Spatial Representation of Property Rights
Considerations of Doxastic & Epistemic Systems

Term paper for GEOG495 B&M: GIS and Society

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Abstract

Rights of a person or an entity is an extremely contentious term in most contexts. For they are seldom delineated elaborately and exhaustively. They depend upon implicit social norms such as power mechanisms, notions of social good etc. and on explicit, often ambiguous, legislations and doctrines. Thus, almost every land use right is fundamentally dependent on its location in a space-time continuum. This paper aims to explore how different belief and knowledge systems along with ethics of obligation and permission, compulsorily constrain the way in which property rights of an individual and entities can be represented spatially and visualised. It will also argue that the changes in rights with time poses special problems that need to be considered. It will claim that GIS with its emphasis on McHargian overlays is extremely limited to deal with the complexity, in different scales, from a cadastral map to common's land. While the intent is not to suggest a set of comprehensive representative mechanisms that will do justice to all deontic, doxastic and epistemic systems, but to suggest possible directions of research for critical evaluation and debate.

Frontiers are of social, not geographic origin. Only after the concept of a frontier exists can it be attached by the community that has conceived it to a geographical configuration. The consciousness of belonging to a group, a group that includes certain people and excludes others, must precede the conscious claim for that group of the right to live or move about within a particular territory.

Owen Lattimore in *Studies in Frontier History*

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Introduction

Rights of an individual or an entity is nebulous concept. They are explicitly defined by the institutional mechanisms in place, implicitly by the social norms of the context, the beliefs and ethics of individuals, groups and societies. They are constantly changing with the evolution of cultural beliefs, with changes to institutions, to enforcement mechanisms and social responses to the changes in technology. Natural rights, some have argued, is not an viable independent concept, and as such rights have to be discerned and explained only through interactions of the power structures that are in place over them and through capabilities of right holder, in protecting that right. Thus a complete characterisation of rights is almost always never possible.

Property rights are the rights associated with individuals, entities and institutions over natural resources or man-made objects.(we shall ignore the notion of intellectual property for the moment.) The origin of such rights can be linked to formation of reasonably complex social structures and protection and transfer of these rights are crucial duty of "governments" . In a Foucaldian sense these rights invariably establish or reinforce or dramatically alter at times, the power of various classes and groups at different times depending on the set of rights the class, group or the collection of individuals hold and the dynamics of change. In *Property Rights: A Primer* McDowell (1998) lists a few key points about property rights which are illuminative of which I quote some below.

- The economy is an exchange of claims, or property rights, not of things.
- Property rights have their origin in some sense of community or some level of agreement among people.
- Property rights are collectively (publicly) chosen.
- Some property rights are formal, codified in law, administrative rules, and practice. Other property rights are customary, informal, mostly unconscious, and embedded in culture or habit.
- Attributes of things create different types of interdependencies, which lead to different choices of property rights.
- Property rights are needed because people are interdependent and often conflict. Conflicts that arise out of interdependencies among people are influenced, or even partly determined by, people's relationships to things.
- Alternative rights, or institutions, will resolve conflicts in different ways, with different performances and different distribution of costs and benefits.

This paper neither deals with the ethics of holding such rights nor with the class, gender, and societal dynamics that directly reinforce or change these rights. This paper argues that these rights are uniquely contingent on the the qualities of the governance, enforcement practises of the time, of the cultural context, of the spatial location and of the individual beliefs about their capabilities in protecting and propagating these rights. It further argues that a GIS which tends to represent these relationships in a "passive" tone (Rights over X are held by A as opposed to A holds Y rights over X), deliberately misinforms and hence an information

system, albeit in close co-ordination with GIS, should be constructed to allow for the incredible complexity of these rights to be codified, represented and visualised.

This paper attempts to illustrate that a traditional thinking in GIS using overlay analysis and relational tables severely restricts the ability to represent rights. It will illustrate in landed property rights, in interactions of surface and sub-surface rights, where different individuals, entities and organisations are entitled different sets of rights because of historical practises and current property rights regimes. It will try to argue that power or capabilities are conferred and legitimised in traditional maps as well as Geographic and Land Information Systems presents at best a partial view of property rights. This work does not attempt to be a comprehensive evaluation of the characteristics of spatial attributes of rights. It merely serves to point the possible directions of research which might be better justified.

The Question of Rights and Responsibilities

Nozick (1974) in articulating, "constraint based deontology", argues that rights "set the constraints in which social choice is to be made, by excluding certain alternatives, fixing others and so on." Thus rights are a relationship, a capability to act in a certain fashion, sanctioned by the society in place. "Own-labour entitlement" is a right defined through social norms; while "inheritance and transfer entitlement" is typically codified explicitly by regulations, while the content itself is heavily dependent on the cultural norms of the time and place (Sen 1981). Bentham's characterisation of natural rights as "nonsense on stilts" has a particular importance in understanding the nature of institutional mechanisms and in particular regulations that affect the choices we can have in a society. In a trenchant critique of Utilitarianism, Dworkin (1978) argues that rights precede regulations. However in both cases it can be granted that regulations attempt to define or re-define the rights.The set of rights, a role has, over a choice of actions or activities is thus at best ambiguous and certainly not exhaustive. So then rights can be defined as permitted choices of actions available or restrictions thereof. The philosophical question of who derives the authority to constrain these choices of the "regulated" , though a veritable one, is not especially pertinent to this work (see Hurley 1989, Rawls 1993). The acknowledgement that such authority exists and the authority itself is subject to change is, however, very germane. Authority, whether appropriated or delegated, is a right in itself.

Responsibilities are not fundamentally different from rights. Responsibility is a right with a negative pay off (Hopkins 2001). The pay off is not necessarily economic in a traditional sense. By exercising a right we gain certain value, by exercising a responsibility we lose value (time, effort, risk etc.) and ought to be compensated. Collectively as a society we *quid pro quo* responsibilities with rights, to make enforcement easier. Thus a set of rights and responsibilities sets individual and social choices. In a logical sense rights define what one "can do" (permission), responsibilities what one "should do" (obligation).

Explicitly defined rights sometimes have some conformance requirements. That is to say actions are permitted only when they meet certain criteria. For eg. State of Delhi, India, permits alcoholic beverage shop to be setup only when it is not within 75m of any major educational institution or a religious place. Other standard local government regulation that have delineation of rights by specifying permitted actions and standards either the actions or the

results of such actions should satisfy, are the building code requirements, health code requirement for food vending places, bulk-density requirements, performance zoning etc. (Kendig et al. 1980). To represent any rights of establishment of a beverage shop, we should agree upon ontology of not only, what constitutes a "Major educational institution", "a religious place" but also on the ontology of what constitutes spatial or topological relationship (spatial buffer, adjacency etc.). It is also useful to note that it is not only actions but also activities, relationships of the activities and actions to actors and assets that are regulated. In the US, federal or State governments have the sole right of ownership of the land beneath the river. In many developing countries, national governments have the sole right of ownership to the minerals beneath the land.

Not all codified rights, nor all regulations are embodied in text. Maps, for a long time, have been used to define rights, to assert and legitimise them. *Nation states boundaries* define the jurisdiction of the sovereign right of 'the nation'. At a much lesser scale a *Zoning map* for a city is a collection of permitted activities in different parcels. An *Official city* map asserts the City jurisdiction as well as the ownership of "Right of Ways" by the City at a particular time. At different scales, across different jurisdictions, maps of counties, regional authorities, Watershed management agencies etc., use maps to define the authority as well as mandates given to them by other political agencies and agents. Thus all political maps are about beliefs, jurisdictions and regulations.

Land Rights and GIS

Land rights are the most contentious rights in property rights. Until few years ago, it was viewed as one of the prime factors for economic activity. It should come as no surprise then that a precursor to the GIS, the Canadian land information systems was developed to ensure the management of vast rural lands in Canada which led to the formative intellectual development of geographically based information systems. Land information systems should not be merely boundaries, corners, field notes and plats. It involves the notions of rights, tenures of such rights, the nature of transmission of rights, the responsibilities associated with the rights in protecting other right holder's rights.

Although Land is part of human natural heritage, access to land is controlled by ownership patterns. Land is partitioned for administrative and economic purposes, and it is used and transformed in a myriad ways. Typically all Land information systems and cadastral representations of administrative data focussed only on two different entities. One the plat boundaries and other the identity of the owner. This is a result of age old practices of book keeping and enforcement and collection of tax. For an excellent overview of cadastral mapping in the western hemisphere and its colonies see Kain and Baigent (1992). These land records typically would include the plat boundaries, ownership and transfer information (refer to figure 1).

However the land record rights do not include all the information on the notions of rights. For example in figure 2 the coal and oil rights are either leased to private entities or leased under government exploration sites. To depict these rights they are considered overlapping layers of information in a GIS. The use of the multiple layers to depict different rights, for example surface rights, and sub-surface rights is essentially misleading. For example if the Federal government has right to explore oil under the surface of a private property, it will
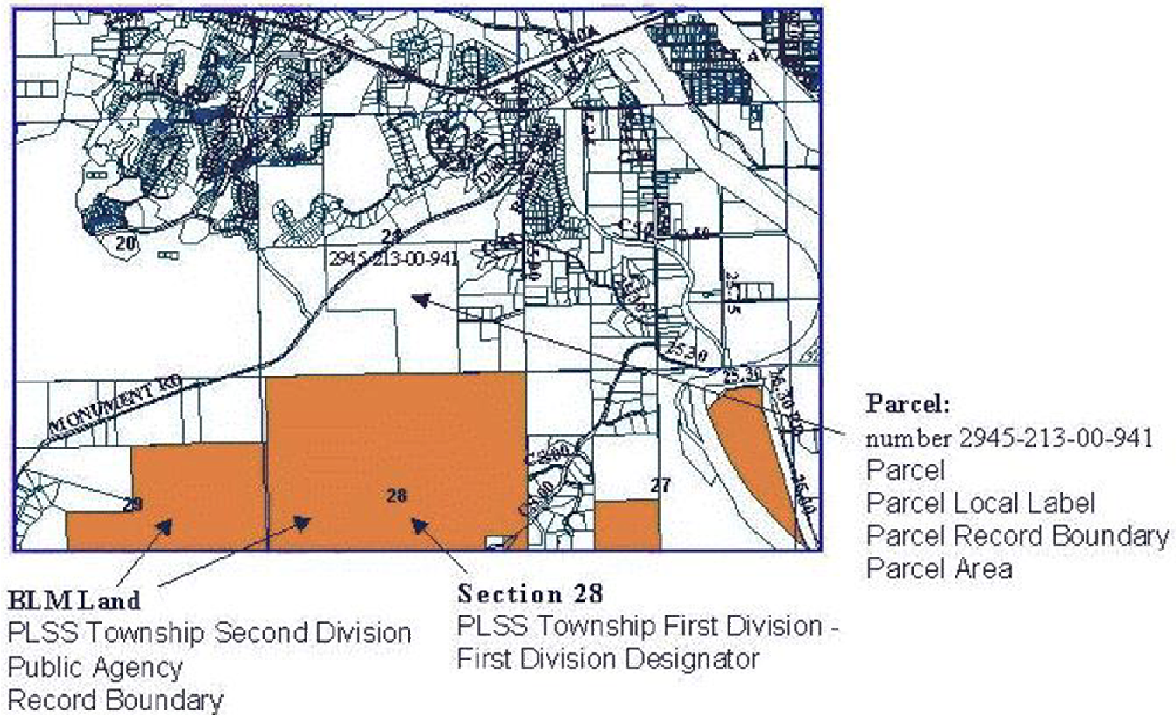
Figure 1: Map from Mesa County, Colorado.
see http://mcweb.co.mesa.co.us/imd/gis/autoFrame.htm

have to take an explicit permission from a owner of the property. It can however drill into
the oil under that property, from a site that is owned by the government. Also position of the
oil lines, cut across both private and public lands. The easements access to these oil lines are
dictated by the dedication of easements by both private and public agencies, over which the
owner of the oil pipe line would have limited authority. That is to say that the owner of the
Gas pipeline would have an access right over that surface of land under which the pipe is laid
out, but the ownership in the traditional sense is still held by the owner of the private land.
That is to say a owner can sell entire parcel of land to another actor, including the easement
land, but there could be restrictions on the continuity of easement rights to the owner of the
Oil pipe line.

Endogenising Rights in a GIS

The examples described above provide clues as to how GIS should be extended to incorporate
the notions of rights and how rights are dependent on the beliefs of a particular context.
To represent these beliefs we need to incorporate the concepts of the holders of beliefs, the
contexts of belief, the historical contingency, changes over time etc.

Ownership as a concept is not an useful entity to be described in an information system.
Ownership entitles a different set of rights in different social systems (legal, political etc.).
Thus we should be direct our focus on the set of rights a rights holder is entailed with that
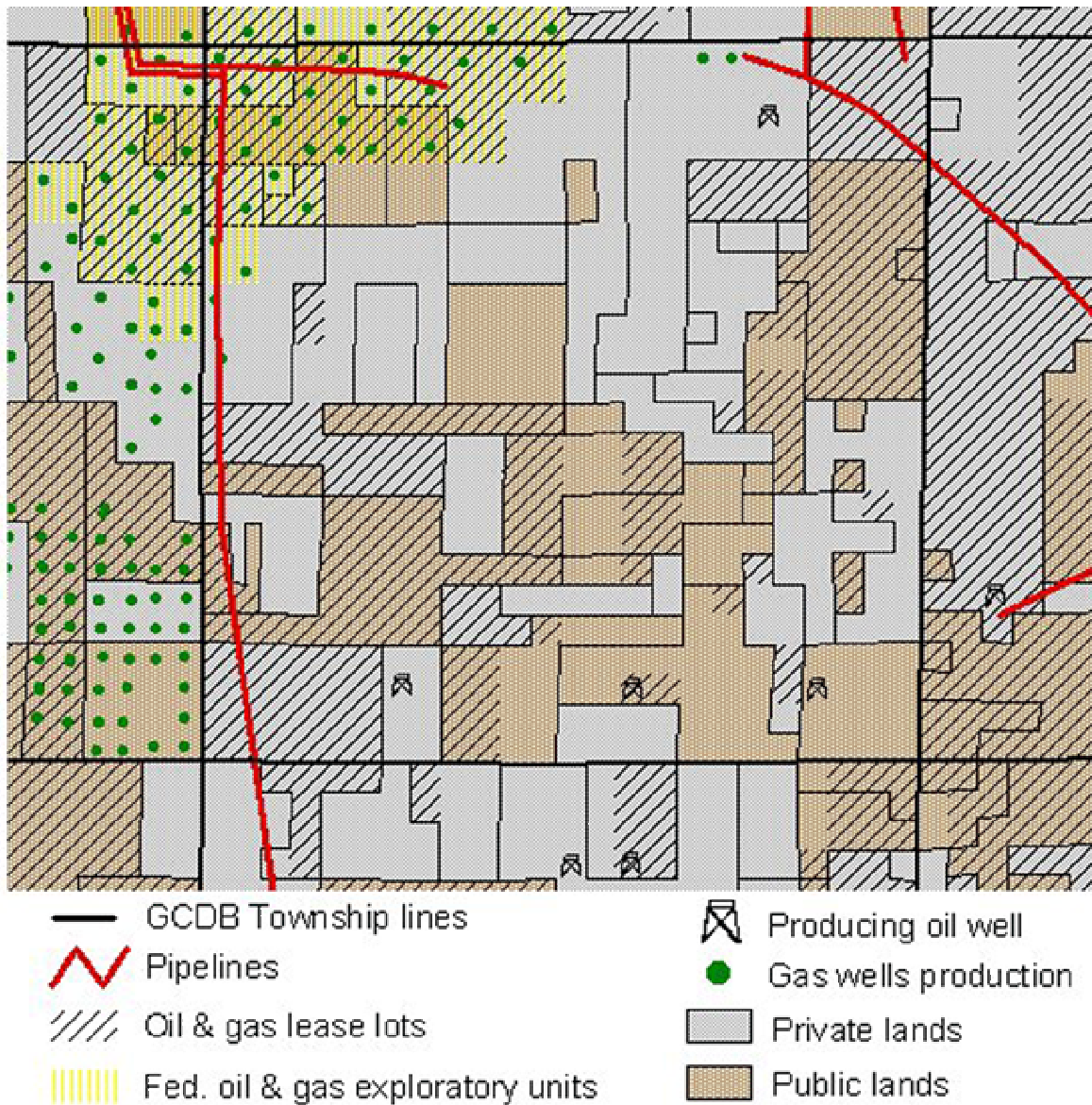
GCDB Township lines   Producing oil well
Pipelines   Gas wells production
Oil & gas lease lots   Private lands
Fed. oil & gas exploratory units   Public lands

Figure 2: Wyoming Coal Leasing and Private Land
http://www.fairview-industries.com/gismodule/PartTwoWyomingOil&Gas.html

particular object (s)he owns. Ownership of a property does not completely elaborate the rights of the non-owners to the same property. Historically grazing rights are given to the herdsmen in India after the harvesting season is done by the farmer who owns the land. To specify only ownership of a parcel of land in an information system deliberately gives precedence to the rights of one group over the rights of the other. Thus we should revisit the paradigms of "bundles of rights" in the lines of Sen's bundles of "entitlements" that are relationships between the person or entity (state for e.g.) and certain assets over which those rights are held. Ownership of a parcel should then be replaced with a list of actions or activities that are permitted (or a negative list that are forbidden), by a permitting mechanism (state for e.g.),

and they can only be defined with respect to the person or entity who could perform these activities. That is to say, for example ownership of a parcel of land would entitle a person A the right to sell the property to person B or consent to temporary grazing rights to person C. But if the parcel of land is held under public trust by the government (still considered ownership in the traditional sense), then transfer of such right to another private individual D would require a procedural due process which is defined *a priori* (public notification, hearing etc.). This due process requirements are different in different political and cultural contexts (rule by decree being one example). These bundles of rights are extremely specific to property involved. It could be due to historical importance of the property, land use or zoning regulation pertaining to a jurisdiction, private agreements, covenants about rights and responsibilities etc. Thus to represent rights we would a much richer frame work which I will attempt to formulate in the next few sections.

Rights and Right holders

Rights can not be defined independent of the right holders. In the current Geographic Information Systems there cannot be any Epistemic Agents (agents who can posses or acquire knowledge) nor Doxastic agents (agents who can acquire beliefs.) These agents are fundamental objects and are not necessarily tied to location. They may have spatial characteristics as regards to place of residence, work or incorporation but these spatial properties are not fundamental in that by knowing the address of the corporation who owns/leases a particular property, we cannot identify the nature of ownership. Thus the spatial attributes of the rights holders themselves are incidental. However the spatial attribute of the property over which they hold rights may not be. The owner/lesse/lessor have to be separate entities in a data system de-coupled from geography. Once these entities who hold rights are defined then we can link the beliefs to the rights as ownership towards a particular property. Rights holder can be individual agents, or entities such as organisations and governments. Governments can "take" the rights through the exercise of police power in which case transfer of rights may not be completely voluntary. But transfer of rights in any case is codified through inscribed records. Where no such records exist,or oral record keeping is a tradition, any information system including a GIS will undermine the tradition because of the persistent nature of the data as well as the errors.

Rights about Assets

Property rights thus are described are the rights a Right-holder holds with respect to a property. A property is an Asset (for elaborate definitions and characterisation refer to Hopkins et al. (2003)) Perhaps it is in defining these constructs where GIS is very useful and conceptual framework is well developed. An asset typically is a natural feature or man-made tangible entity (though not always the case). All of these assets are representable with a simple feature data set. However there is a room for improvement here as well. Assets need not be fundamentally linked to physical location. They could have spatial properties on realisation. If we are to define rights of a clan of individuals over a trees of a particular type, we should able to specify such right without even knowing where exactly these trees are located. However adding locational information will enhance the quality of the information.
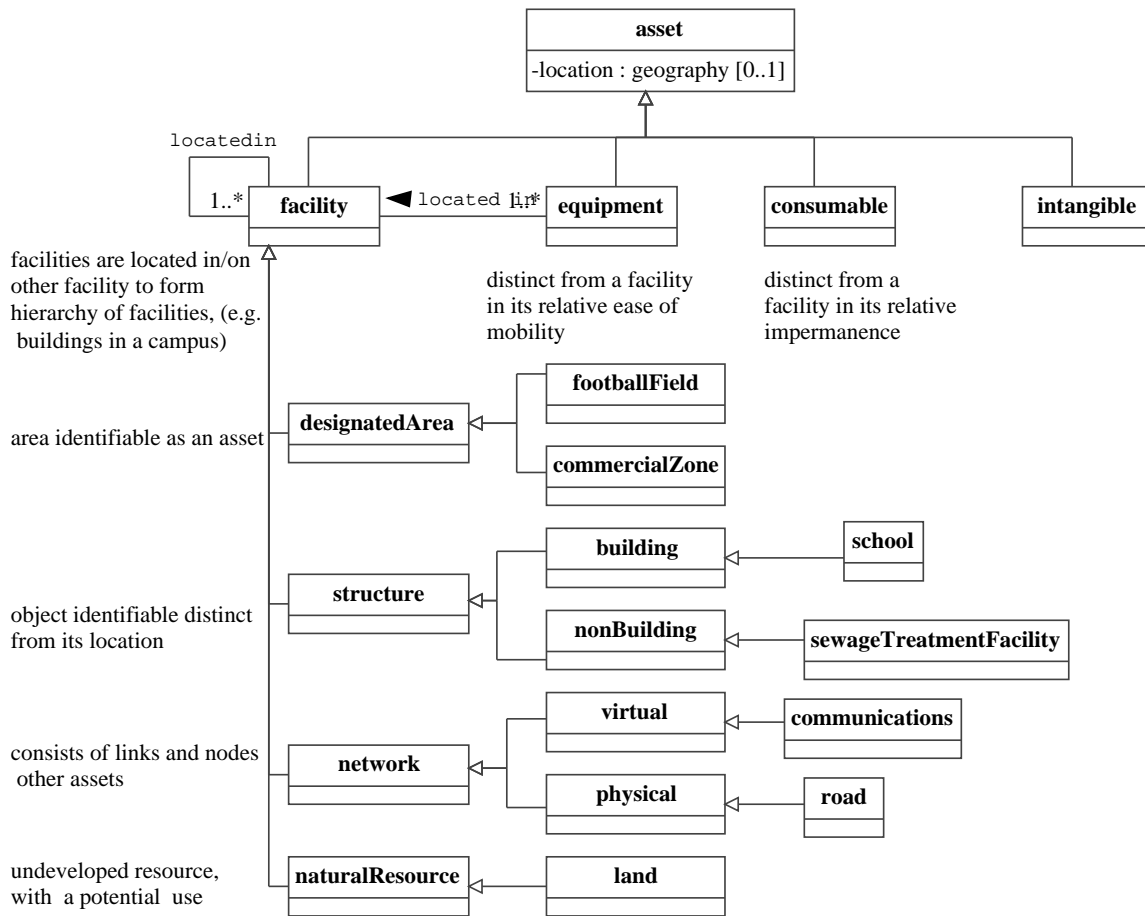
Figure 3: Asset class diagram

We should be able to describe rights of a prospective owner of beverage shop, in the example described earlier in the paper, without actually specifying where the beverage shop is located or about to be located. Note that the relationship between school and beverage shop (both of which are assets)is a spatial relationship (75 m buffer). This relationship can be represented in a GIS only when the objects [school and beverage shop] are instantiated and tied to a specific geographic location and given co-ordinates. We should be able to represent these entities without specifying the geographic locations that is to say the spatial attributes of assets is an optional one. To represent sub-surface rights, we would need to represent the "ore" as an asset, which is located under the land at a location, a 3- tuple co-oridnates. However access to these ores are limited from another location not necessarily from the location where the ore is located.

Tenure of rights

There are certain events which change rights. These are not necessarily tied to time, but time is an important attribute (see Pequet and Duan 1995). For example sale of a property is an

event which changes the rights of a current rights holder. The state can enact regulations about how this sale of property would be executed and what procedures should be complied so that state will guarantee this transaction with out specifying when exactly this sale would occur. Hence, defining time of the exact sale of the property is not sufficient to describe rights. We should be able to represent these events, sale, enactment of a superceding regulation, leasing, renting, taking (in the V amendment sense) which routinely alter the set of rights and transfer these rights to other parties. Also Land tenure rights are subject to influence by ,

- multiple overlapping uses of land and water resources.

- fees, charges, rentals, leases.

- acquisition of land from, and disposition to, other actors.

- access and trespass laws and norms.

- above surface, surface, and subsurface rights

- overlapping jurisdictions.

- fee ownership and less than fee ownership.

- unwritten property rights, future rights, reversionary rights, revocable rights.

Land interests involve the intricacies of ownership, zoning, rights-of-way and easements, political jurisdictions, valuation, and taxation. Land interest also is concerned with the extent of interests, that is, the boundaries of the interests in space and time. At present we can represent these changes in these interests in a GIS currently when these event occur. That is to say that these feature data sets changes attributes in ownership,lease etc. as these after the dates of occurrence. Subsurface rights can be transferred in the USA to another entity through sale while keeping with the surface rights. The transfer of such rights will curtail the right of a surface rights owner as opposed to the rights of the neighbor who owns the subsurface rights. This transfer of rights are events, actions that can be taken by agents who have a capability to take them. This segues into the next section on capabilities.

Rights and capabilities

One cannot talk about capabilities without referring to the theories expounded by Nussbaum (1999), Sen (1999). Nussbaum theory of capability ethics are more ambitious than what is being required to represent property rights. While she is concerned with the just distribution of capabilities in a social structure, the capabilities take a much narrower meaning in this context. Sen holds that a person's capability identifies that person's effective freedom to achieve valuable states of beings and doings, or functioning.

Capabilities can be defined as the ability of persons to enforce their right. It need not be raw physical force or capacity. They can be legitimised in the institutional mechanisms of society. For example contractual agreement of transfer of rights with regards to sale of Development Rights (Transfer Development Rights (TDR)) is guaranteed by the state as long as the agreement complies with the procedural and substantial norms prescribed. Even if one party

can not physically force the other party to be bind to the clauses of such agreement (infact the State discourages such use), the state shall use its monopoly over police power to enforce it for the aggrieved. Thus the capability to enforce the clauses is vested with both the parties, may be through a proxy of State. Rousseau once said "The first person who, having fenced a plot of ground, took it into his head to say this is mine, and found people simple enough to believe him, was a true founder of civil society." Thus the beginnings of a property rights should be traced to the fact that some one took the trouble of fencing (even when speaking figuratively) and then found people to believe that those rights are justified. Thus both existence of a capability to enforce that right should be present and also the existence of a framework where the society condones that enforcement should be present.
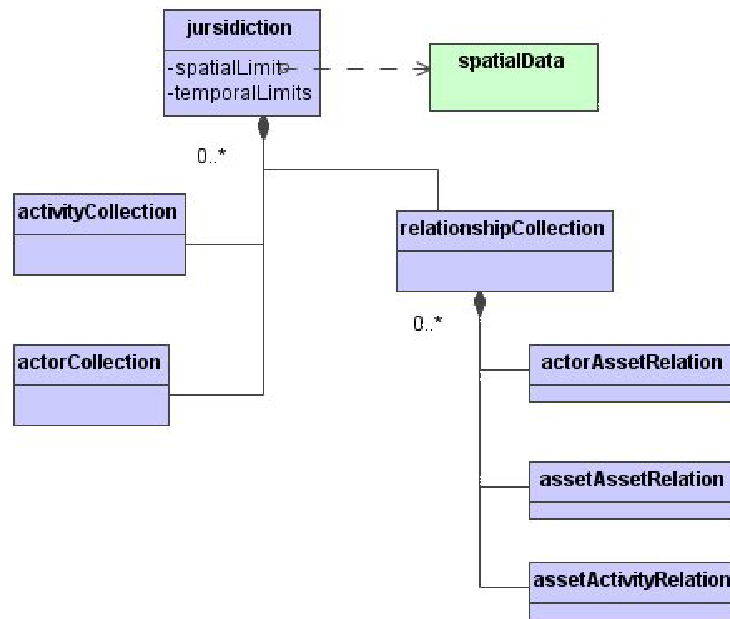

Figure 4: Jurisdiction class diagram

Capabilities exists only with rational agents who can hold these capabilities. So to define these capabilities we have to first define right-holders in the first place. These capabilities also have spatial characteristics. Consider the example of "jurisdiction". Jurisdictional authority is a capability that is assigned to the agencies that typically have spatial characteristics. They represent the mandates given to them by others, with in a boundary of spatial scope, over a set of assets, possibly over certain type of actions. Urbana Champaign Sewage District has a jurisdiction that cuts across Champaign Urbana region, independent of the city limits. The jurisdiction is about provision of sewage service and the authority is on the sewage pipes that run underground which are more than 6" in diameter. (refer to figure 4)

Interdependent Rights

It has been recognised that human rights are interdependent rights and form a cohesive whole only when they are indivisible. It is fair to say that almost all rights, including property rights,

share similar cannons. Rights cannot exist in isolation for specific individuals, agencies with out rights for others. Thus these rights form an incredibly complex web of linkages, not all of which are immediately elucidated. However there needs to be a framework in which these rights of different persons can be connected and Relational databases do a poor job at it.

Rights of an individual may be dependent on the rights of another. For example if person A leases a property from the person B and there is a sale of property from B to C then then in some legislative frameworks A's right of lease is not automatically transferred from B to C. Also a group might hold grazing rights on a land only after certain other groups have harvested the land or collected resources by orally or implicitly negotiated agreements. City governments might designate the right of use the public roads in a city for all the citizens but national governments might prohibit traffic on the roads in selected protected areas (military bases for example) even on public roads. Thus A right to lease is dependent on ownership by B and grazing rights are contingent on event of harvesting. To represent these rights we need a web instead of a structured relational table much like a WWW. Thus rights are to be represented in a loosely structured, sparsely populated and flexible databases.

Rights are Fuzzy

It is well known that many elements of land plot properties (soil, fertility of soil, microclimate, etc) have uncertainties. Not all uncertainty in spatial data relates to error. A very common source of uncertainty in categorical geospatial data is that of fuzzy sets. Fuzzy sets are classifications in which the boundaries between classes are not distinct. The fuzzy sets theory originated in the work of Lotfi Zadeh. According to Zimmerman (2001) "The theory of fuzzy sets is, in effect, a step toward a rapprochement between the precision of classical mathematics and the pervasive imprecision of the real world - a rapprochement born of the incessant human quest for a better understanding of mental processes and cognition". Rights which are social constructs are even more fuzzier. When rights are dependent on spatial properties which depend on characteristics of land which are uncertain in themselves, It is appropriate for a data model that will encompass spatial rights employ a fuzzy data structure in the lines formulated by Sui (1992), Vert (2000) etc.

Gendered spaces and psychogeographies

Now that we have discussed the possible directions of research in representing rights spatially, let me revisit some of the articles that are discussed for the class. I wish to especially focus on the articles by Rocheleau et al. (1995), Peluso (1995) and Rundstorm (1995). These articles especially focus on multiple perspectives and the inability of the current GI systems to engage different viewpoints. The framework presented in this paper endeavour to lift the GIS out by the bootstraps by showing of how GIS should be extended to represent social constructs such as right. Potentially this could be extended to another constructs as well.

Rocheleau et al. (1995) argue that women's spaces are nested in the spaces controlled by men typically. To represent these rights/responsibilities we will have to contend that over the same assets different groups of people will hold different sets of right and responsibilities by historical contingencies or codified regulation. To elaborate the how the framework applies

to represents the rights consider the map on Rocheleau et al. (1995, 66) . Men (rights holder type) have control (probably ownership or other rights so defined) over Grazing land (Assets). Note that the grazing land need not have spatial location instantiated. It could be the fact of the culture that men typically hold ownership over any grazing lands. Women on the other hand (rights holder) have responsibility to provide labour (responsibility as a negative right) in the same Grazing lands. Enumerating them will require a micro-level analysis akin to anthropological studies. But this framework can accommodate these differences. Further one can also specify the how inheritance dictates the rights and responsibilities in the context of gender by specifying events in relation to the rights holders.

On the other hand this framework provides for epistemic agents, which is the main criticism of Rundstorm (1995). Flexibility on how different agents acquire their knowledge is provided to accommodate different modes of learning and viewing the world. Rundstorm, (53) criticises GIS, validly, in saying that, "[GIS] are "re-presentation" of phenomena; people, places, "resources", "nature". Their knowledge producing capabilities stem from their ability to make apparent what was not apparent, an ability we hardly question because we are steeped in the ways of the society that produced them. " Thus in the current framework we make it explicit as to who is producing the knowledge, what are the historical modes of production of the same and what conclusions we can draw from them given this information. Thus to make it explicit and endogenise the process of production of knowledge, we should include information about rights-holders and their beliefs about these rights in the particular social, legal and cultural context so that we can address some of the issues that he raises very aptly. These beliefs and rights are to be constantly re-adjusted in the face of inconsistency and conflict. Thus we should allow for a frame work that is flexible and self-organising.

In their seminal book Quine and Ullian (1978) postulate that beliefs are fundamental to human reasoning. All of our rationality and rationalisation is based on beliefs and belief revision under contradiction and communication. Thus it should be possible for agents to hold potentially or seemingly contradictory beliefs because it is almost impossible to test if all our beliefs against every other. When encountered with a contradiction or an inconsistency we change our beliefs to make it consistent. This is one aspect of learning, the other being formation of new beliefs. In a geographic context we should be able to revise our beliefs with respect to geographic knowledge as well as social construction of the same, with time. Since these rights-holders are agents who hold belief and these agents can communicate not only with themselves (rational choice and instrumental rationality) they communicate with other as well (communicative rationality). Thus we can begin to address the issues raised by Aitken and Michel (1995).

Different individuals in any given context would have different versions of the world. This is particularly true in the case of the delineation of rights (Peluso 1995). Thus there should be a provision to allow for multiple even conflicting representations of rights, not so much for better delineation and distribution of the bundles of rights, but for the access to representation. Inevitably inscription of rights, lends an aura of legitimacy to those rights with out a regard to the nature of the"origin" and "transfer" of such rights. These conflicts should be recorded by allowing for multiple versions of the rights to be represented, by multiple agencies that are consistent with their own beliefs. Any attempt to legitimize one group's right over the other without an explicit consent of the aggrieved will only lead to disempowerment and simmering mistrust that might lead to conflict.

Social Construction of Rights- The Unfinished Business

An interesting attempt to use ontology for non-traditional entities such as rights is elaborated in Searle (1995). Searle claims a distinction between brute and institutional facts. Institutional facts are a consequence of human convention, some power is given, some is taken and some is transformed. Rights are institutional facts. They exist merely because some one legitimised them either through an ethical principle or through arbitrary use of power. These institutions are constantly in change, either incrementally or dramatically. The facts are also dynamic with in the framework of the institution.

The ontology and the structure for representing rights and regulations have to evolve as the social construction evolves. They should evolve with respect to property rights as the social construction of geographies evolve. Rights are seldom completely defined or transferred completely because of prohibitive transaction costs (Barzel 1997). Thus as societies continue to evolve and clarify the ambiguous rights, through legal or legislative action, representation of regulations that affect those rights should adapt these standards. Also one has to be cognizant of different epistemic systems that legitimize those regulations. It thus is an *Inchoatus negotiatum - ad infinitum*

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