Legal Requirements: From Theory to Practice

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IFIP WG2.9 Talk Outline

next: research setup

(1) Research Setup

- Problem and motivation
- Background
- Research methodology

(2) Acquisition

- Types of legal statements
- Identifying requirements
- Standard upper ontology
- Frame-based method

(3) Formalization

- Stakeholder/ Goal hierarchies
- Catalogue of constraints
- Priority hierarchies

(4) Specification

- Requirement metrics
- Refinement patterns

Problem and Motivation

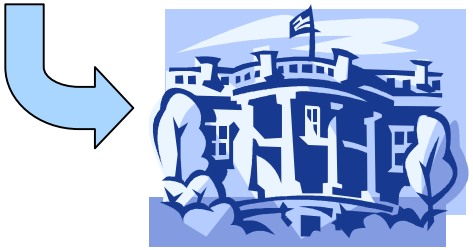
- Health Insurance Accountability and Portability Act (HIPAA) Privacy Rule governs access to medical information
- HIPAA is limited to electronic patient health information
- HIPAA Privacy Rule affects 545,000 establishments who employ 13.5M people
- Projected HIPAA compliance costs: $12-$42B

In software engineering, verification begins by understanding the software requirements

Background

laws, regulations and standards

U.S. Congress ratifies legislation (statutes)



Executive branch agencies (FAA, FDA, FTC, HHS) create regulations (rules)

Industry creates standards that support regulations
Industry and government perform regulatory audits

U.S. Federal courts decide:
(1) industry compliance with regulations
(2) regulatory compliance with statutes
(3) statutory compliance with the Constitution

Background

characteristics of legal requirements

- Legal requirements are never reworded – they may only be interpreted, refined or superseded
- The meaning of compliance and enforcement for each requirement is subject to change
- Legal requirements are reusable across industries

Background

defining legal compliance

- *Compliance* means to maintain a defensible position in a court of law
- *Due diligence* refers to reasonable efforts that persons make to satisfy legal requirements or discharge their legal obligations
- *Standard of care* means "under the law of negligence or of obligations, the conduct demanded of a person in a situation; typically, this involves a person giving attention both to possible dangers, mistakes and pitfalls and to ways of minimizing those risks."

Black's Law Dictionary, 8th ed.

Research Methodology

- Exploratory case studies [Yin 2003]
- Constructivist and pragmatist knowledge claims [Creswell 2003]
- Grounded theory [Glaser and Strauss 1967]
- Pattern-matching to formulate propositions [Campbell 1966]

Research Methodology

research questions

- **RQ1**: What types of legal requirements exist in policies and regulations?
- **RQ2**: What inferences must engineers make to account for these requirements?
- **RQ3**: How do practitioners manage conformance with legal requirements?

Research Methodology
domains and phenomena

- (**Privacy**) Use and disclosure of patient medical information
  - Health Insurance Portability and Accountability Act (HIPAA) of 1996
  - Gramm-Leach-Bliley Act (GLBA) of 1999
  - Stakeholder focus
- (**Accessibility**) Access by individuals with disabilities
  - Section 508, as amended in the Workforce Investment Act of 1998
  - Product focus

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Types of Legal Statements

Statements about actions that a stakeholder or product is…

- Permitted to perform (**Permission**)
- Required to perform (**Obligation**)
- Required to *not* perform (**Refrainment**)
- Not expressly permitted or required to perform (**Exclusion**)

Definition is a statement that restricts the meaning of a term by one or more constraints

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Identifying Legal Requirements – 2

marking rights, obligations and constraints

1) The covered entity who has a direct treatment relationship with the individual **must**…

   a) Provide notice no later than the first service delivery;

2) For the purposes of paragraph (1), a covered entity who delivers services electronically **must** provide electronic notice **unless** the individual requests to receive a paper notice.

Obligations are red;

Constraints are underlined; and

Modal/ condition keywords are **bold**.

From HIPAA §160.520(c)(2)-(3).

2006 IEEE RE

Identifying Legal Requirements – 3

extracting rights, obligations and constraints

1) [O_1] The covered entity [C_1] who has a direct treatment relationship with the individual **must**…

   a) Provide notice [C_2] no later than the first service delivery;

O_1: The covered entity **must** provide notice *to the individual*. **(1)(a)**; [$C_1 \wedge C_2$]

C_1: The covered entity has a direct treatment relationship with the individual. **(1)**

C_2: The notice is provided no later than the first service delivery. **(a)**

Identifying Legal Requirements – 4

negating constraints for exceptions

2) For the purposes of paragraph (1), [O_2] a covered entity [C_3] who delivers services electronically **must** provide electronic notice **unless** [C_4] the individual requests to receive a paper notice.

O_2: The covered entity **must** provide electronic notice *to the individual*. **(2)**: [$C_3 \wedge \neg C_4$]

C_3: The covered entity delivers services electronically *to the individual*. **(2)**

C_4: The individual requests to receive a paper notice. **(2)**

Identifying Legal Requirements – 5

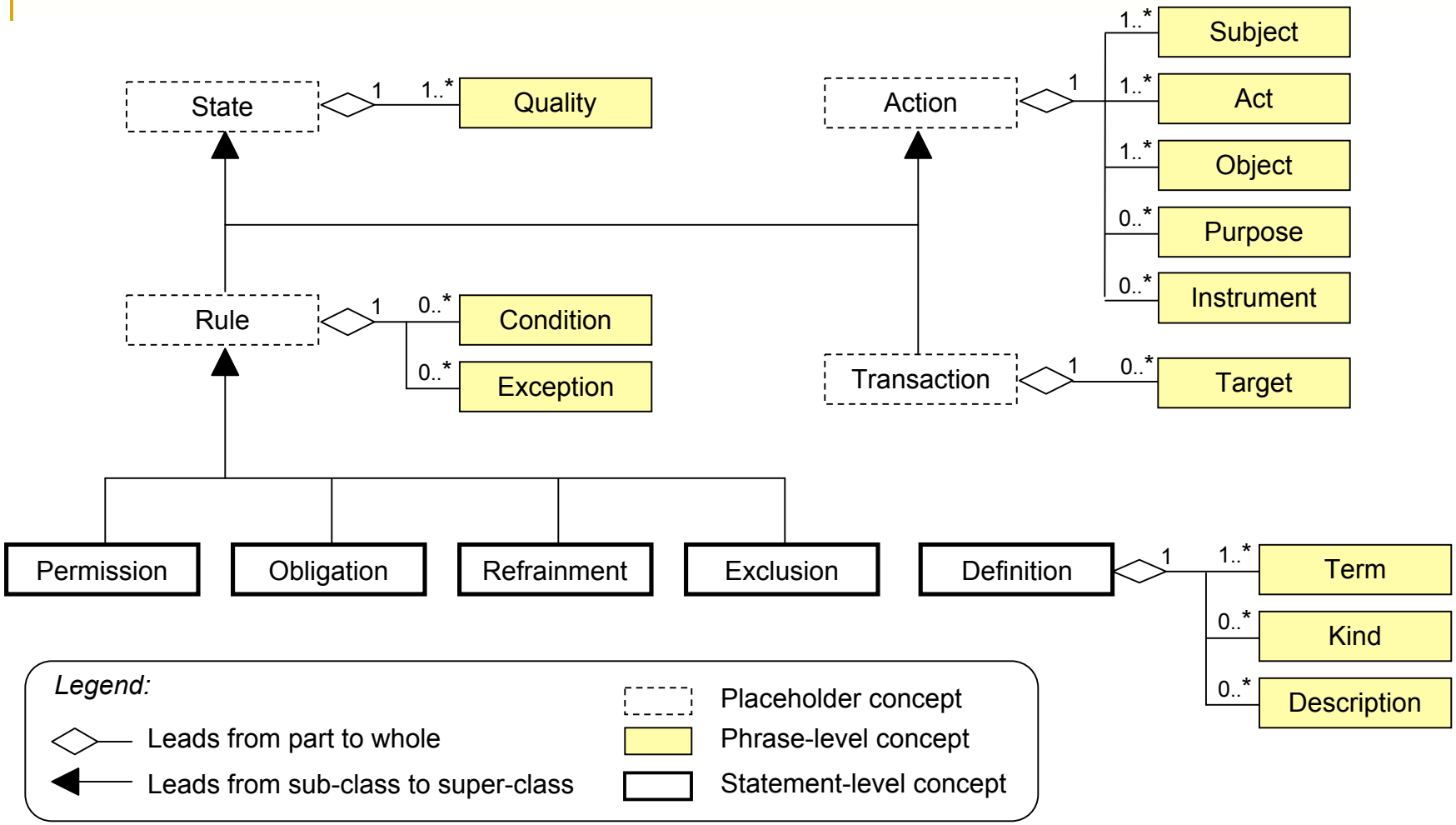
interpreting constraints across contexts

1) [O_1] The covered entity [C_1] who has a direct treatment relationship with the individual **must**…
   a) Provide notice [C_2] no later than the first service delivery;
2) For the purposes of paragraph (1), [O_1] a covered entity [C_3] who delivers services electronically **must** provide electronic notice **unless**… [C_4]

- From paragraph (1) we extracted O_1: [$C_1 \wedge C_2$]
- Now we carry down C_1 and C_2 from paragraph (1) to yield O_2: [$C_1 \wedge C_2 \wedge C_3 \wedge \neg C_4$]

Standard Upper Ontology

for legal requirements



Identifying Legal Requirements – 1

phrase heuristics

Phrase Pattern	Concept	Phrase Pattern	Concept
if	Condition	must deny*	Obligation
when	Condition	must permit*	Obligation
except when	Exception	must request*	Obligation
is not required to	Exclusion	has a right to	Permission
may not	Obligation	may	Permission
may not require*	Obligation	may deny*	Permission
must	Obligation	may require*	Permission

**These patterns denote delegations.*

Frame-based Requirements

the tabular format

Record Number: **O-520.7**	
Property	**Value**
Subject	Covered Entity
Subject	Who has a direct treatment relationship with the individual
Modality	Obligation
Action	Provide
Object	Notice
Condition	No later than the first service delivery

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Frame-based Markup

1) [#O [#s The covered entity & who has a direct treatment relationship with the individual] must…
   a) [#a Provide] [#o notice] [#c/1 no later than the first service delivery]];
2) For the purposes of paragraph (1), [#O [#c *1] [#s a covered entity & who delivers services electronically] must [#a provide] [#o electronic notice] [#e unless…]]

Markup provides…

- Improved traceability
- Operators for cut, copy and paste of legal phrases

IFIP WG2.9 Talk Outline

next: formalization

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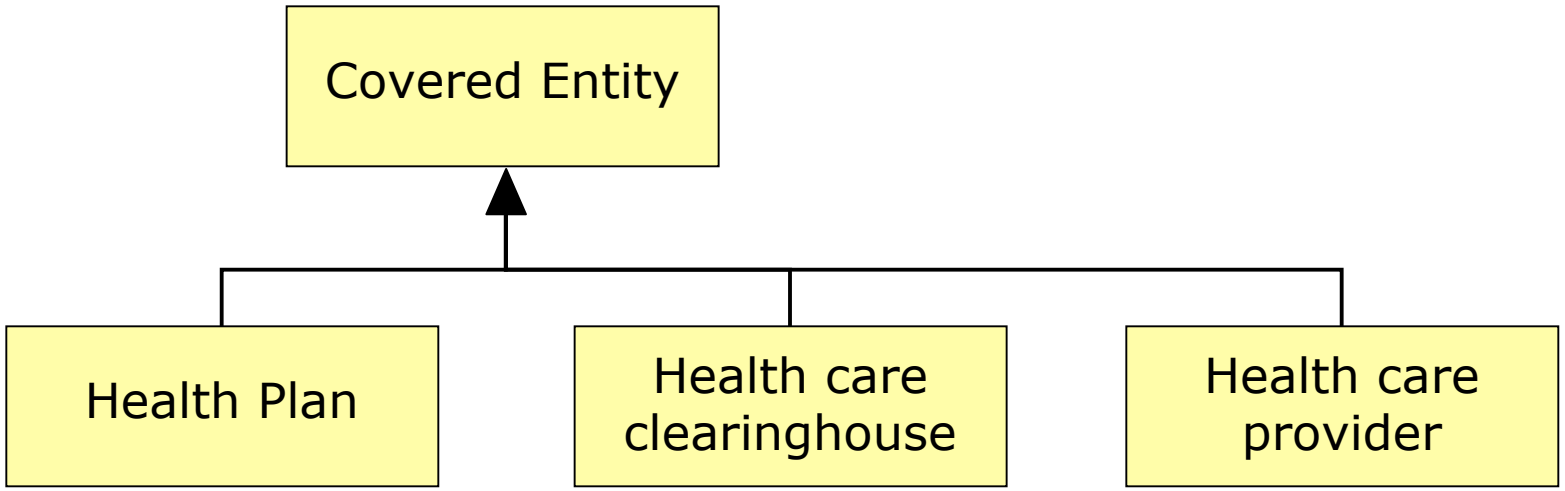
Stakeholder Class Hierarchy – 1

HIPAA §160.103: Covered entity means: a health plan, a health care clearinghouse and a health care provider who transmits any health information in electronic form in connection with a transaction covered by this subchapter.



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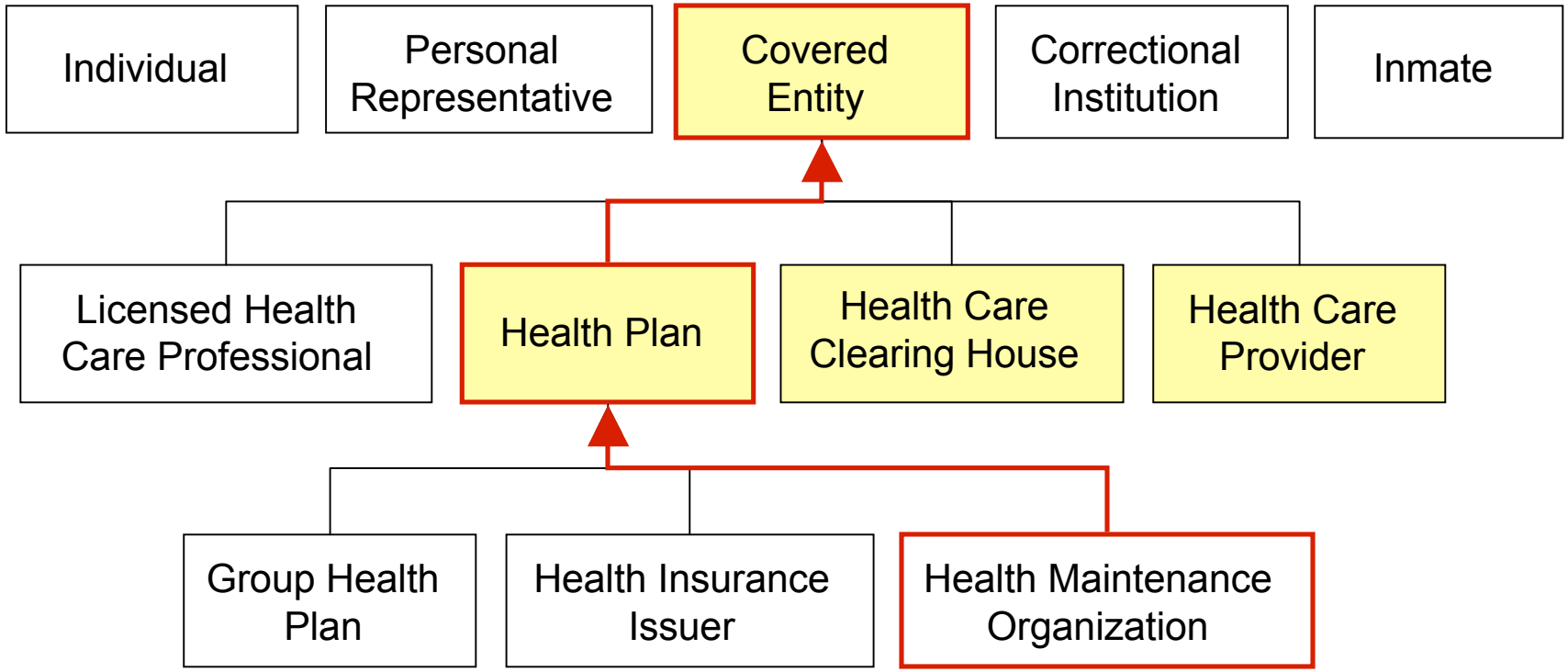
Stakeholder Class Hierarchy – 2

multiple definitions and transitivity

- Stakeholders must satisfy all of the obligations in their classification hierarchy.



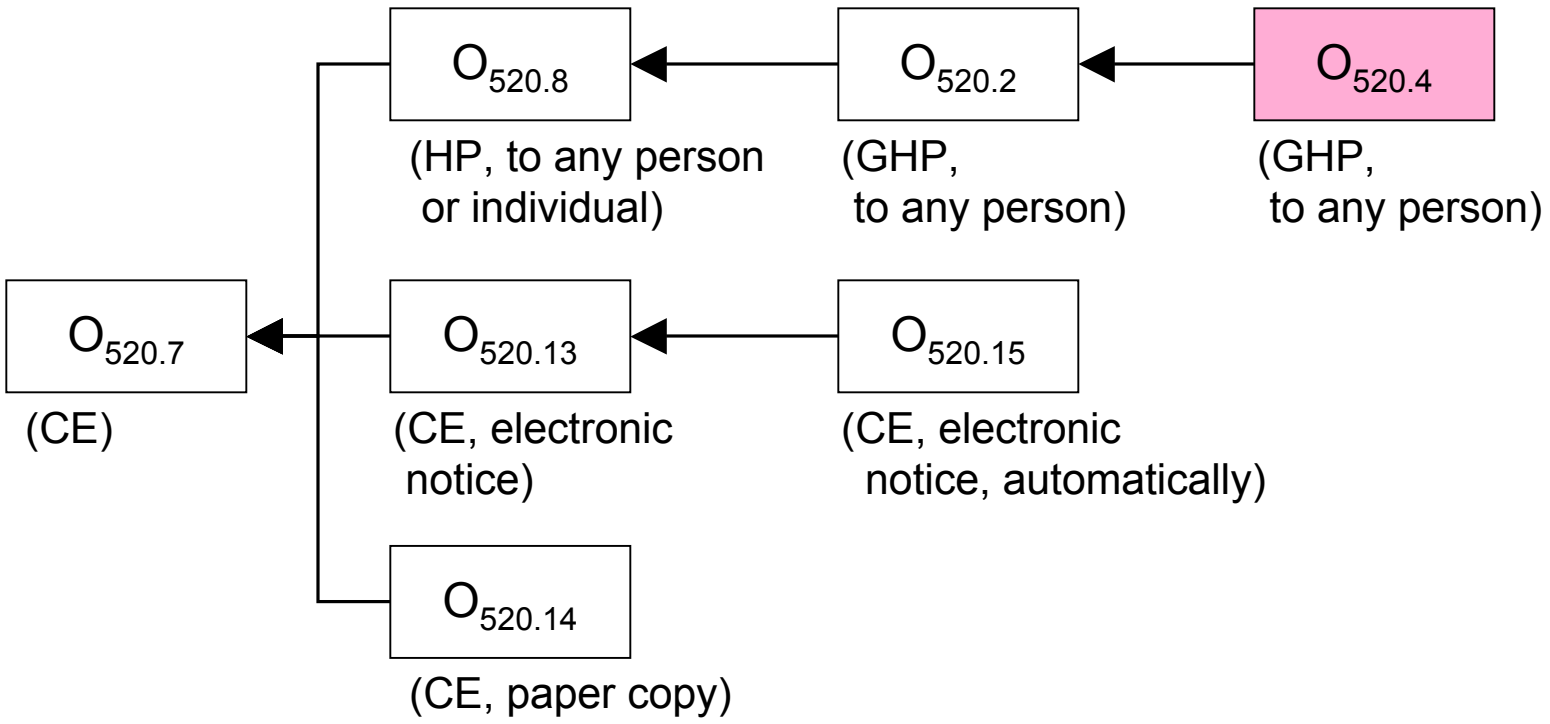
Goal Specialization Hierarchy – 1

- Show Description Logic formula

(To Appear) 2009 ACM TOSEM

Goal Specialization Hierarchy – 2

- Under what constraints must a stakeholder provide what type of notice to whom?



(To Appear) 2009 ACM TOSEM

Catalogue of Constraints

- Identified over 300 information access requirements (legal uses and disclosures)

Constraints on Information Access	Total
Legal Determinations	231
Medical Determinations	184
Personal Beliefs	71
Contractual Statements	170
Data Subjects	42
Data Purposes	389

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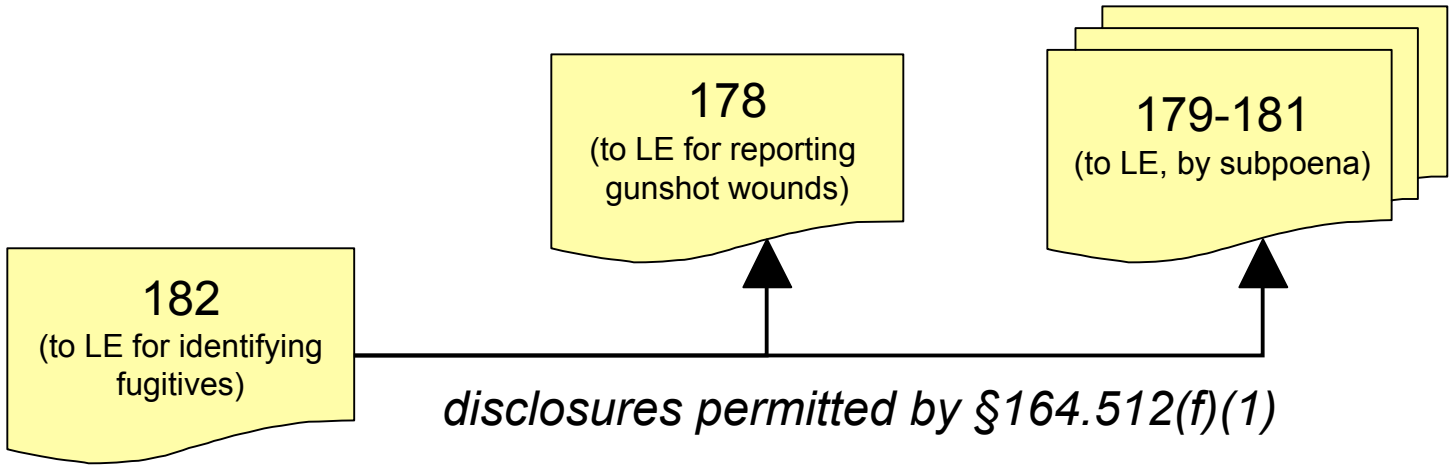
Beliefs, Determinations, Statements

constraints on use and disclosure

1. **Constraints on the user, discloser or recipient**
   a. (Beliefs) Who determines the consent of the individual is inferred from the circumstances.
   b. (Legal) Who has lawful custody of an inmate or individual.
   c. (Medical) Who determines the individual is incapacitated.
2. **Constraints on data subjects**
   a. About individuals who are Armed Forces personnel.
3. **Constraints on data purposes**
   a. (Explicit) For marketing.
   b. (Inferred) Which is compiled for use in a civil, criminal or administrative proceeding

Priority Hierarchies – 1

HIPAA §164.512(f)(2): *Except for disclosures required by law as permitted by paragraph 164.512(f)(1),* a covered entity may disclose PHI in response to a law enforcement (LE) official's request for the purpose of identifying or locating a suspect



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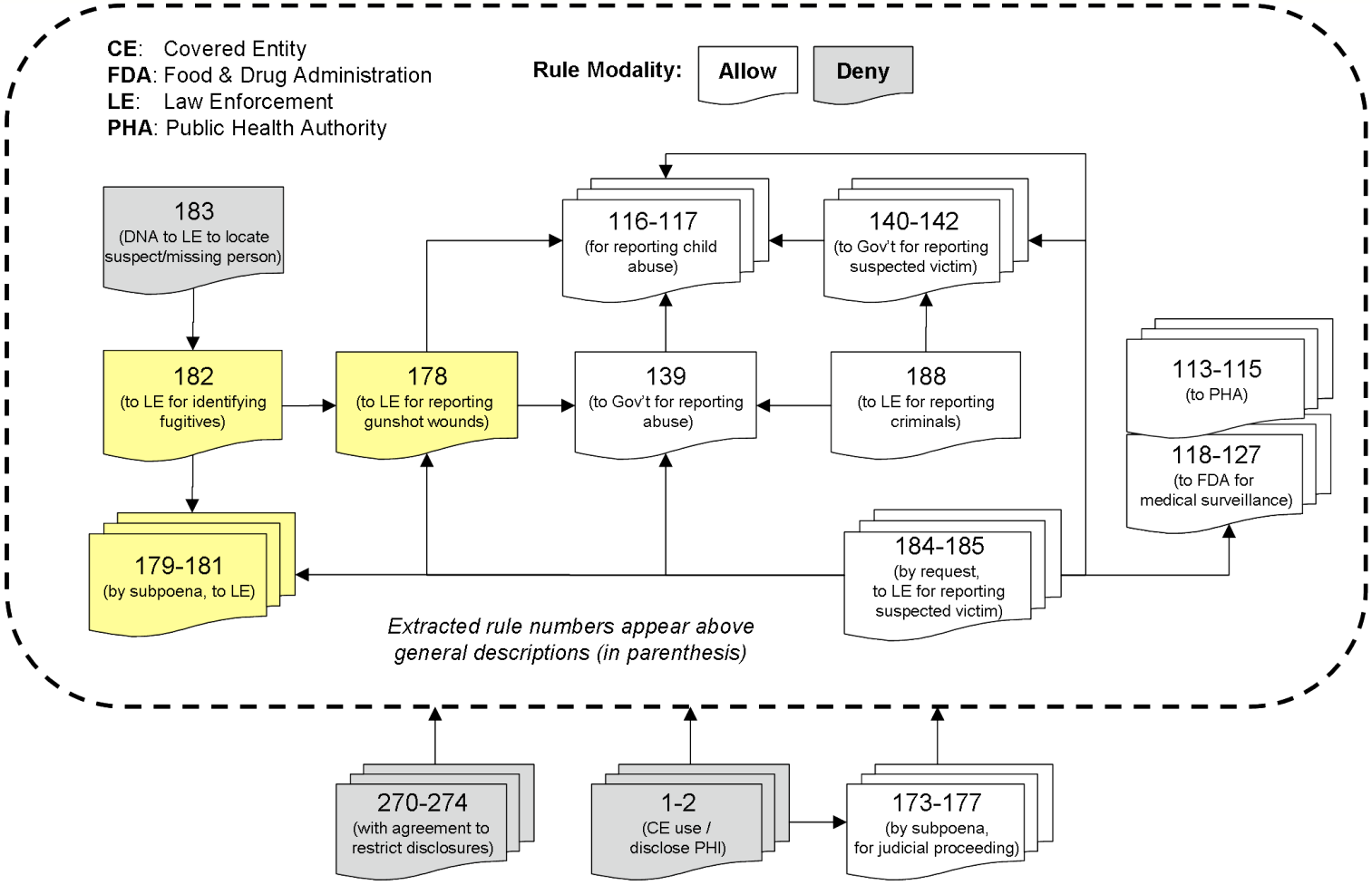
Priority Hierarchies – 2



Experimental Evaluation

- **Hypothesis**: The formal artifacts (stakeholder, priority hierarchies, etc.) improve requirements comprehension when deciding applicable jurisdiction.

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Requirements Specification

identifying compliance gaps

- Compared 389 Cisco product requirements to 141 NCSU legal requirements
- In this study, a "gap" refers to both:
  - A mapping between a product requirement and a paragraph reference in a regulation
  - A difference in semantics between two requirements

In Submission to 2008 IEEE RE

Requirements Metrics

statement metrics

- **NCSU O-29**: PROVIDE textual information through operating system functions for displaying text.
- **Cisco SW-50.11 (M2)**: Draw text using the standard function calls
- **Cisco SW-50.11 (M3)**: Use standard functions to copy or erase text and graphics.

Metric	A #	B #
S-E (Equivalent)	NCSU O-29	Cisco-SW-50.11 (M2)
S-G (Goal)	NCSU O-29	Cisco SW-50.11 (M3)

Requirements Metrics

phrase metrics

- **NCSU O-29**: PROVIDE textual information through operating system functions for displaying text.
- **Cisco SW-50.11 (M2)**: Draw text using the standard function calls

Metric	NCSU O-29	Cisco SW-50.11 (M2)
P-R	provide	draw
P-R	textual information	text
P-G	operating system functions for displaying text	standard function calls

Experimental Evaluation

- **Hypothesis**: What factors (domain knowledge, interests, etc.) influence agreement between analysts who apply the metrics?

- Are there strong correlations between applications of statement and phrase metrics?

Requirements Refinement Patterns

- A *refinement pattern* is a structure that an analyst applies to a legal requirement to yield a new legal, policy or product requirement

Example patterns:

- Balancing rights and obligations
- Removing pre-conditions (simplification)
- Refine by refrainment (clarification)
- Broadly applying the regulatory goal (innovation)

Balancing Rights and Obligations

delegations, transactions, purposes

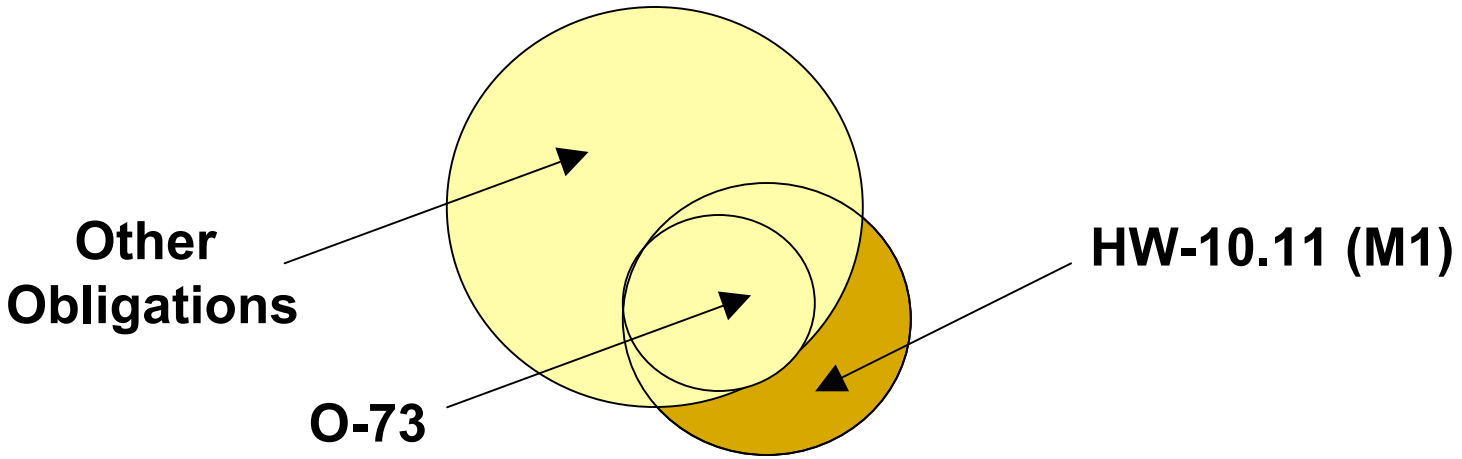
- The CE **requires** the individual to request an amendment in writing.
  - **(implied obligation)** The individual **must** request an amendment in writing.
- The individual **has a right to** receive notice.
  - **(implied obligation)** The CE **must** provide the notice.
- The CE **must** post the notice for the individual to read.
  - **(implied right)** The individual **has a right to** read the notice.

Using formal models of rights and obligations, we can infer rights from obligations and vice versa.

Removing Pre-conditions

simplifying compliance

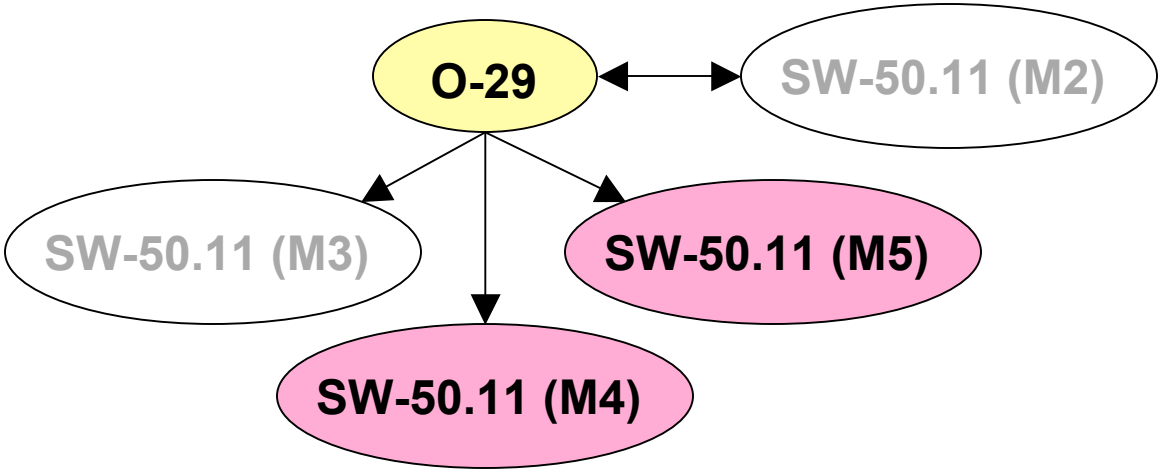
- **NCSU O-73:** OPERATE telecommunications products, which have mechanically operated controls or keys, with one hand…
- **Cisco HW-10.11 (M1):** All physical controls must be activated by one hand…



Refine by Refrainment

clarifying compliance

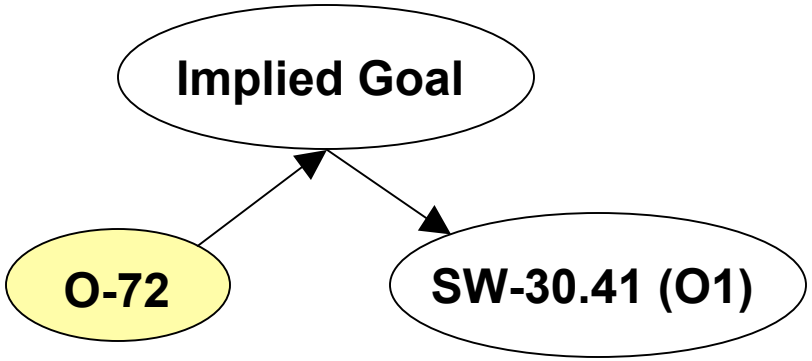
- **NCSU O-29**: PROVIDE textual information through operating system functions for displaying text
- **Cisco SW-50.11 (M4):** Avoid directly manipulating bitmaps
- **Cisco SW-50.11 (M5):** Avoid directly modifying the screen



Broadly Applying the Goal

innovating under the law

- **NCSU O-72**: Controls and keys shall be tactilely discernible without activating the controls or keys
- **Legal Goal (implied by O-72):** Provide methods for I/O that are discernable under limited sense and mobility
- **Cisco SW-30.41 (O1):** Design the default set of tones so that each tone is as distinct and intelligible as possible



Related Work

- **Natural Language Requirements Analysis**
  [Goldin and Berry 1994; Overmyer et al. 2001; Cysneiros and Leite 2004; Wasson 2006]
- **Extracting Models from Regulations**
  [Kerrigan and Law 2003; May et al. 2005; Lee et al. 2006; Dinesh et al. 2006]
- **Goal-oriented Requirements Engineering**
  [Dardenne et al. 1993, Anton 1997; Potts et al. 2004, Breaux et al. 2005]
- **Frame-based representations**
  [Fillmore 1967; Misky 1975; Schank and Abelson 1977]

Feedback and Questions?

- T.D. Breaux, A.I. Antón. “Analyzing regulatory rules for privacy and security requirements” Appears in the *IEEE Transactions on Software Engineering*, v. 34, n. 1, pp. 5-20, January 2008
- T.D. Breaux, A.I. Antón, J. Doyle. “Semantic parameterization: a conceptual modeling process for domain descriptions” To Appear: *ACM Transactions on Software Engineering Methodology*, April 2009 (tentative)
- T.D. Breaux, A.I. Antón, K. Boucher, M. Dorfman, “Legal requirements, compliance and practice: a case study in accessibility” In Submission: *IEEE International Conference on Requirements Engineering*, 2008.