Research Taxonomy

by

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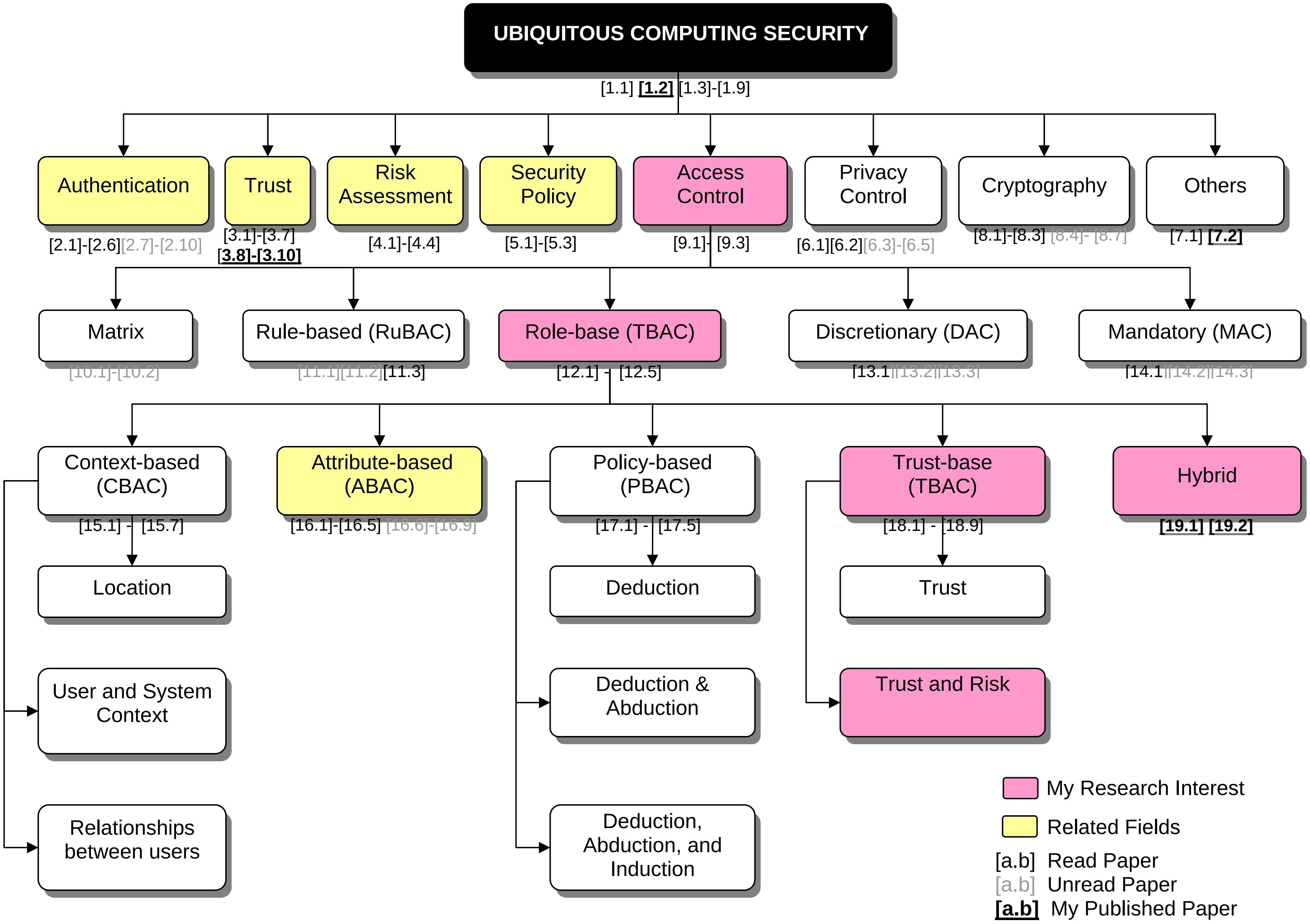
Research Taxonomy



Term Descriptions

1. Authentication

In computer security, authentication is the process of attempting to verify the digital identity of the sender of a communication such as a request to log in. The sender being authenticated may be a person using a computer, a computer itself or a computer program. A blind credential, in contrast, does not establish identity at all, but only a narrow right or status of the user or program.

In a web of trust, "authentication" is a way to ensure users are who they say they are—that the user who attempts to perform functions in a system is in fact the user who is authorized to do so.

2. Trust

Trust in computer security includes Trust Negotiation and Trust Management. Trust Negotiation deals with establishing trust between two parties who attempt to communicate with each other without any prior relationship. Trust Management concerns about maintaining all factors related to trust negotiation. Figure 1 shows an example of trust negotiation between a doctor (Dr. Jones) and a patient's primary care physician.

Fig. 2.1 describes a scenario where Dr. Jones wishes to access the EMR of a new patient, Ms. Sally White, who is visiting from out of town.

- He sends a request to the office of Ms. White's primary care physician, asking for her digitally signed medical re cord along with the credential containing the key used to sign it.
- To authenticate the requesting party, the primary care physician's trust negotiation system responds with a message containing a policy stating that records will only be disclosed to licensed medical doctors.
- In order to satisfy this policy and establish adequate trust, Dr. Jones supplies a digital credential signed by the local medical association asserting his status as a licensed practicing physician.
- The primary care physician's server confirms Dr. Jones' digital credential by verifying its signature using a credential issued by a uusted third party (e.g., a national licensing association). This fulfills the primary care physician's policy, resulting in a sufficient level of trust to complete the transaction.
- The server then encrypts Ms. White's EMR using a unique shared session key and sends it via the Internet along with a credential asserting the primary care physician's status as a licensed medical doctor.
- Dr. Jones decrypts the EMR and verifies its legitimacy using the primary care physician's credential. The use of trust negotiation in this scenario provides a mechanism for the authorized, confidential transfer of Sally's medical record.

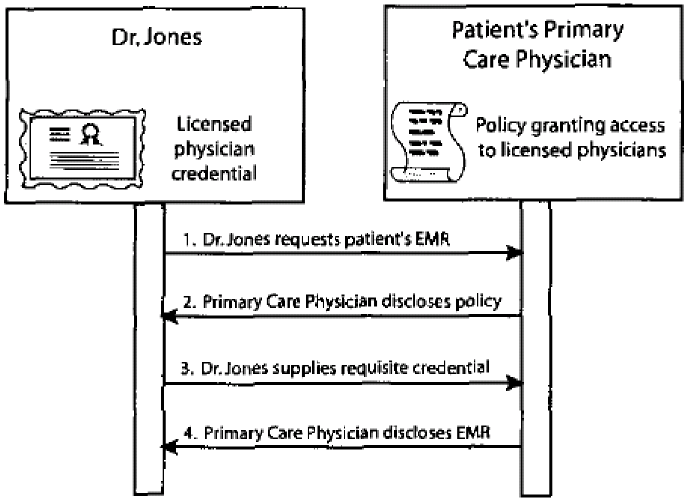

Dr. Jones
Licensed physician credential
Patient's Primary Care Physician
Policy granting access to licensed physicians
1. Dr. Jones requests patient's EMR
2. Primary Care Physician discloses policy
3. Dr. Jones supplies requisite credential
4. Primary Care Physician discloses EMR

Fig. 2.1. Using Trust negotiation to control access to EMR information.

3. Risk

There are many definitions of risk depending on the specific application and situational contexts. Generally, risk is related to the expected losses which can be caused by a risky event and to the probability of this event. The harsher the loss and the more likely the event, the worse the risk. Measuring risk is often difficult; rare failures can be hard to estimate, and loss of human life is generally considered irreplaceable

In information security a "risk" is defined as a function of three variables:

- the probability that there's a threat
- the probability that there are any vulnerabilities
- the potential impact.

If any of these variables approaches zero, the overall risk approaches zero.

4. Security Policy

Security policy is set of all policy statements of the system or organization defined to protect information. It states who are authorized to access to what resource, how to disclosure sensitive information, etc. Usually, security policy goes together with the mechanism using it. It includes access control policy, firewall policy, etc.

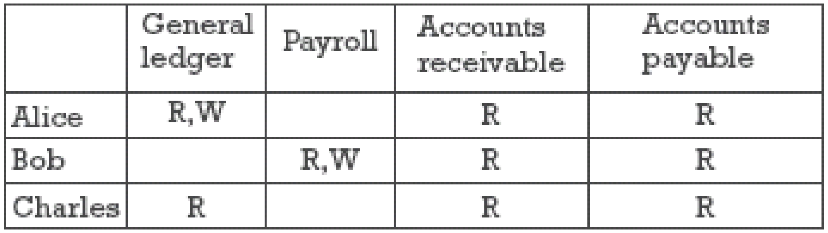
5. Access Control: General View

Access Control is one aspect of comprehensive computer security solution. Basically, it means to control access privileges from a user to a certain resource. Every time an user attempts to access to a resource, access control is enforced.

Typically, access control is criteria to preserving confidentiality and integrity of information. Confidentiality refers to the need to keep information secure and private. For example, sensitive medical information of a patient cannot be disclosure to unauthorized persons. Integrity refers to the concept of protecting information from being improperly altered or modified by unauthorized users. For example, most users want to ensure that bank account numbers used by financial software cannot be changed by anyone else and that only the user or an authorized security administrator can change passwords.

6. Matrix Access Control

Access Control term was considered in the late 1960s. The earliest work in defining a formal, mathematical description of access control is that of Lampson [10.1], who introduced the formal notions of subject and object and an access matrix that mediated the access of subjects to objects. An access matrix is a simple conceptual representation in which the (i,j) entry in the matrix specifies the rights that subject i has to object j. An example is shown in Figure 6.1. Subjects (processes invoked by users) are allowed to access objects such as files or peripherals according to the rights specified in the matrix. For example, user Bob is allowed read and write access to the payroll file, and read access to the accounts receivable and accounts payable file.



	General ledger	Payroll	Accounts receivable	Accounts payable
Alice	R,W		R	R
Bob		R,W	R	R
Charles	R		R	R

Fig. 6.1. Access Matrix

7. Rule-based Access Control (RuBAC)

In 1976, a new model, Rule-based Access Control was introduced by Bell [11.1]. It is an enhancement of matrix access control. It defines access control rules in a mathematical model. RuBAC allows users to access systems and information based on pre determined and configured rules. It is important to note that there is no commonly understood definition or formally defined standard for rule-based access control. “Rule-based access” is a generic term applied to systems that allow some form of organization-defined rules, and therefore rule-based access control encompasses a broad range of systems.

8. Mandatory Access Control (MAC)

DAC leaves a certain amount of access control to the discretion of the object's owner or anyone else who is authorized to control the object's access. For example, it is generally used to limit a user's access to a file; it is the owner of the file who controls other users' accesses to the file. Only those users specified by the owner may have some combination of read, write, execute, and other permissions to the file. DAC policy tends to be very flexible and is widely used in the commercial and government sectors

9. Discretionary Access Control (DAC)

Mandatory access control (MAC) policy means that access control policy decisions are made by a central authority, not by the individual owner of an object, and the owner cannot change access rights. An example of MAC occurs in military security, where an individual data owner does not decide who has a Top Secret clearance, nor can the owner change the classification of an object from Top Secret to Secret

The need for a MAC mechanism arises when the security policy of a system dictates that:

- Protection decisions must not be decided by the object owner.
- The system must enforce the protection decisions (i.e., the system enforces the security policy over the wishes or intentions of the object

owner).

10. Role-based Access Control (RBAC)

Role-based Access Control was emerging approach in late 1990s and became NIST standard in 2004. It is an approach to restricting system access to authorized users. It is a newer and alternative approach to Mandatory Access Control (MAC) and Discretionary Access Control (DAC). The fundamental of RBAC is that it controls the access privileges of users based on their roles, not individual. Each user is assigned some role. Each role is mapped to certain permission such as read, write, etc. Fig 10.1 shows this relationship

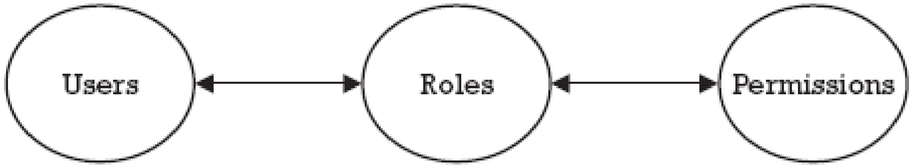


Fig. 10.1. Users, roles and permission relationship

Within an organization, roles are created for various job functions. The permissions to perform certain operations ('permissions') are assigned to specific roles. Members of staff (or other system users) are assigned particular roles, and through those role assignments acquire the permissions to perform particular system functions.

Since users are not assigned permissions directly, but only acquire them through their role (or roles), management of individual user rights becomes a matter of simply assigning the appropriate roles to the user, which simplifies common operations such as adding a user, or changing a user's department

RBAC has became foundation for afterward access control approaches such as context-based access control (CBAC), policy-based access control (PBAC), trust-based access control (TBAC), etc.

11. Context-based Access Control (CBAC)

Basically, Context-based Access Control is an improvement of Role-based Access Control to take advantage of context in context-awareness systems. In this case, context includes user context (e.g time, location, etc), system context (e.g. system state, network bandwidth, etc), environment context (e.g. temperature, humidity, etc). CBAC restricts user’s permissions according to current context at accessing time.

For example, Dr. Jones is visiting a patent at bed number 22. Based on his location the system know that he is visiting bed 22 patient, so it automatically transmits EMR of the patient to Dr. Jones’s PDA. Once he leaves to another location, he no longer views EMR of this patient.

12. Attribute-based Access Control (ABAC)

Attribute-based Access Control is another approach which is based on digital credential to authorize access permission to users.

In the past, access decisions were based on the identity of the entity requesting a resource, in open systems such as the Internet, this approach is ineffective when the resource owner and the requester belong to different security domains controlled by different authorities that are unknown to each other. One alternative is to use digital credentials for satisfying access policies. Digital credentials, the digital equivalent of paper credentials, are digitally signed assertions about the credential owner by a credential issuer. Each digital credential contains an attribute (or set of attributes) about the owner. The decision to allow or deny access to a resource is based on the attributes in the requester's credentials, such as age, citizenship, employment, group membership, or credit status. This approach is called attribute-based access control

13. Trust-based Access Control (TBAC)

In highly dynamic environment like ubiquitous computing, it's not always possible to maintain a pre-defined Access Control List (ACL) because this requires prior knowledge about who is trying to access and what their access rights are.

Under this circumstance, controlling access permission of unknown users based on trust level on those users is an emerging approach. A good scenario for TBAC is Ubiquitous Healthcare environments (U-Healthcare).In such environments, electronic medical record (EMR) plays a core portion of the systems. EMR should be shared to appropriate person like licensed doctors, treating nurse, etc in order to give better care to patients. However, it's not possible to maintain all types of users and what kinds of access permission they may have. Applying trust in this case solves the problem. It would be how much the system trusts on a user so that the system can disclosure sensitive medical information.

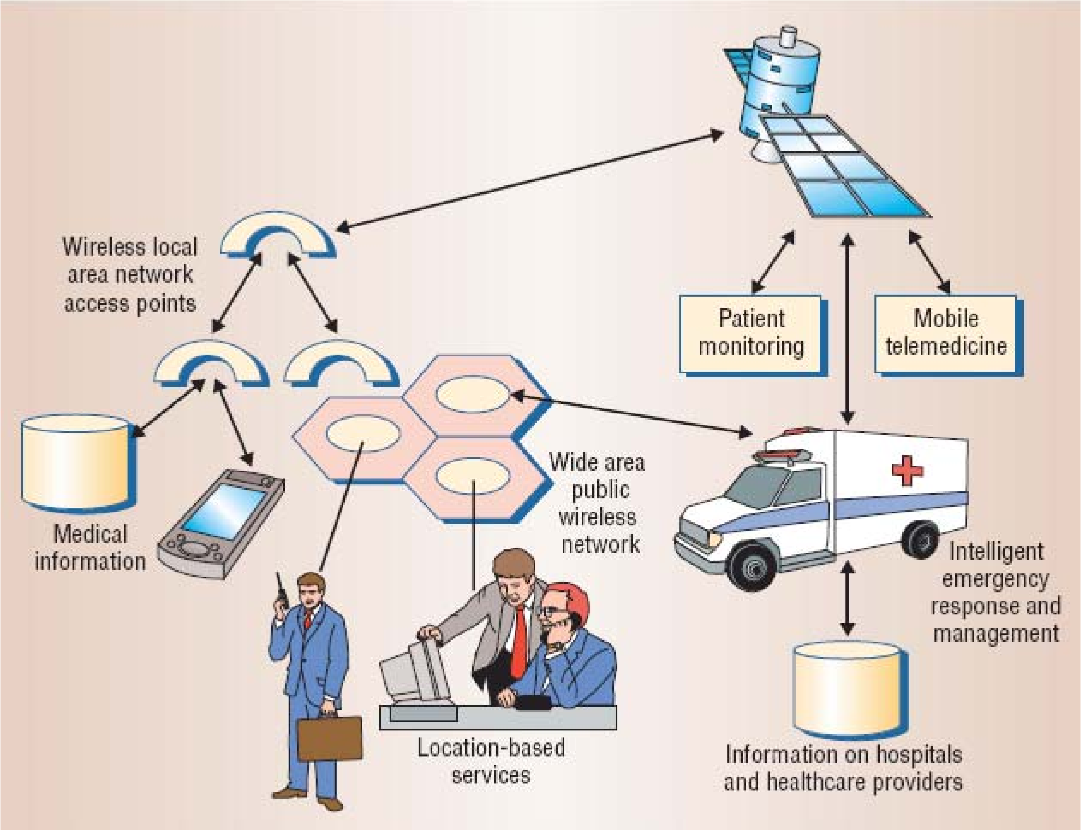
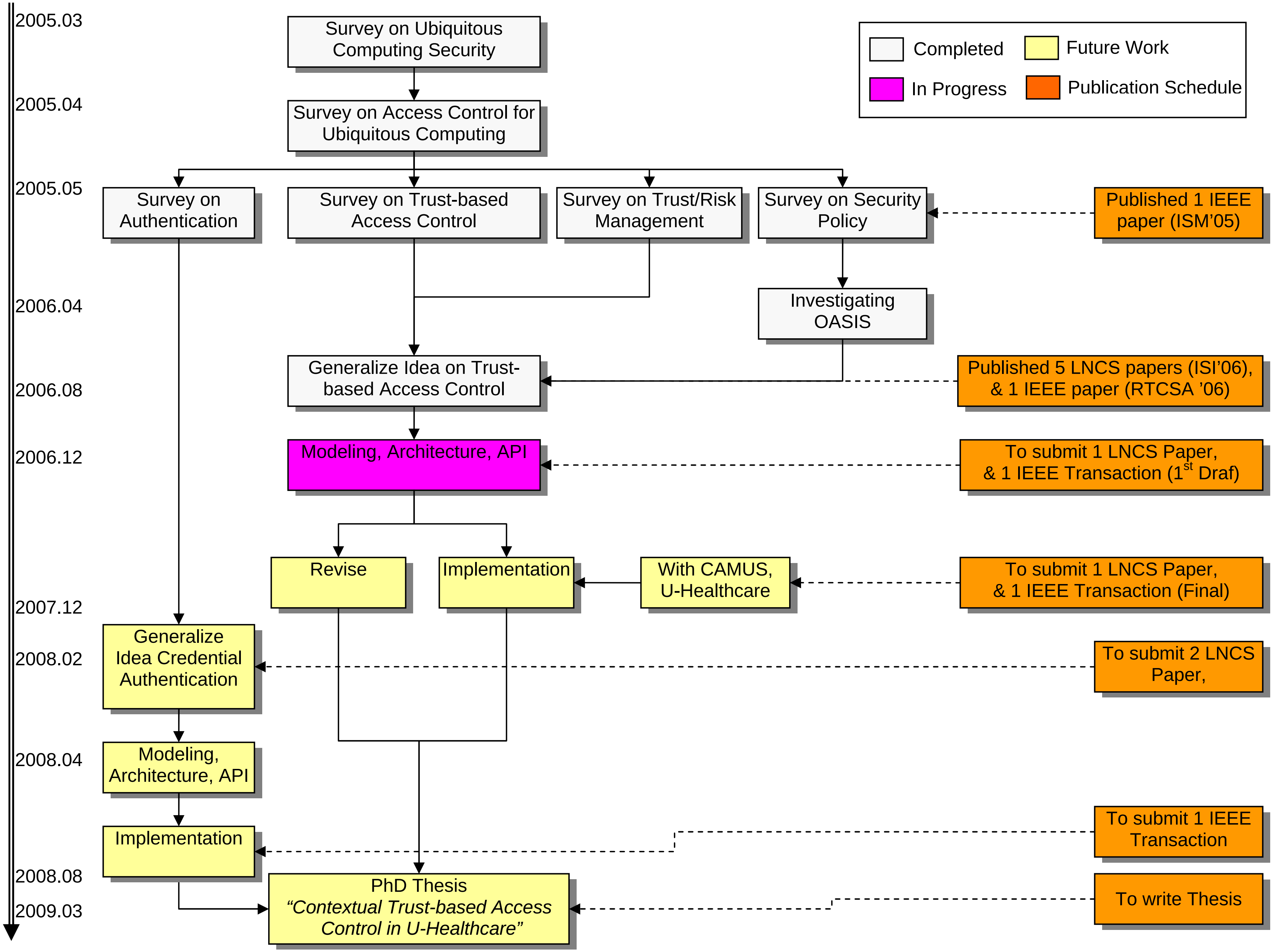

Wireless local area network access points
Patient monitoring
Mobile telemedicine
Medical information
Wide area public wireless network
Intelligent emergency response and management
Location-based services
Information on hospitals and healthcare providers

Fig. 13.1. Pervasive Healthcare Scenario. Medical information should be shared to legitimate users to give a better care while restricting to the others

Milestones



□ Completed
🟨 Future Work
🟪 In Progress
🟧 Publication Schedule

2005.03
Survey on Ubiquitous Computing Security

2005.04
Survey on Access Control for Ubiquitous Computing

2005.05
Survey on Authentication
Survey on Trust-based Access Control
Survey on Trust/Risk Management
Survey on Security Policy
Published 1 IEEE paper (ISM'05)

2006.04
Investigating OASIS

2006.08
Generalize Idea on Trust-based Access Control
Published 5 LNCS papers (ISI'06), & 1 IEEE paper (RTCSA '06)

2006.12
Modeling, Architecture, API
To submit 1 LNCS Paper, & 1 IEEE Transaction (1st Draf)

Revise
Implementation
With CAMUS, U-Healthcare
To submit 1 LNCS Paper, & 1 IEEE Transaction (Final)

2007.12

2008.02
Generalize Idea Credential Authentication
To submit 2 LNCS Paper,

2008.04
Modeling, Architecture, API

Implementation
To submit 1 IEEE Transaction

2008.08

2009.03
PhD Thesis *"Contextual Trust-based Access Control in U-Healthcare"*
To write Thesis

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