abc.org

```
<client id="112345" firstName="Tim"
   lastName="Malone"
   loginEmail="tim@xyz.com" />

<client id="223456" firstName="Sally"
   lastName="Mott"
   loginEmail="sally@abc.org" />
```

Modeling relationships

One-to-many



Clients

ID	FirstName	LastName	LoginEmail
112345	Tim	Malone	tim@xyz.com
223456	Sally	Mott	sally@abc.org

Client-phones

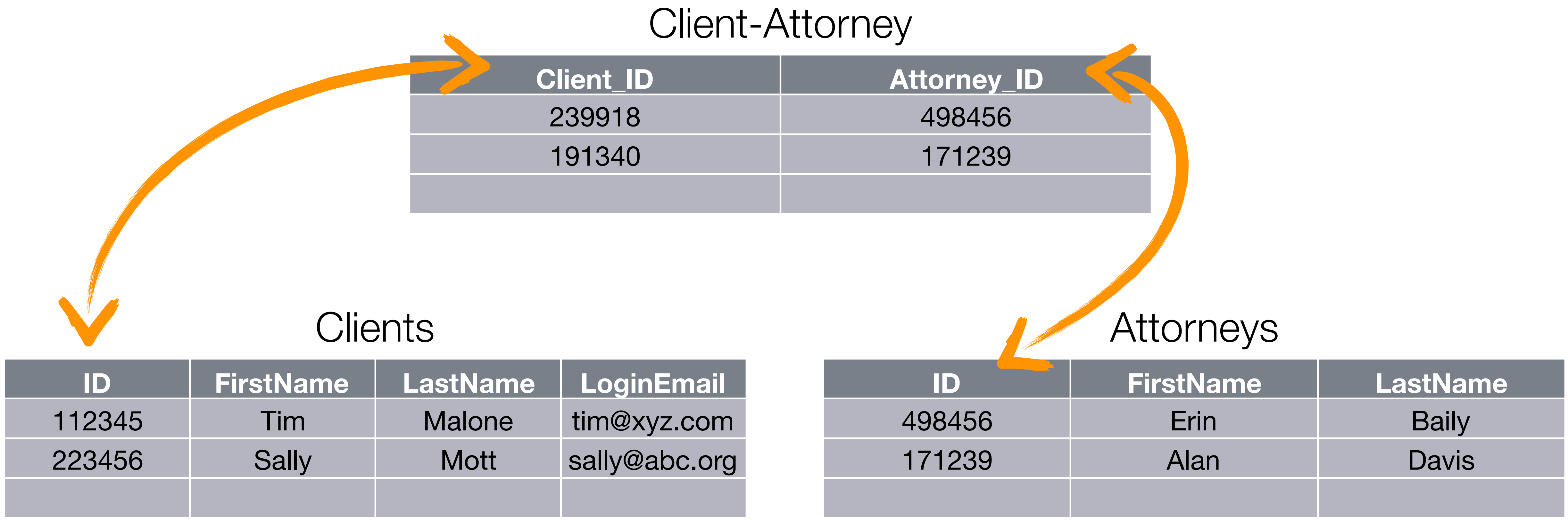
Client_ID	PhoneLabel	PhoneNumber
112345	Home	202-555-1654
112345	Mobile	202-555-1876
223456	Work	408-555-2780

```
<client id="112345" firstName="Tim"
   lastName="Malone"
   loginEmail="tim@xyz.com">
   <phone-number label="Home">202-555-1654</
   phone-number>
   <phone-number label="Mobile">202-555-1876</
   phone-number>
</client>
```

```
<client id="223456" firstName="Sally"
   lastName="Mott"
   loginEmail="sally@abc.org">
   <phone-number label="Work">408-555-2780</
   phone-number>
</client>
```

Modeling relationships

Many-to-many



Client-Attorney

Client_ID	Attorney_ID
239918	498456
191340	171239

Clients

ID	FirstName	LastName	LoginEmail
112345	Tim	Malone	tim@xyz.com
223456	Sally	Mott	sally@abc.org

Attorneys

ID	FirstName	LastName
498456	Erin	Baily
171239	Alan	Davis

Modeling relationships

Many-to-many

`<xml>`

?

Many-to-many relationships

Alternative : **Discard relationship data**

```
<client id="112345"
   firstName="Tim" lastName="Malone">
   …
</client>
```

```
<client id="223456"
   firstName="Sally" lastName="Mott">
   …
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   …
</attorney>
```

```
<attorney id="171239"
   firstName="Alan" lastName="Davis">
   …
</attorney>
```

Many-to-many relationships

Alternative : **Degrade relationship**

```
<attorney id="498456"
   firstName="Bob" lastName="Shapiro">
   <client id="538989"
      firstName="O.J." lastName="Simpson">
      ...
   </client>
   <client id="185703"></client>
   <client id="220540"></client>
</attorney>
```

Many-to-many relationships

Alternative : Degrade relationship

```
<attorney id="171239"
   firstName="Bob" lastName="Shapiro">
   <client id="538989"
      firstName="O.J." lastName="Simpson">
      ...
   </client>
   <client id="185703"></client>
   <client id="220540"></client>
</attorney>
```

```
<attorney id="498456"
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   <client id="538989"
      firstName="O.J." lastName="Simpson">
      ...
   </client>
   <client id="975412"></client>
   <client id="880990"></client>
</attorney>
```

Many-to-many relationships

Alternative : Degrade relationship

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<attorney id="171239"
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   <client id="538989"
      firstName="O.J." lastName="Simpson">
      ...
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   <client id="220540"></client>
</attorney>
```

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      ...
   </client>
   <client id="975412"></client>
   <client id="880990"></client>
</attorney>
```

Many-to-many relationships

Keys and Joins

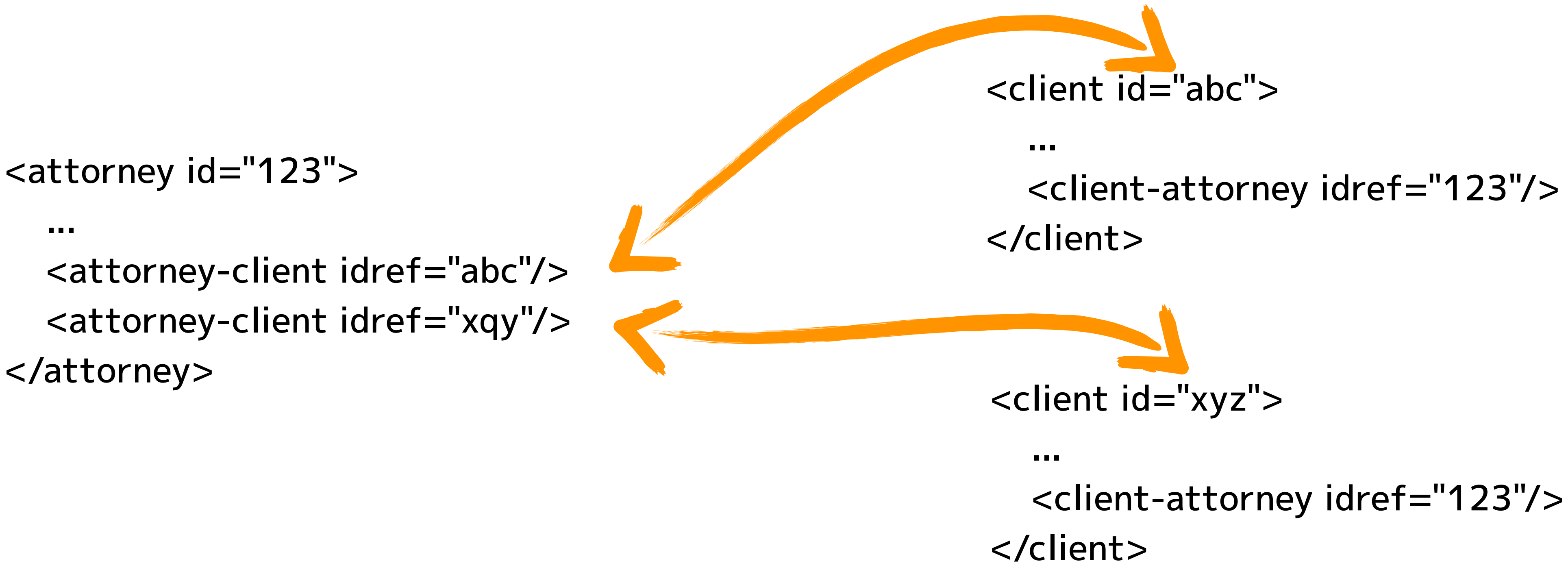
```
<attorney id="123">
   ...
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   ...
   <client-attorney idref="123"/>
</client>
```

```
<client id="xyz">
   ...
   <client-attorney idref="123"/>
</client>
```

Many-to-many relationships

Keys and Joins



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<attorney id="123">
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   <attorney-client idref="xqy"/>
</attorney>
```

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</client>
```

```
<client id="xyz">
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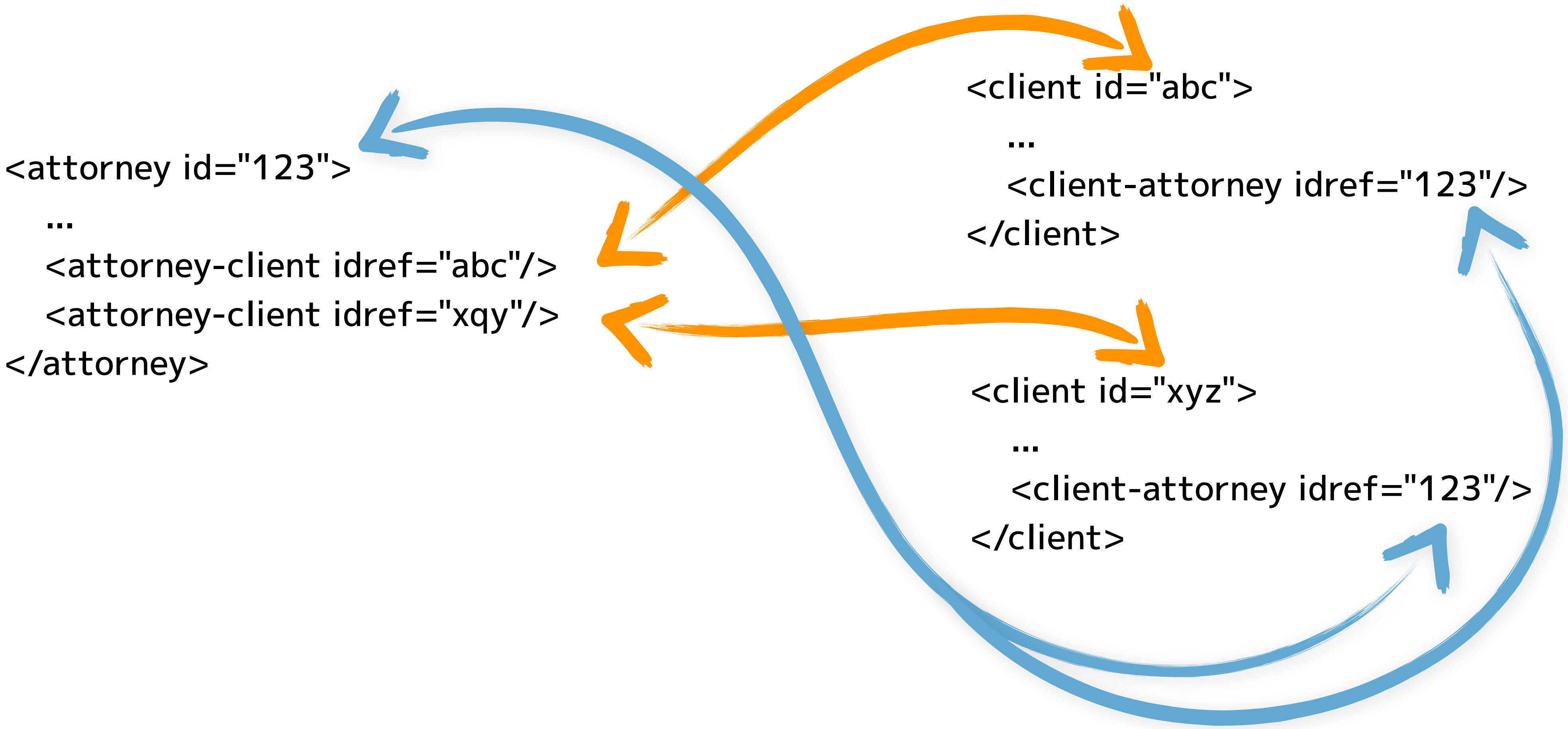
   <client-attorney idref="123"/>
</client>
```

Many-to-many relationships

Keys and Joins



```
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   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   ...
   <client-attorney idref="123"/>
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```

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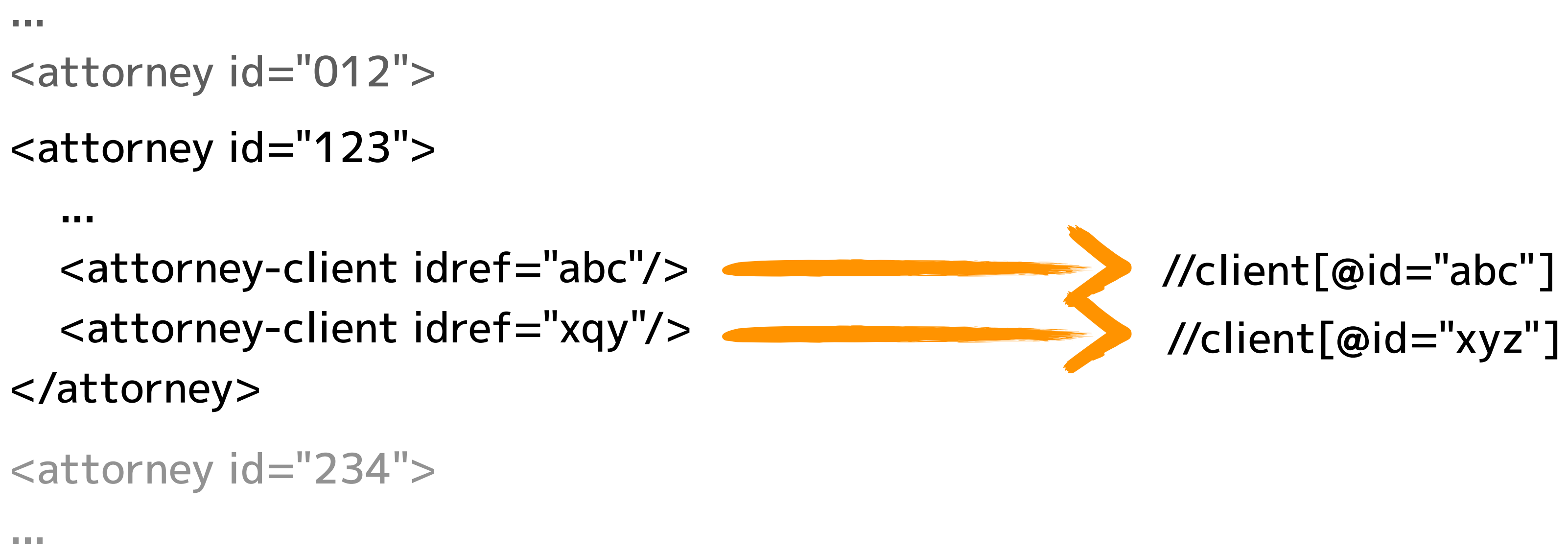
```

Many-to-many relationships

Keys and Joins : **Views**



```
...
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<attorney id="123">
   ...
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
<attorney id="234">
...
```

```
//client[@id="abc"]
//client[@id="xyz"]
```

- *Join functions must be explicitly built*
- *Reads are multiplied*

Many-to-many relationships

Keys and Joins : Joining on related data

```
<attorney id="123">
   <address>...<state>CA</state>...</address>
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   <address>...<state>ME</state>...</address>
   <client-attorney idref="123"/>
</client>
```

"*West Coast attorneys representing East Coast clients*"

Many-to-many relationships

Keys and Joins : Joining on related data

```
<attorney id="123">
   <address>...<state>CA</state>...</address>
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   <address>...<state>ME</state>...</address>
   <client-attorney idref="123"/>
</client>
```

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
let $clients-east := //client[address/state = $states-east]
let $attorneys-west := //attorney[address/state = $states-west]
return $attorneys-west
           [attorney-client/@idref = $clients-east/@id]
```

- *Big join*
- *May read large portions of the database*
- *Hard to optimize reliably*

Many-to-many relationships

Keys and Joins : **Joining on related data**

```
<attorney id="123">
   <address>...<state>CA</state>...</address>
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   <address>...<state>ME</state>...</address>
   <client-attorney idref="123"/>
</client>
```

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
let $clients-east := //client[address/state = $states-east]
let $attorneys-west := //attorney[address/state = $states-west]
return $attorneys-west
           [attorney-client/@idref = $clients-east/@id]
```

- *Big join*
- *May read large portions of the database*
- *Hard to optimize reliably*

Many-to-many relationships

Keys and Joins : Joining on related data

```
<attorney id="123">
   <address>...<state>CA</state>...</address>
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
</attorney>
```

```
<client id="abc">
   <address>...<state>ME</state>...</address>
   <client-attorney idref="123"/>
</client>
```

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
let $clients-east := //client[address/state = $states-east]
~~let $attorneys-west := //attorney[address/state = $states-west]~~
return //attorney[address/state = $states-west]
           [attorney-client/@idref = $clients-east/@id]
```

- *Big join*
- *May read large portions of the database*
- *Hard to optimize reliably*

Many-to-many relationships

Keys and Joins : Joining on related data

```
<attorney id="123">
   <address>...<state>CA</state>...</address>
   <attorney-client idref="abc"/>
   <attorney-client idref="xqy"/>
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```

```
<client id="abc">
   <address>...<state>ME</state>...</address>
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</client>
```

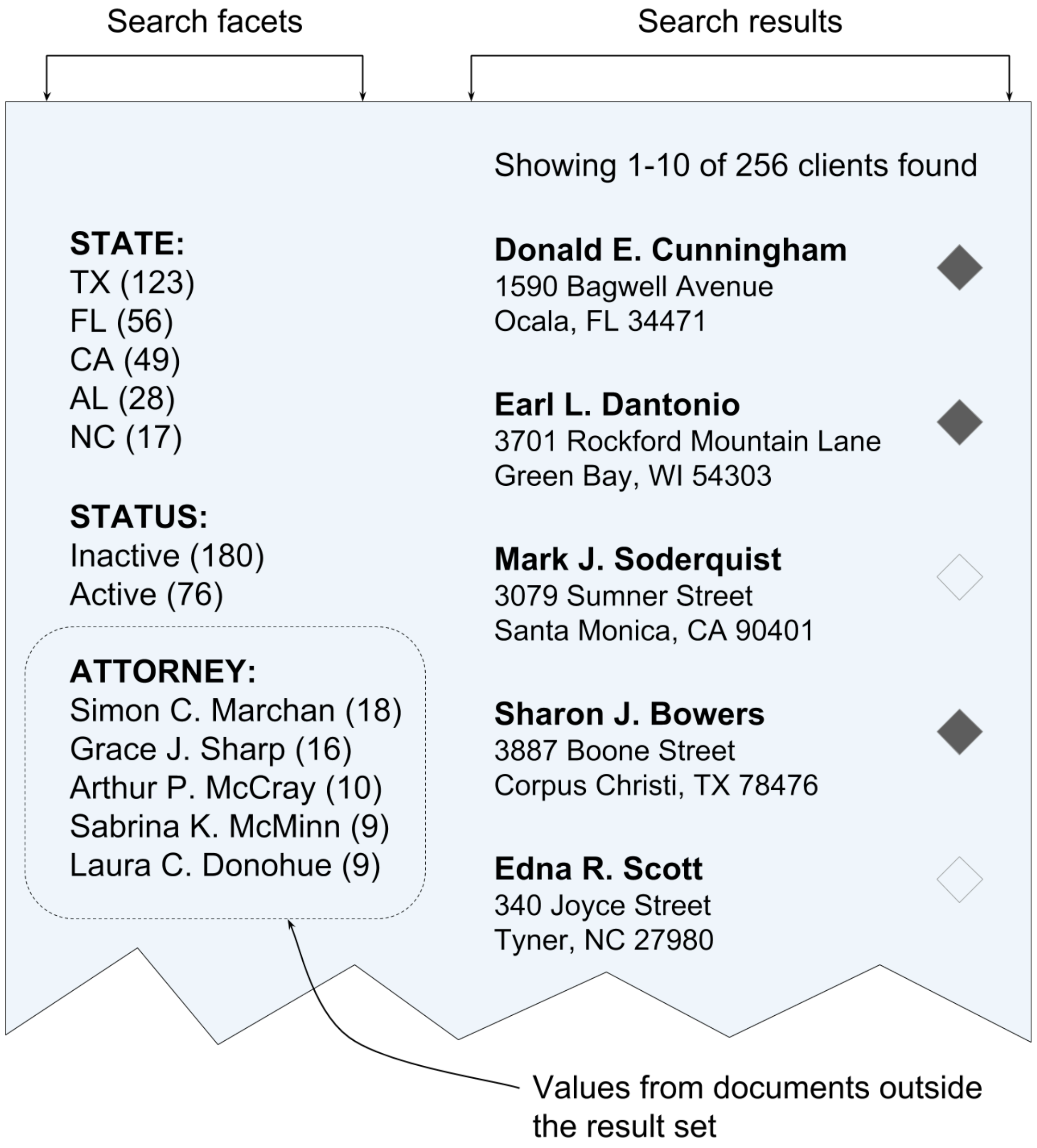
"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
let $clients-east-ids := //client[address/state = $states-east]/@id
~~let $attorneys-west := //attorney[address/state = $states-west]~~
return //attorney[address/state = $states-west]
          [attorney-client/@idref = $clients-east-ids]
```

- *Big join*
- *May read large portions of the database*
- *Hard to optimize reliably*

Many-to-many relationships

Keys and Joins : Joining on related data



Search facets

Search results

Showing 1-10 of 256 clients found

STATE:
TX (123)
FL (56)
CA (49)
AL (28)
NC (17)

STATUS:
Inactive (180)
Active (76)

ATTORNEY:
Simon C. Marchan (18)
Grace J. Sharp (16)
Arthur P. McCray (10)
Sabrina K. McMinn (9)
Laura C. Donohue (9)

Donald E. Cunningham ◆
1590 Bagwell Avenue
Ocala, FL 34471

Earl L. Dantonio ◆
3701 Rockford Mountain Lane
Green Bay, WI 54303

Mark J. Soderquist ◇
3079 Sumner Street
Santa Monica, CA 90401

Sharon J. Bowers ◆
3887 Boone Street
Corpus Christi, TX 78476

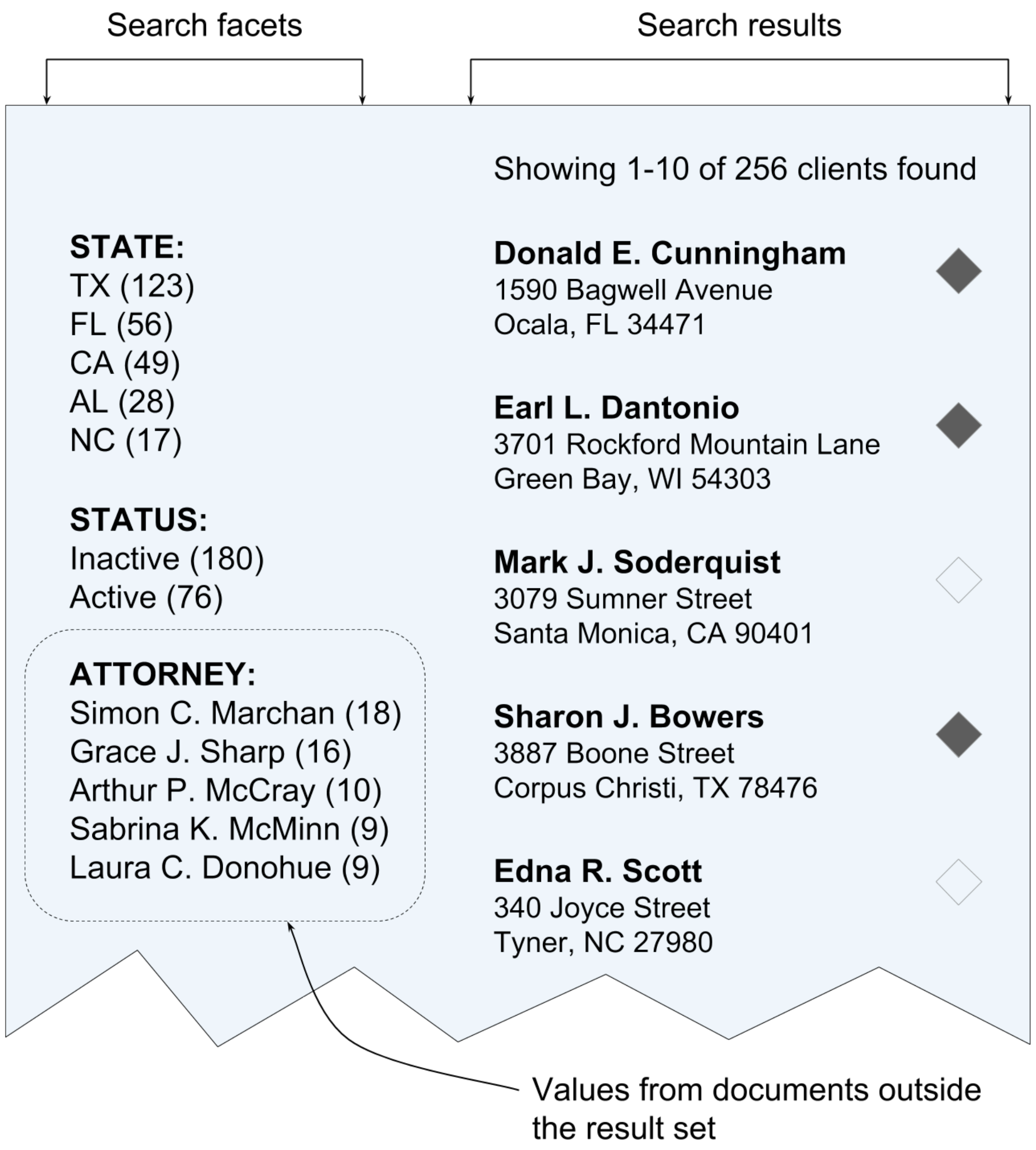
Edna R. Scott ◇
340 Joyce Street
Tyner, NC 27980

Values from documents outside the result set

- *Facets are calculated for entire result set*
- *Indexing facilitates fast facet calculations on values in result documents*
- *Joins required for related document values*
- *Query cost scales with size of result set*

Many-to-many relationships

Keys and Joins : Joining on related data



Search facets

Search results

Showing 1-10 of 256 clients found

STATE:
TX (123)
FL (56)
CA (49)
AL (28)
NC (17)

STATUS:
Inactive (180)
Active (76)

ATTORNEY:
Simon C. Marchan (18)
Grace J. Sharp (16)
Arthur P. McCray (10)
Sabrina K. McMinn (9)
Laura C. Donohue (9)

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Earl L. Dantonio ◆
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Santa Monica, CA 90401

Sharon J. Bowers ◆
3887 Boone Street
Corpus Christi, TX 78476

Edna R. Scott ◇
340 Joyce Street
Tyner, NC 27980

Values from documents outside the result set

- *Facets are calculated for entire result set*
- *Indexing facilitates fast facet calculations on values in result documents*
- *Joins required for related document values*
- *Query cost scales with size of result set*

```
let $client-results := db:implementation-defined(…)
let $client-attorney-refs := $client-results/client-attorney/@idref
return subsequence(
   for $attorney in //attorney[@id = $client-attorney-refs]
   let $count := count($client-results
                   [client-attorney/@idref = $attorney/@id])
   order by $count descending
   return <attorney-facet
            value="{ $attorney/full-name }"
            count="{ $count }" />,
  1, 5)
```

Many-to-many relationships

Keys and Joins : Code maintenance

Organization	*Abstraction*
• *Two commingled document concepts* • *Fractured codebase*	• *Join-based model harder to generalize* • *Dependencies*

Many-to-many relationships

Keys and Joins : Code maintenance

Organizati

- ***Two*** ***odel harder to conc***
- ***Fract***

Automatic denormalization

Overview

Precomputation

Shifts responsibility from run-time to write-time

Conceptually similar to SQL indexed/materialized views

Explicit trade-off
  - *Run-time performance*
  - *<u>Simplicity</u>*

Automatic denormalization

Overview

```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...

      <attorney-client idref="498456" />




</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...

      <client-attorney idref="112345" />

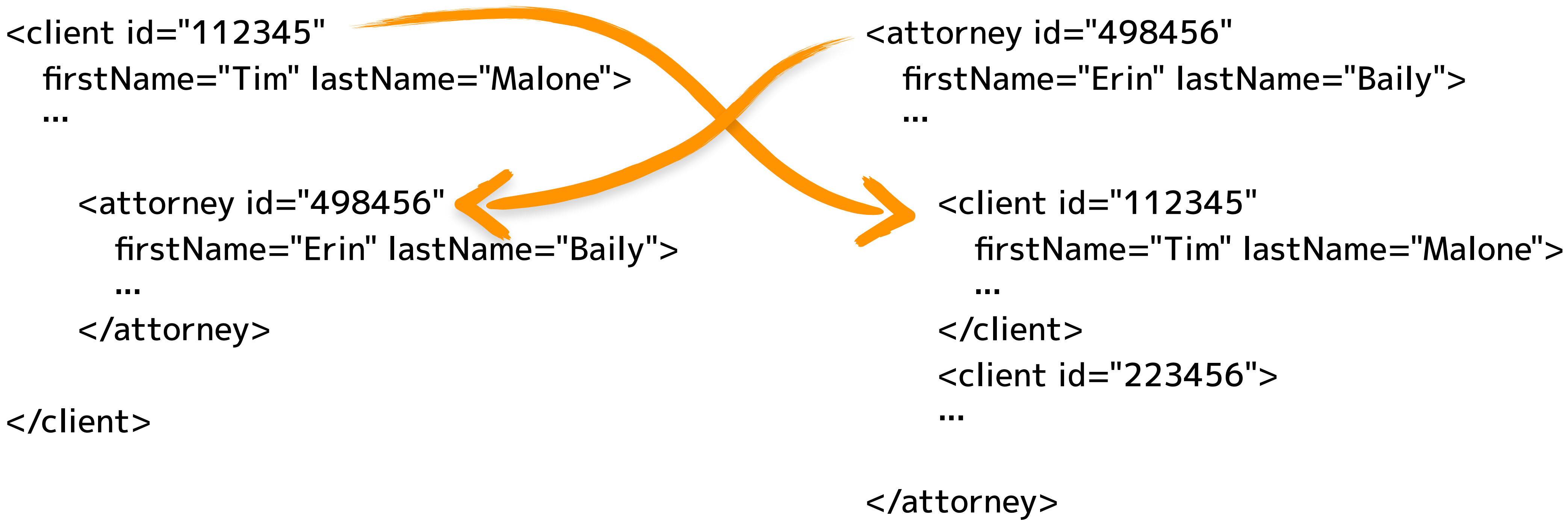


      <client-attorney idref="223456" />


</attorney>
```

Automatic denormalization

Overview



```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...

      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>

</client>
```

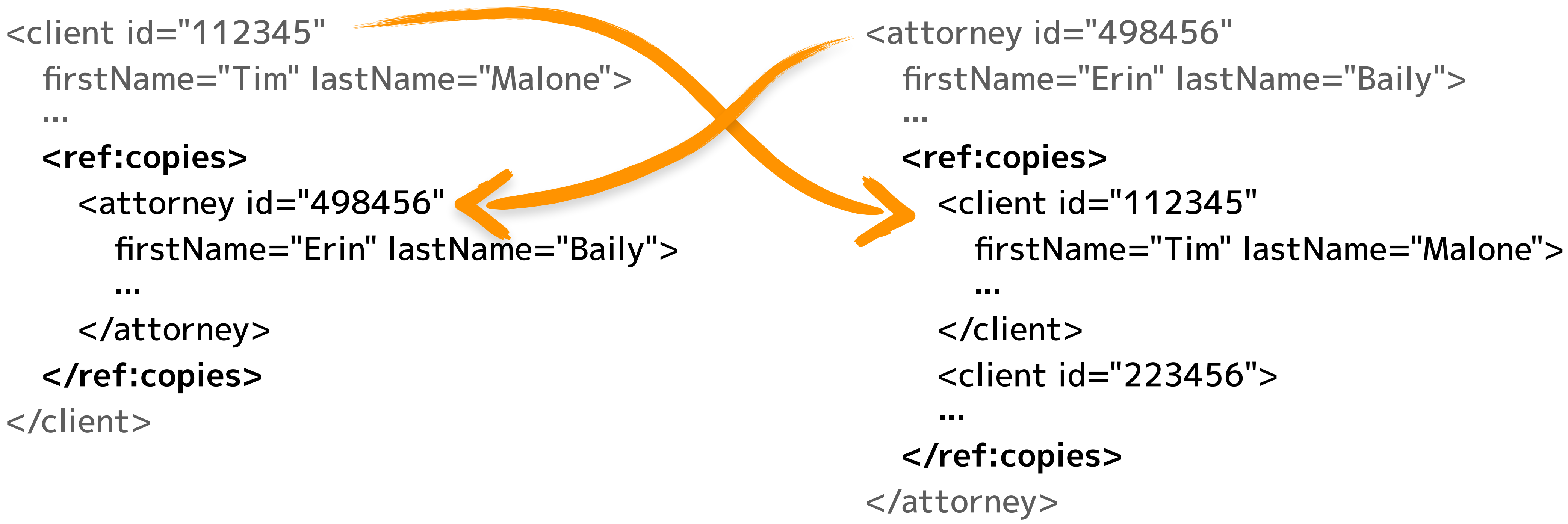
```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...

      <client id="112345"
         firstName="Tim" lastName="Malone">
         ...
      </client>
      <client id="223456">
      ...

</attorney>
```

Automatic denormalization

Relationship create

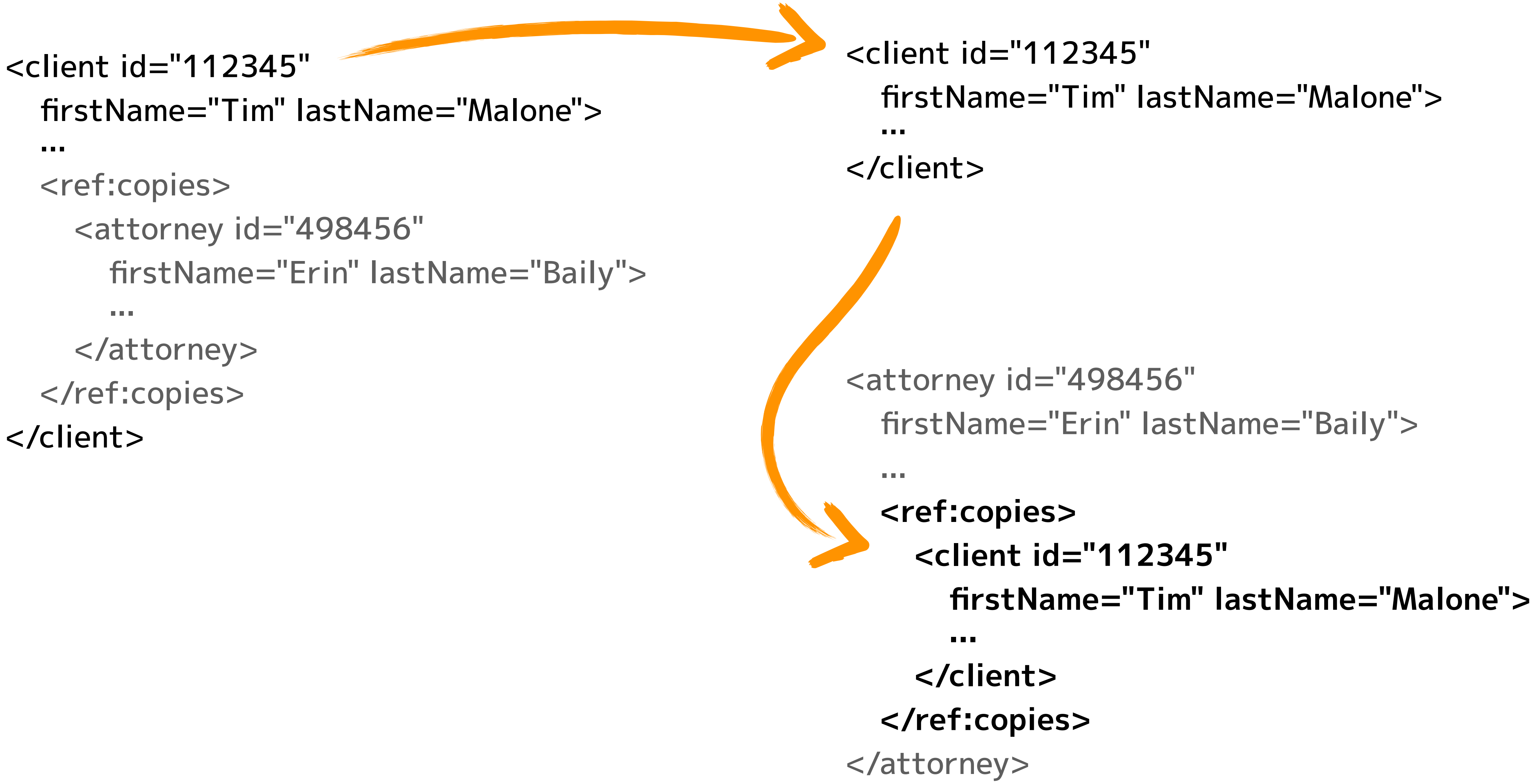


```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      <client id="112345"
         firstName="Tim" lastName="Malone">
         ...
      </client>
      <client id="223456">
      ...
   </ref:copies>
</attorney>
```

Automatic denormalization

Entity copy transformation



```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      <client id="112345"
         firstName="Tim" lastName="Malone">
         ...
      </client>
   </ref:copies>
</attorney>
```

Automatic denormalization

Update

```
<client id="112345"
  firstName="Tim" lastName="Malone">
  ...
  <ref:copies>
    <attorney id="498456"
      firstName="Erin" lastName="Baily">
      ...
    </attorney>
  </ref:copies>
</client>
```

Automatic denormalization

Update

```
<client id="112345"
    firstName="Timothy" lastName="Malone">
    ...
    <ref:copies>
        <attorney id="498456"
            firstName="Erin" lastName="Baily">
            ...
        </attorney>
    </ref:copies>
</client>
```

Automatic denormalization

Update

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

Entity copy transformation

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
</client>
```

Automatic denormalization

Update

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
```

Get referenced document

```
         firstName="Tim" lastName="Malone">
         ...
      </client>
   </ref:copies>
</attorney>
```

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
</client>
```

Automatic denormalization

Update

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         ...
      </client>
   </ref:copies>
</attorney>
```

Update referenced document with copy

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
</client>
```

Automatic denormalization

Update

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         ...
      </client>
   </ref:copies>
</attorney>
```

```
<client id="112345"
   firstName="Timothy" lastName="Malone">
   ...
</client>
```

Automatic denormalization

Delete

```
<client id="112345"
   firstName="Tim" lastName="Malone">
   ...
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
</client>
```

Automatic denormalization

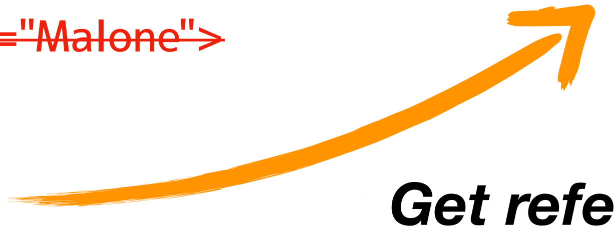
Delete

```
~~<client id="112345"~~
  ~~firstName="Tim" lastName="Malone">~~
  ~~...~~
  <ref:copies>
    <attorney id="498456"
      firstName="Erin" lastName="Baily">
      ...
    </attorney>
  </ref:copies>
~~</client>~~
```

Automatic denormalization

Delete

```
~~<client id="112345"~~
  ~~firstName="Tim" lastName="Malone">~~
  ~~...~~
  <ref:copies>
    <attorney id="498456"
      firstName="Erin" lastName="Baily">
      ...
    </attorney>
  </ref:copies>
~~</client>~~
```



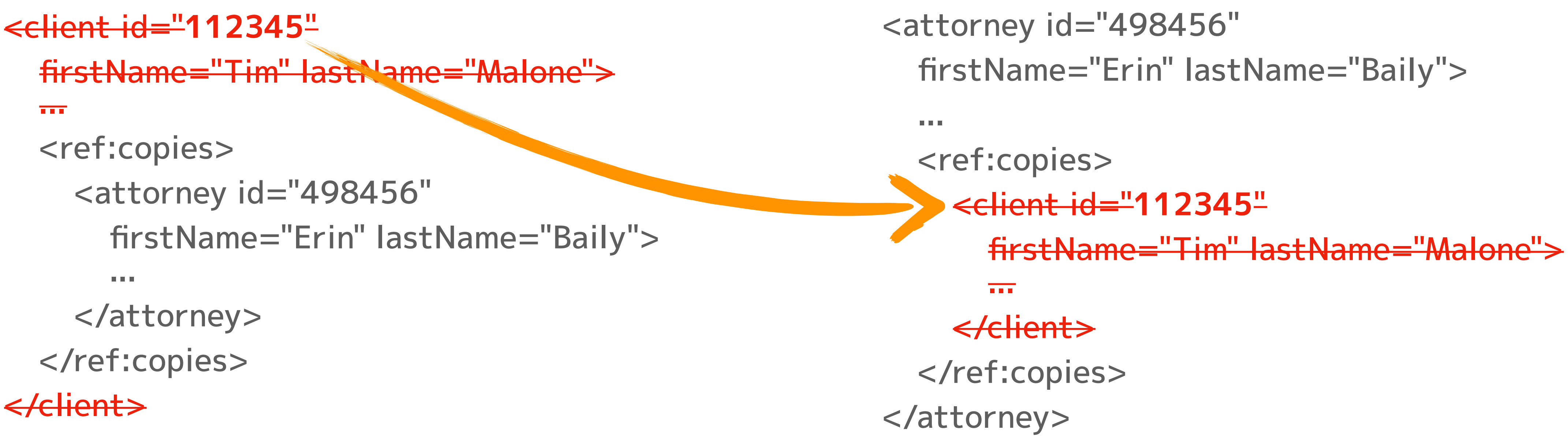
Get referenced document

```
<attorney id="498456"
  firstName="Erin" lastName="Baily">
  ...
  <ref:copies>

      firstName="Tim" lastName="Malone">
      ...
    </client>
  </ref:copies>
</attorney>
```

Automatic denormalization

Delete



```
~~<client id="~~112345~~"~~
   ~~firstName="Tim" lastName="Malone">~~
   ~~...~~
   <ref:copies>
      <attorney id="498456"
         firstName="Erin" lastName="Baily">
         ...
      </attorney>
   </ref:copies>
~~</client>~~
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      ~~<client id="~~112345~~"~~
         ~~firstName="Tim" lastName="Malone">~~
         ~~...~~
      ~~</client>~~
   </ref:copies>
</attorney>
```

Remove copy from referenced document

Automatic denormalization

Delete

```
~~<client id="112345"~~
   ~~firstName="Tim" lastName="Malone">~~
   ~~...~~
   ~~<ref:copies>~~
      ~~<attorney id="498456"~~
         ~~firstName="Erin" lastName="Baily">~~
         ~~...~~
      ~~</attorney>~~
   ~~</ref:copies>~~
~~</client>~~
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   ...
   <ref:copies>
      ...



   </ref:copies>
</attorney>
```

Automatic denormalization

Read

```
<client id="112345"
  firstName="Tim" lastName="Malone">
  <address> … <state>CA</state> … </address>
  <ref:copies>
    <attorney id="498456"
      firstName="Erin" lastName="Baily">
      <address> …
        <state>NY</state> …
      </address>
      …
    </attorney>
  </ref:copies>
  …
</client>
```

```
<attorney id="498456"
  firstName="Erin" lastName="Baily">
  <address> … <state>NY</state> … </address>
  <ref:copies>
    <client id="112345"
      firstName="Timothy" lastName="Malone">
      <address> …
        <state>CA</state> …
      </address>
    </client>
    <client id="223456">
    …
  </ref:copies>
</attorney>
```

Automatic denormalization

Read

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
let $clients-east := //client[state = $states-east]
return
   //attorney
      [address/state = $states-west]
      [attorney-client/@idref = $clients-east/@id]
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   <address> ... <state>NY</state> ... </address>
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         <address> ...
            <state>CA</state> ...
         </address>
      </client>
      <client id="223456">
      ...
   </ref:copies>
</attorney>
```

Automatic denormalization

Read

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, ... , ‘FL’)
~~let $clients-east := //client[state = $states-east]~~
return
   //attorney
      [address/state = $states-west]
      ~~[attorney-client/@idref = $clients-east/@id]~~
      [ref:copies/client//state = $states-east)]
```

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   <address> ... <state>NY</state> ... </address>
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         <address> ...
            <state>CA</state> ...
         </address>
      </client>
      <client id="223456">
      ...
   </ref:copies>
</attorney>
```

Automatic denormalization

Read

"*West Coast attorneys representing East Coast clients*"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, … , ‘FL’)
~~let $clients-east := //client[state = $states-east]~~
return
   //attorney
      [address/state = $states-west]
      ~~[attorney-client/@idref = $clients-east/@id]~~
      [ref:copies/client//state = $states-east]
```

- *Single document-scoped query*
- *Join eliminated*

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   <address> … <state>NY</state> … </address>
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         <address> …
            <state>CA</state> …
         </address>
      </client>
      <client id="223456">
      …
   </ref:copies>
</attorney>
```

Automatic denormalization

Read

"West Coast attorneys representing East Coast clients"

```
let $states-west := (‘CA’, ‘OR’, ‘WA’)
let $states-east := (‘ME’, ‘NH’, ‘RI’, … , ‘FL’)
~~let $clients-east := //client[state = $states-east]~~
return
   //attorney
      [address/state = $states-west]
      ~~[attorney-client/@idref = $clients-east/@id]~~
      [ref:copies/client//state = $states-east]
```

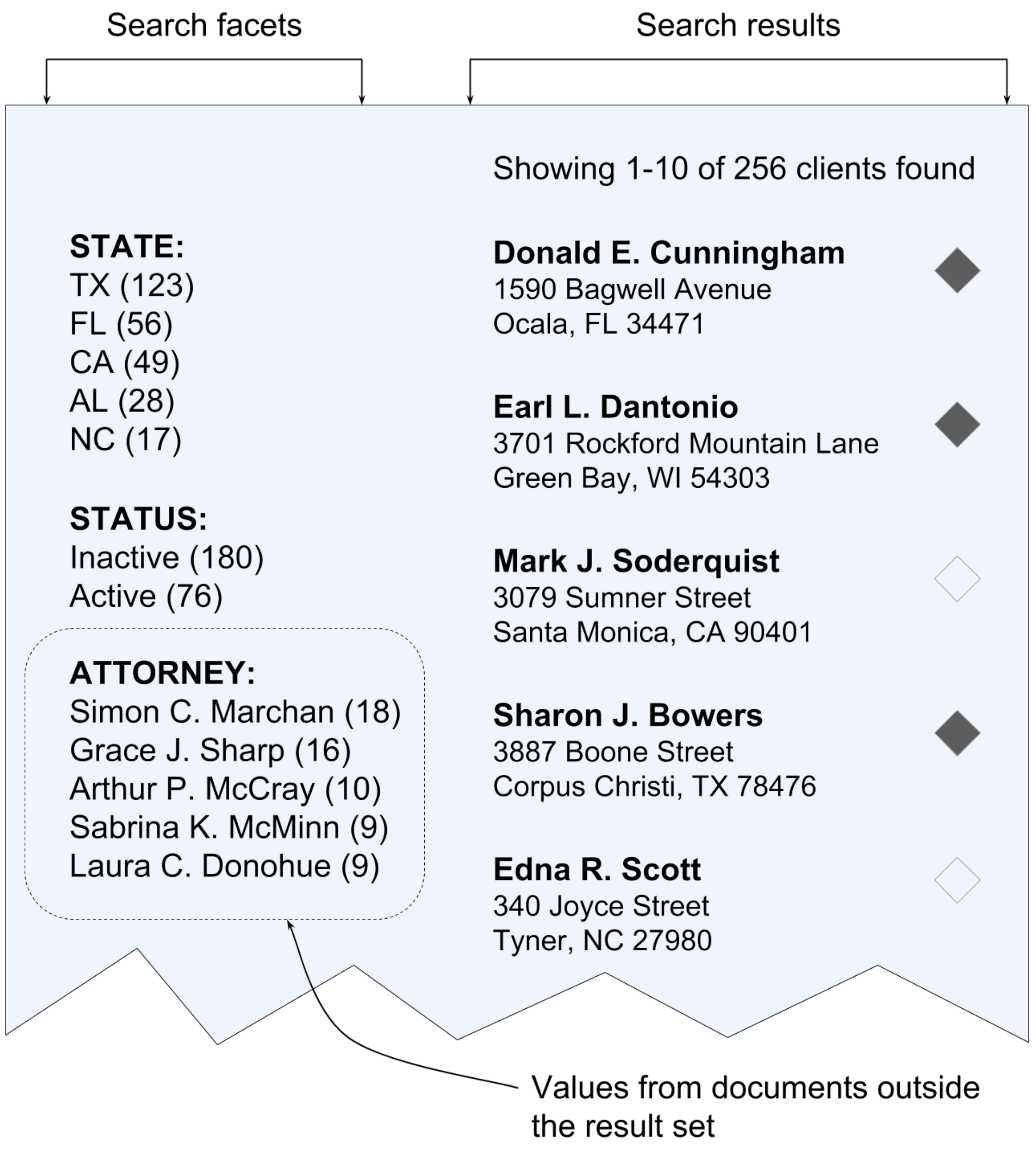
- *Single document-scoped query*
- *Join eliminated*
- *Indexable!*

```
<attorney id="498456"
   firstName="Erin" lastName="Baily">
   <address> … <state>NY</state> … </address>
   <ref:copies>
      <client id="112345"
         firstName="Timothy" lastName="Malone">
         <address> …
            <state>CA</state> …
         </address>
      </client>
      <client id="223456">
      …
   </ref:copies>
</attorney>
```

Automatic denormalization

Read

```
let $client-results := db:implementation-defined(…)
let $client-attorney-refs := $client-results/client-attorney/@idref
return subsequence(
    for $attorney in //attorney[@id = $client-attorney-refs]
    let $count := count($client-results
                        [client-attorney/@idref = $attorney/@id])
    order by $count descending
    return <attorney-facet
              value="{ $attorney/full-name }"
              count="{ $count }" />,
   1, 5)
```



Search facets

Search results

Showing 1-10 of 256 clients found

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TX (123)
FL (56)
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Inactive (180)
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Corpus Christi, TX 78476

Edna R. Scott ◇
340 Joyce Street
Tyner, NC 27980

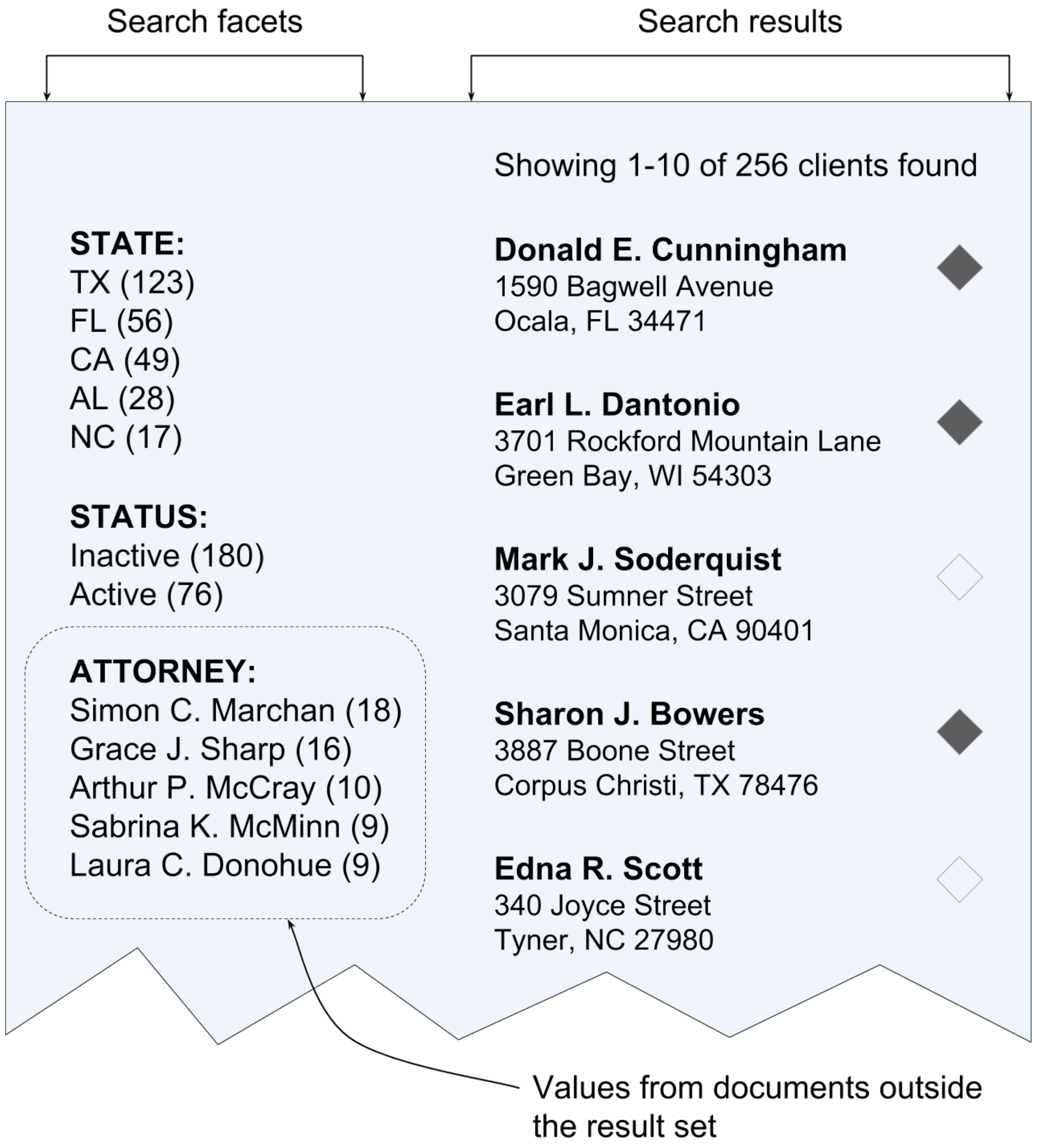
Values from documents outside the result set

Automatic denormalization

Read

```
let $client-results := db:implementation-defined(...)
return subsequence(
   for $attorney-id in distinct-values($client-results//attorney/@id)
   let $count := count($client-results[//attorney/@id= $attorney-id])
   order by $count descending
   return <attorney-facet
               value="{ $attorney/full-name }"
               count="{ $count }" />,
   1, 5)
```

- *Single document-scoped query*
- *Join eliminated*
- *Even more indexable....*



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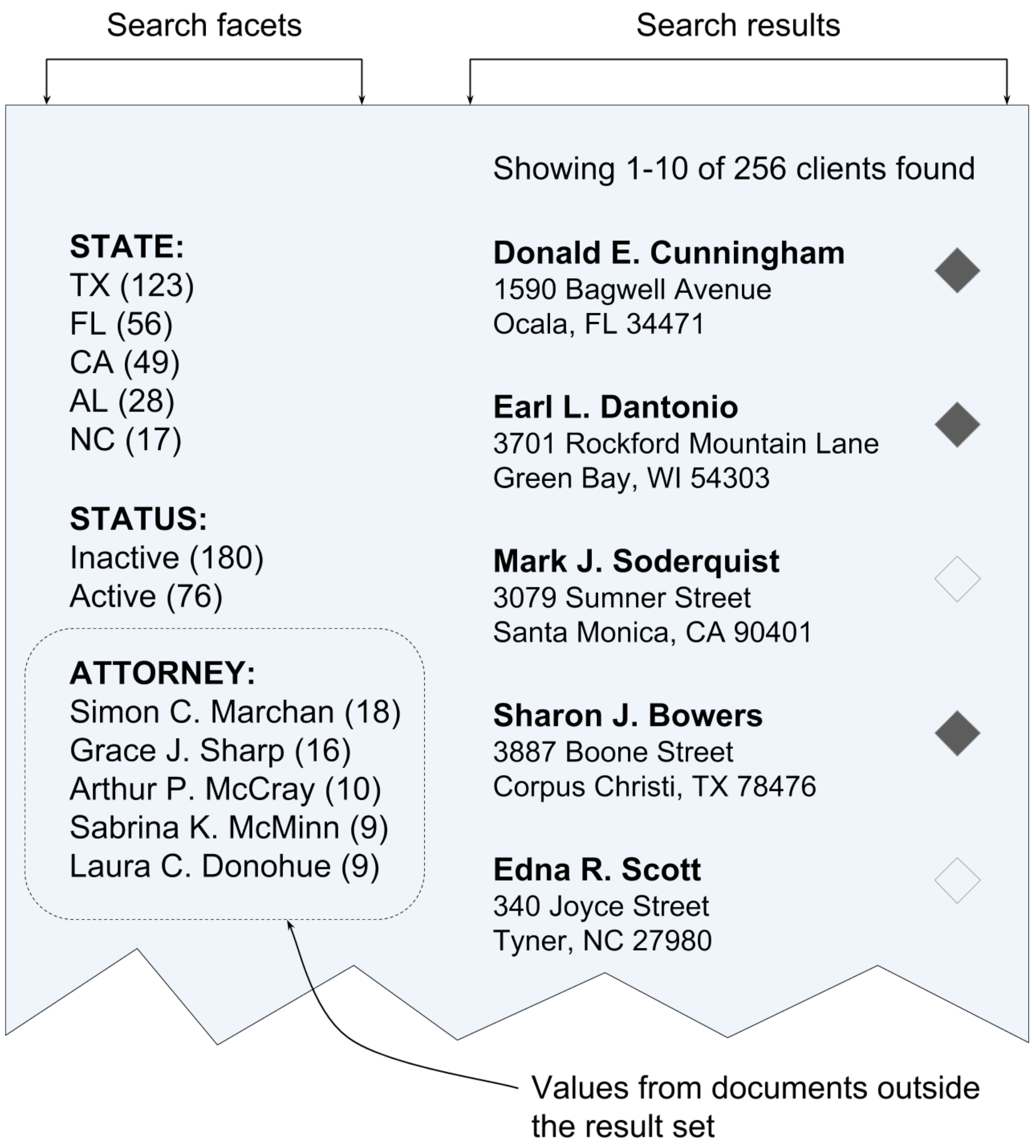
Values from documents outside the result set

Automatic denormalization

Read

```
let $client-results := db:implementation-defined(...)
return subsequence(
   for $attorney-id in distinct-values($client-results//attorney/@id)
   let $count := count($client-results[//attorney/@id= $attorney-id])
   order by $count descending
   return <attorney-facet
               value="{ $attorney/full-name }"
               count="{ $count }" />,
   1, 5)
```

- *Single document-scoped query*
- *Join eliminated*
- *Even more indexable….*
  Get values directly from index!



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Corpus Christi, TX 78476

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340 Joyce Street
Tyner, NC 27980

Values from documents outside the result set

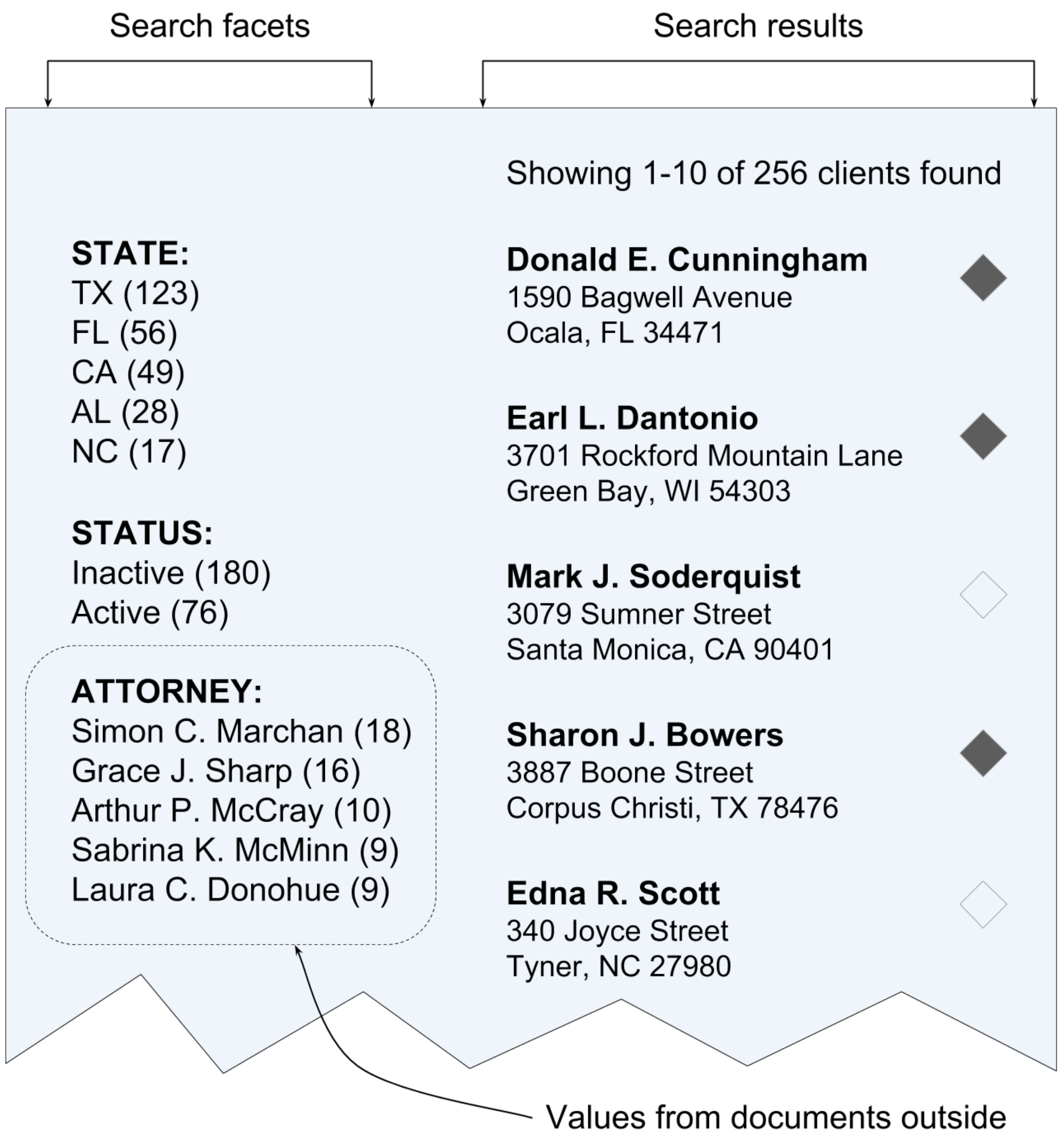
Automatic denormalization

Read

MarkLogic

```
let $client-results := db:implementation-defined(...)
let $facets := cts:values(
    cts:path-reference("/ref:copies/attorney/full-name",
    (), "limit=5", $client-query)
for $f in $facets
let $count := cts:frequency($f)
order by $count descending
return <attorney-facet value="{ $f }" count="{ $count }" />
```

- *Single document-scoped query*
- *Join eliminated*
- *Even more indexable….*
  Get values directly from index!



Search facets

Search results

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Corpus Christi, TX 78476

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340 Joyce Street
Tyner, NC 27980

Values from documents outside the result set

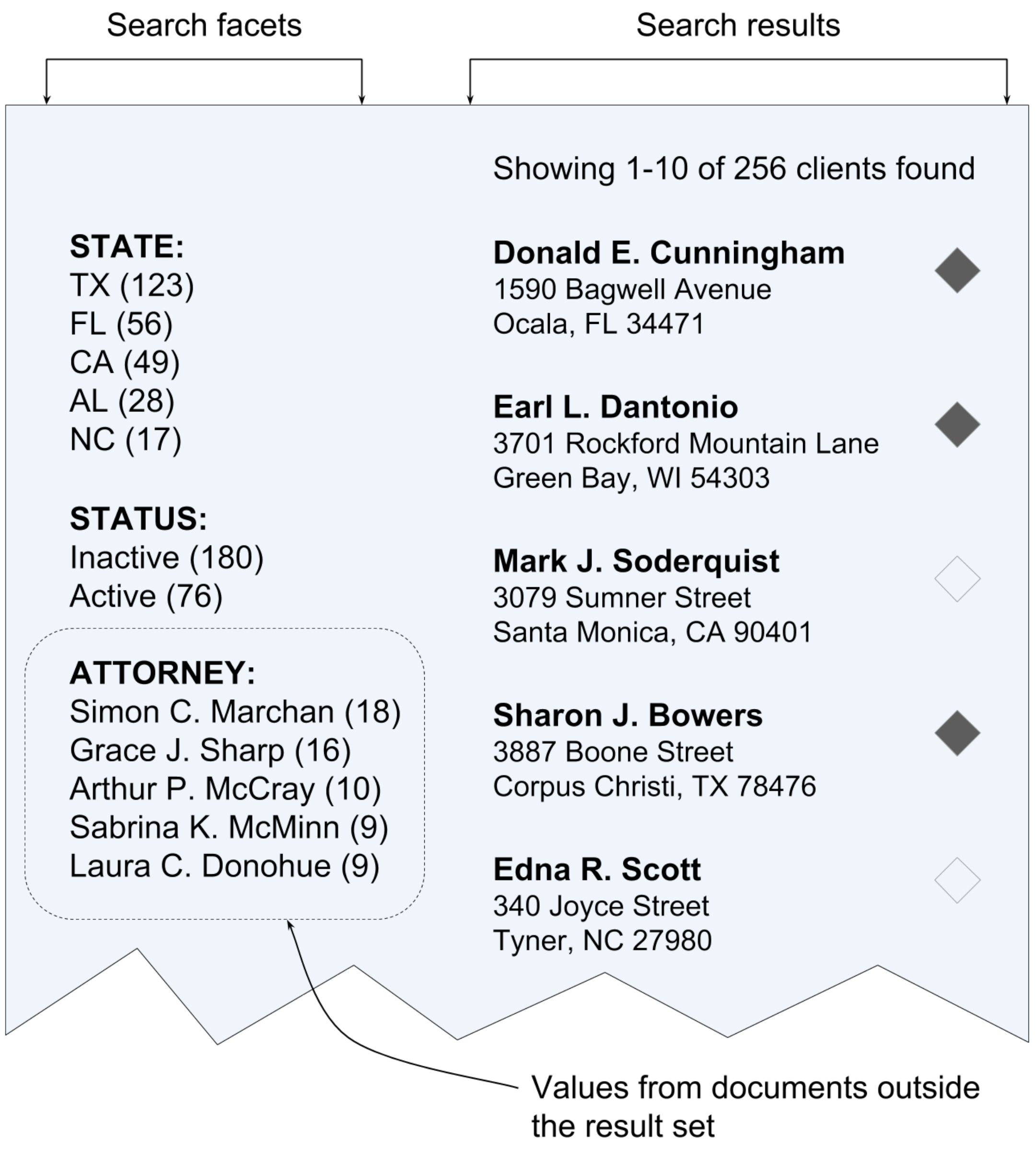
Automatic denormalization

Read

eXist-db

```
let $client-results := db:implementation-defined(...)
let $facets :=
   util:index-keys($client-results/ref:attorney/full-name, (),
      function($key, $count) {
         <attorney-facet value="{$key}" count="{$count[2]}" />
      }, 5, "lucene-index")
for $f in $facets
order by $f/@count
return $f
```

- *Single document-scoped query*
- *Join eliminated*
- *Even more indexable....*
  Get values directly from index!



Search facets

Search results

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STATE:
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Values from documents outside the result set

Automatic denormalization

Caveats : Relationship-heavy workloads and/or update-heavy workloads

High frequency updates

High number of relationships per document

Overlapping relationships

- *Additional write lock contention*

Automatic denormalization

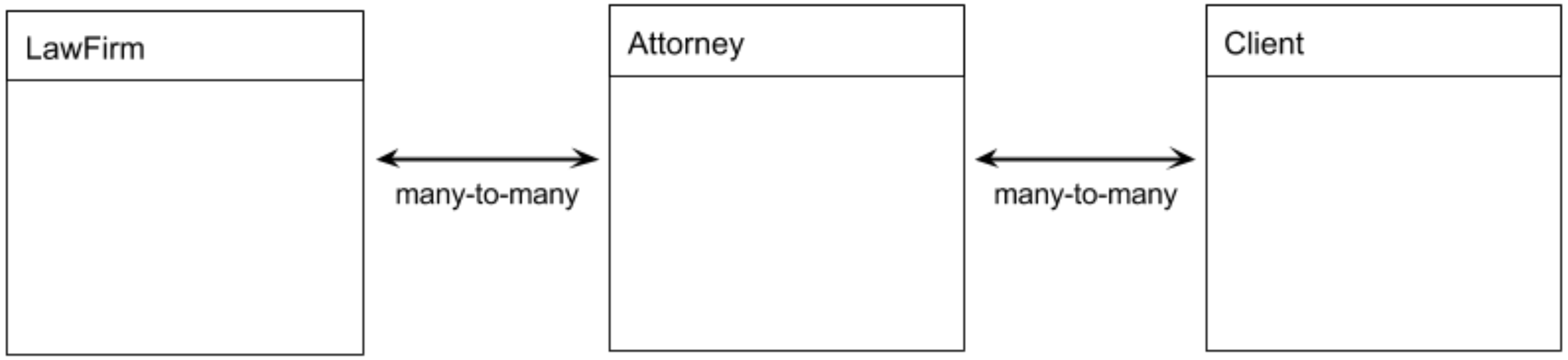
Caveats : Relationship-heavy workloads and/or update-heavy workloads

- *High frequency updates*
- *High number of relationships per document*
- *Overlapping relationships*
  - *Additional write lock contention*

YOU'RE GONNA HAVE A BAD TIME

Automatic denormalization

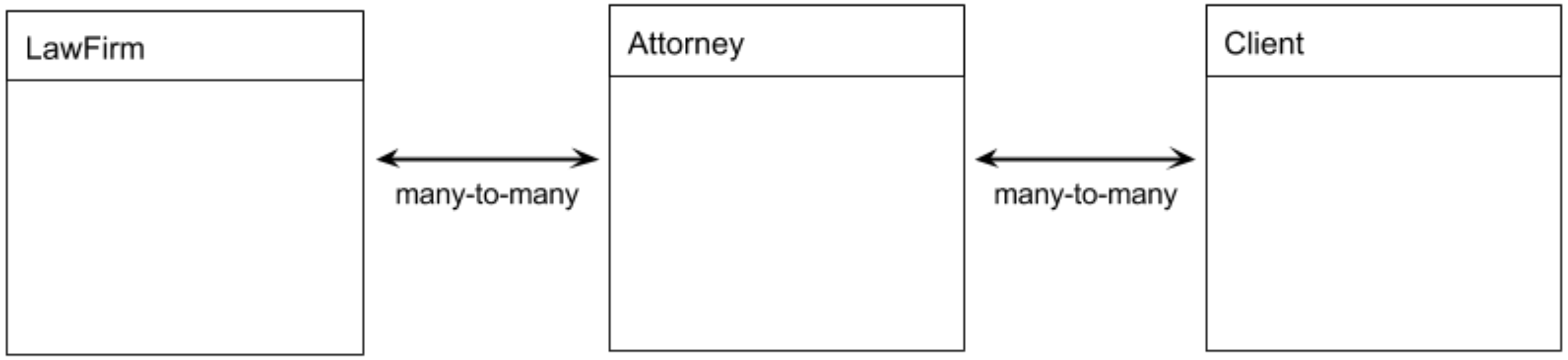
Caveats : **Only recommended for two-way joins**



- *Possible to support 3 (or more)-way joins*
- *Combinatorial explosions*

Automatic denormalization

Caveats : Only recommended for two-way joins



- *Possible to support 3 (or more)-way joins*
- *Combinatorial explosions*

YOU'RE GONNA HAVE A BAD TIME

Automatic denormalization

Extensions and Optimizations :

Sparse entity copy transformation

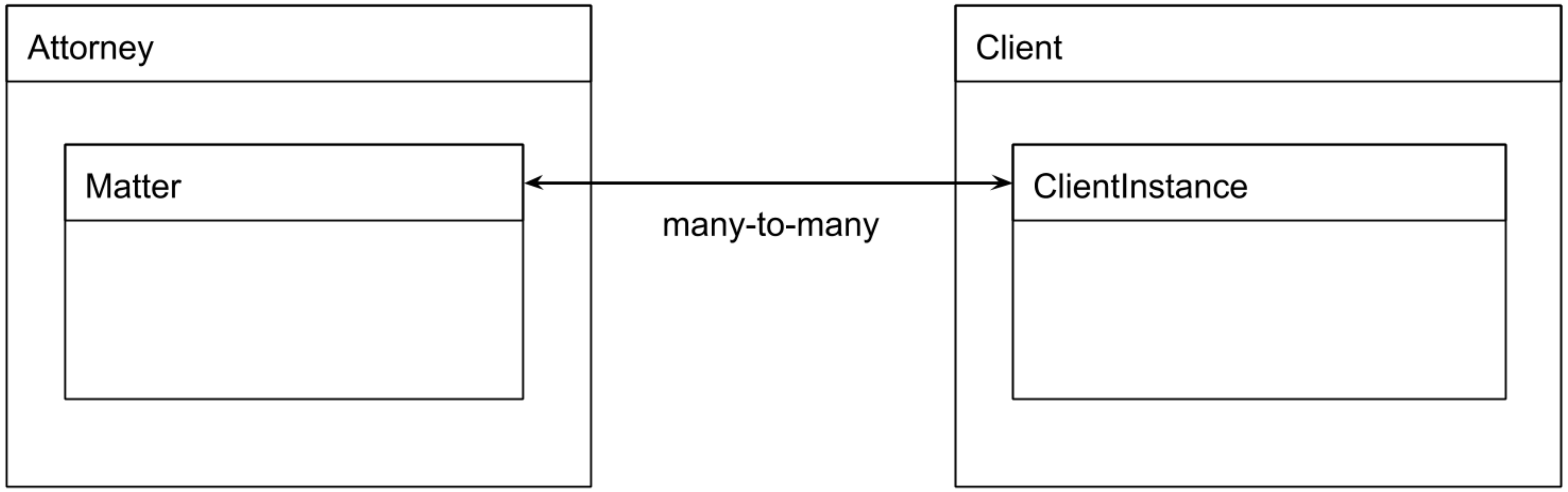
- *Extend transformation to exclude parts of copy*
- *Simple to follow rules based on:*
    - *containing entity*
    - *copied entity*
    - *combination*
- *Simplify documents*
- *Decrease update commit overhead*

```
declare function ref:make-copy(
  $source as element(),
  $target as element()
) as element()
{
    typeswitch($source)
    (: Rules based on copied entity :)
    case element(attorney) | element(client) return
      From: Attorney or Client + To:Anything rules
    case element(matter) return
      (: Combination rules :)
      typeswitch($target)
      case element(client) return From:Matter + To:Client rules
      default return From:Matter + To:Not-Client rules
    default return
      typeswitch($target) return
      (: Rules based on containing entity :)
}
```

Automatic denormalization

Extensions and Optimizations :

Entities and sub-entities

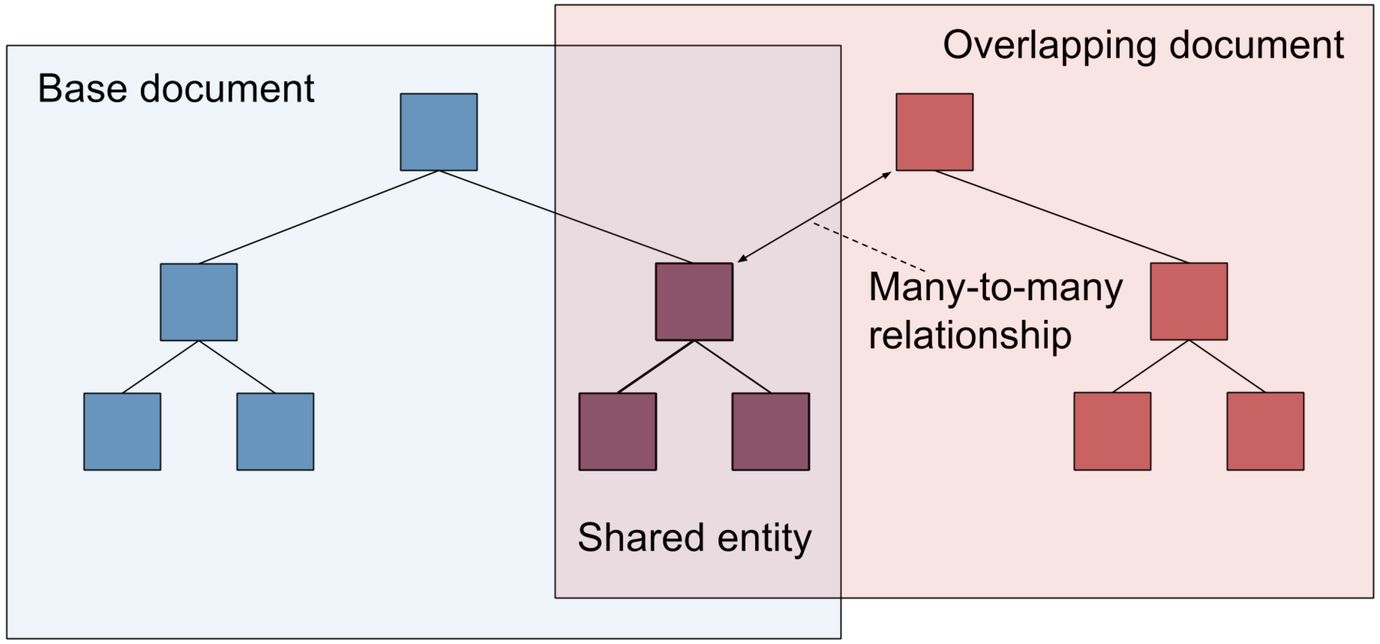


- *More idiomatic*
- *More flexible*
- *Propagate ancestor/descendant data via entity copy transformation updates*

Automatic denormalization

Extensions and Optimizations :

Overlapping documents



- *One tree modeled as "base" document*
- *Overlapping documents modeled using many-to-many relationship*
- *After denormalization, all documents are completely coherent*

Automatic denormalization

Extensions and Optimizations :

Nearline reference updates

Update queue	*Commit canonical document update* *Queue denormalized copy update*
Allows dirty reads	*"Eventually consistent"*
Tunable queue	*More control over resource utilization*

Automatic denormalization

Conclusions

XML databases are great if you need XML (or JSON)	*No database is a panacea*
More complex models will require trade-offs	*Automatic denormalization patterns are a good bet for many-to-many relationships*
‣ ***Simple*** ‣ ***Eliminates runtime dependencies*** ‣ ***Faster to code, faster to query***	*Application relationship size and update behavior can break it*
Not in production...still testing	*No real-world data yet*