Context-Aware Dynamic Knowledge Assembly

Part 1. Context-Aware Systems Review

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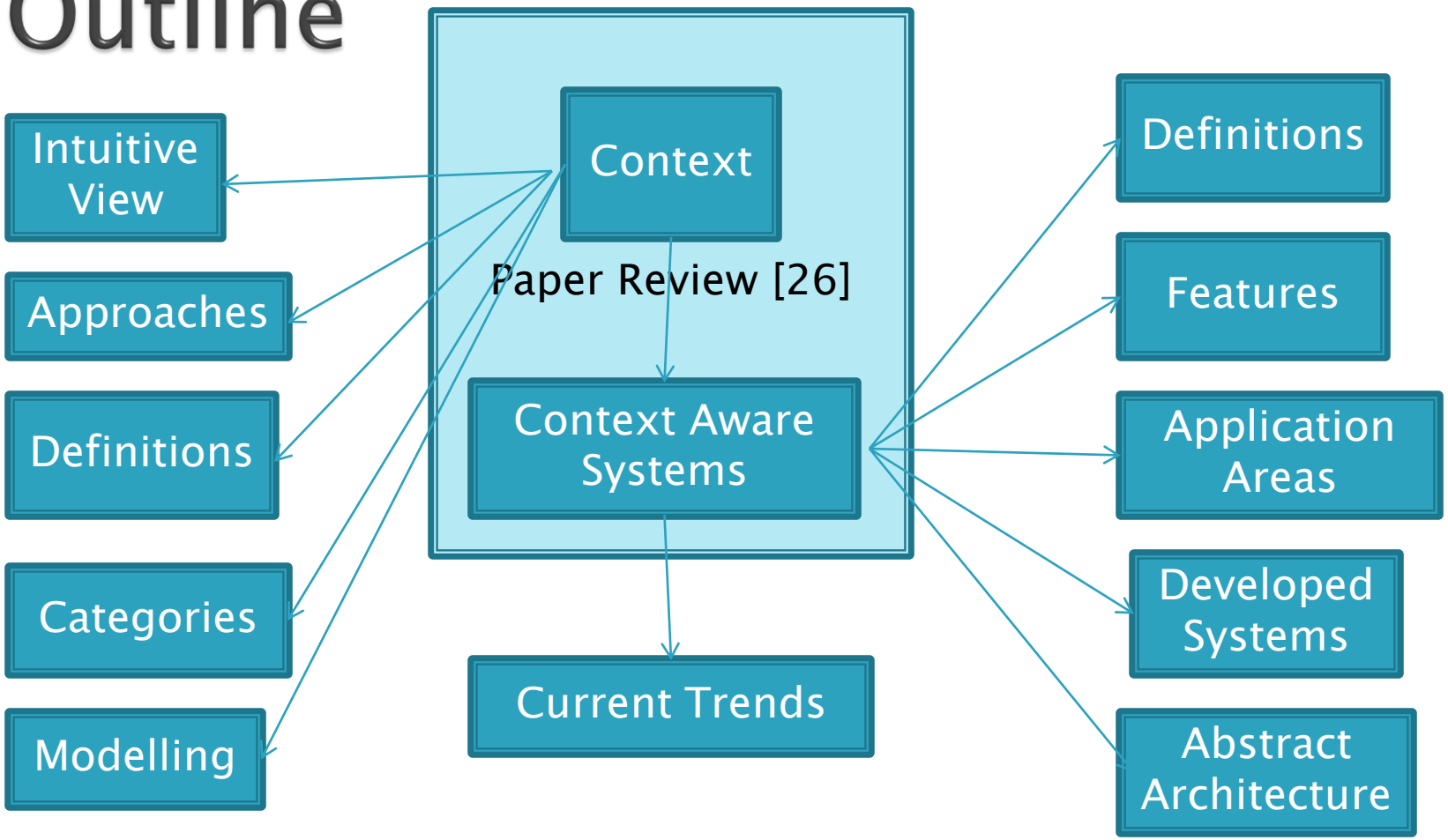
Outline


Intuitive View
Approaches
Definitions
Categories
Modelling
Context
Paper Review [26]
Context Aware Systems
Current Trends
Definitions
Features
Application Areas
Developed Systems
Abstract Architecture

Intuitive View of Context

Entity

- Human
- Object
- Device
- Place
- Application

"the situation within which something exists or happens and that can help explain it"
Cambridge Advanced Learner's Dictionary

Intuitive View of Context

- All the information that encapsulate the entity
- An entity is always in a situation (time point/ duration)
- The set of information for a specific situation consists the description of the entity and characterizes it.

Our programmer likes bowling and this an information entry for his profile. But, in his current situation this does not consist a descriptive characteristic for him

States and attributes of the entity

Enumerated set of values

Measured set of values

Intuitive View of Context

An entity may contain other related entities in its context for a given situation

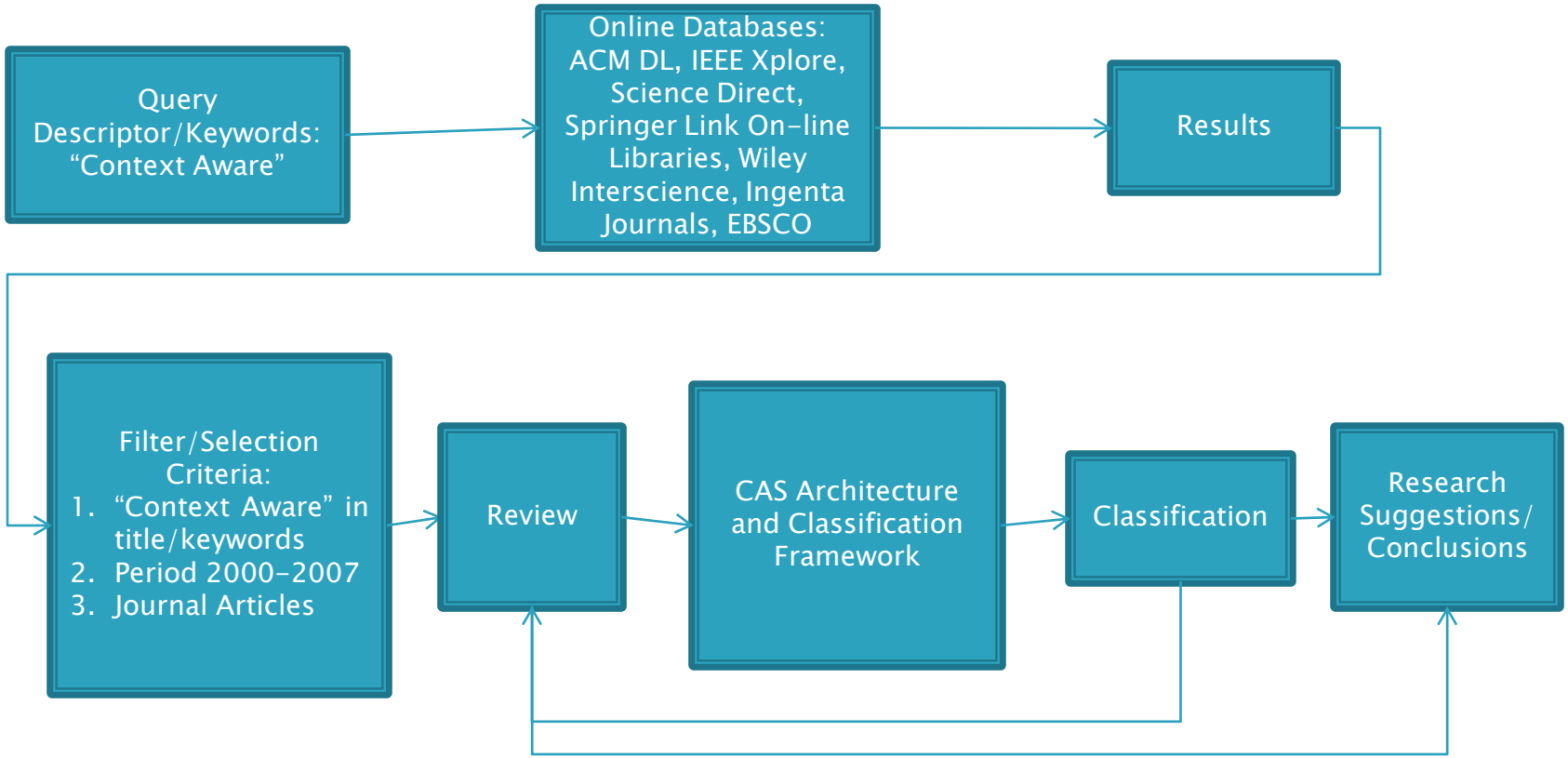
Our programmer is closely related with his PC which consists an other entity with its own context (memory, HD, applications he has used)

Review Paper – Introduction

Scope: The work at [26] aimed to:

- Review literature over Context-Aware Systems (time period 2000 – 2007)
- Provide a Classification Framework based on the architecture of Context – Aware Systems.
- Classify published research work using this framework.
- Suggest research topics and trends based on the literature review.

Review Paper – Workflow



CAS Review paper [26]

Approaches to Define Context

- **Application specific/Example**: refer to specific information that context includes [1, 3], fit to purpose of current application and enumerate characteristics [6]. Include location and time [1, 4, 5], identity and emotional state [8].

- **Provide Synonyms**: environment or situation [4, 12, 13]

- **Global**: a more operational definition that *"helps the developer to enumerate the context for a specific application scenario"* [7], while the definition itself is not fitted to purpose.

Definitions of Context

- Schilit et al. [1]: a combination of location and time characteristics, while later in [2] takes into account *"where you are, who you are with, and what resources are nearby"* and environmental attributes as well.

- Brown et al. [3], Ryan et al. [5] : included identity and environment in their approach.

- Pascoe [6]: enumerates the states of a specific context type in a given situation.

Dey [7, 8]: "*any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered to be relevant to the interaction between a user and an application, including the user and applications themselves*".

Categories of Context

- **Physical** [1, 3, 5, 7, 26]: location, place
- **User** [2, 3, 5, 8]: identity emotional state, preferences
- **Environment** [3, 7, 12,13]]: activity, user situation
- **Time** [3,5,7]: calendar / duration of tasks

Dey at [7]:

- Location
- Identity
- Activity
- Time

A generalization for secondary context

Model approach in [39]:

- Environmental: surroundings (services, people)
- Personal: identity, mood, expertise, disabilities etc.
- Social: user's roles
- Task: goals, tasks, activities
- Spatio-temporal: time, location etc.

Context Modelling Techniques

- **Key – Value** [2]: pairs of variable – value , exact matching for querying.
- **Markup Scheme** [15]: hierarchical data structures, tags – attributes – content, XML/RDF(S). Extend the *Composite Capabilities/ Preferences Profile (CC/PP)*[16] *and the User Agent Profile (UAProf)*[17].
- **Graphical Models** [18]: Unified Modeling Language (UML), Object-Role Modeling (ORM) [19].
- **OO Models** [20, 21, 22]: encapsulation and re-usability.
- **Logic Based** [23, 24]: facts, rules and presuppositions, Prolog
- **Ontology Based** [25, 34]: concepts, interrelations.

Context Aware Systems (CAS) – Intuitive Approach

Use of context to extract necessary (situational) information in order to adapt their functionality.

CAS – Definitions and Features

- **Ability of an application to react in environmental changes** [1, 2]
  - Takes into account other related entities and nearby resources
  - Manual or automatic task for information retrieval and command execution
- **Expand the supported features** [6]
  - Sensing, adaptation, resource discovery and augmentation
- **Uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task** [7, 8]
  - Presentation of information, automatic execution of a service, tagging of context to information for later retrieval
- **A CAS can react and adapt its operations to contextual changes** [9, 10]
  - Combines Dey and Schilit's view

CAS – Main Characteristics

- Independent operation from users
- Anticipate future behaviour
- Interconnectivity and interoperability of devices
- Adaptation to user's movement

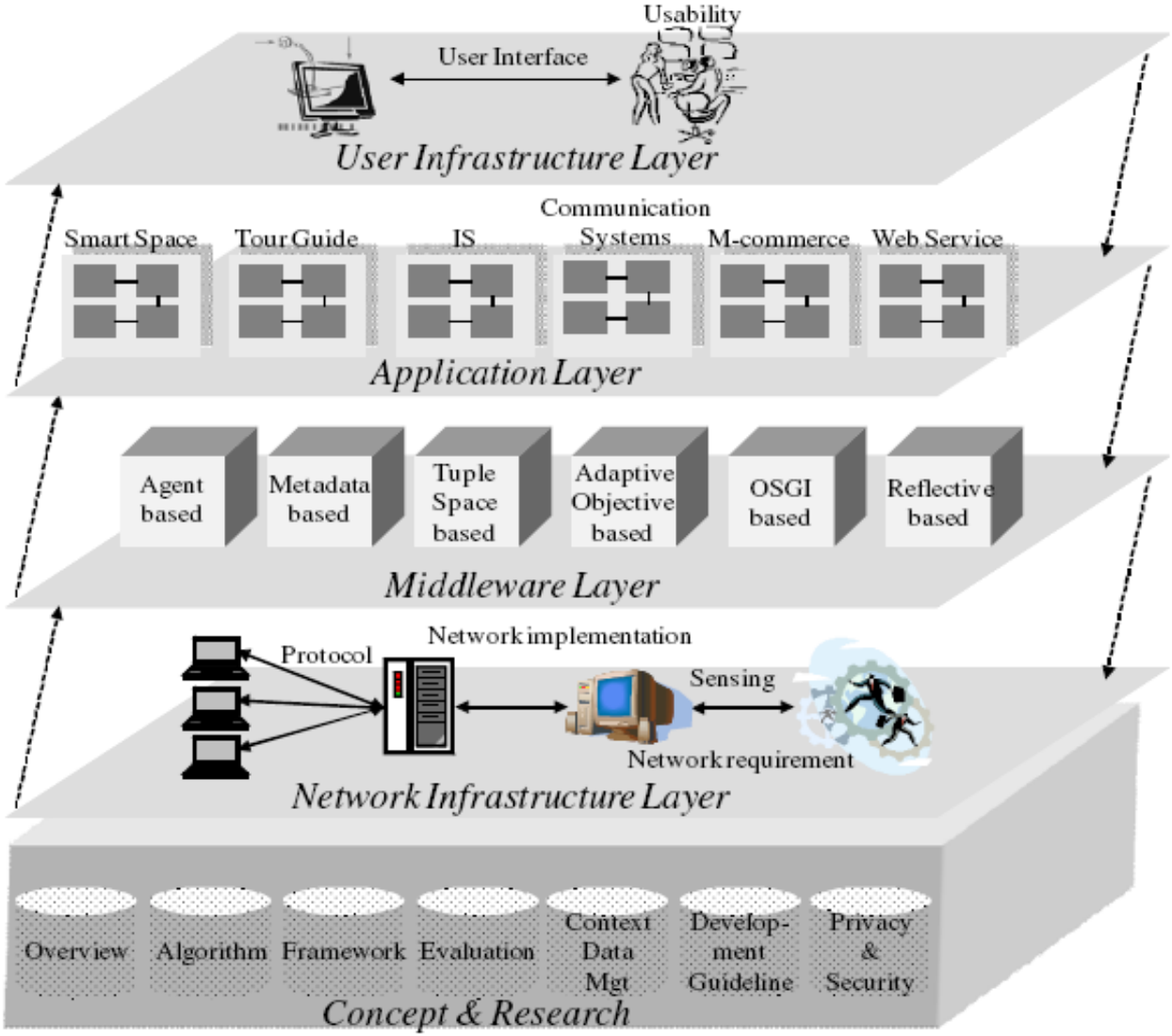
[10, 26]

CAS – Application Areas

- Smart Spaces: Home, Hospital, Office
- Tour Guides
- Information Systems
- Communication Systems
- Mobile Commerce
- Web Services

CAS Review paper [26]

CAS – Abstract Architecture and Classification Framework



CAS Review paper [26]

CAS – Example Applications

- **Prototyping of context aware applications, e.g. Context Toolkit** [31]
- **Frameworks for context aware applications on mobile devices**, e.g. CASS [29], Hydrogen[30], SOCAM [28]
- **Agent-based architecture for supporting context-aware systems in smart spaces**- CoBra [34]
- **Active Space system** – Gaia [32]
- **Tour guide applications**, e.g. CyberGuide[33], GUIDE System[22]:
- **Personalized services in academic communities** – MyCampus [http://www.cs.cmu.edu/~sadeh/mycampus.htm]

Current Trends

- Context-Awareness vs User's awareness [35, 36]
- Utilize context history (*"lifelong user modelling" UMAP 09):security issues on context distribution* [35, 26, 38]
- From simple user profiles to adaptive user models (experiences, preferences, background, interrelations with other individuals, emotional state)[26]
- Adjustment of context -aware system's behaviour according to user's activity [35]
- Context-aware + Adaptive Learning
- Community modelling (resolve preference conflicts)[26]
- Situation monitoring -> decision making [26, 35, 36]
- Content and quality of context (trust) [26, 27]
- Context-Aware Web Services [37]

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