IO2

Virtual Collaborative environment (tools 2.0)

Subunit 1: Virtual Enviroment Basics
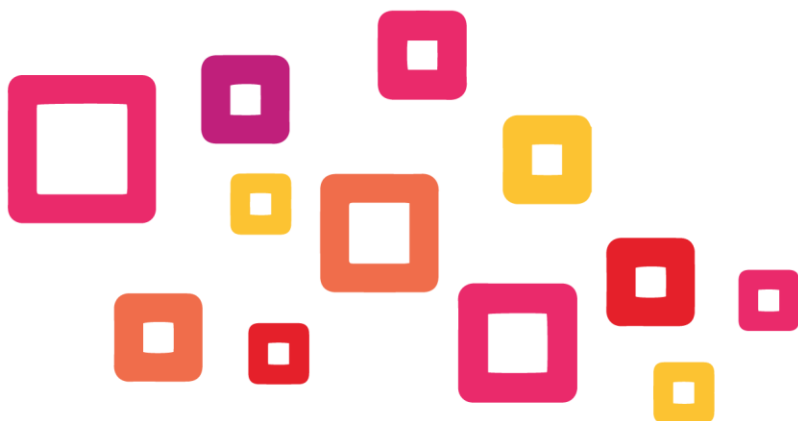
Content

Introduction

Performance of computers has been constantly growing over past several decades. In the 90's, enough performance was already available on standard computers for visualization of Virtual Environments (VE) and VE applications appeared world-wide. In the same decade, the availability of Internet and computer networks brought the need to share and exchange data among the computers. VE followed the trend and Collaborative Virtual Environments (CVE) became a name for VE shared among computers.

Appearance of CVE's was a big step forward in human-computer interaction. Humans were already interacting with computers, but CVE enabled interaction of group of people through the network of computers. Such remote interaction opened new possibilities and changed the understanding of human-computer interaction. Several areas quickly started to benefit from CVE. For example: Computer supported cooperative work (CSCW), engineering software, pilot training simulations, military simulations, computer games, interactive groupware, and many others.

Collaborative virtual environments, or CVEs, are used for collaboration and interaction of possibly many participants that may be spread over large distances. Typical examples are distributed simulations, 3D multiplayer games, collaborative engineering software, and others. The applications are usually based on the shared virtual environment.

1. History

Beginnings of the CVE go back to the 80's of 20th century. In that time, virtual reality was just beginning and it was used only by professionals. The evolution of 3D graphics was then deeply influenced by Silicon Graphics company (today called SGI), which was the leader in this area until the middle of the 90's. Shortly after the beginnings of virtual reality, a need to share the virtual environment between several computers appeared. Two main reasons for it existed: – Connecting of more computers together often provides more computing performance – Remote collaboration of more users in one virtual environment.
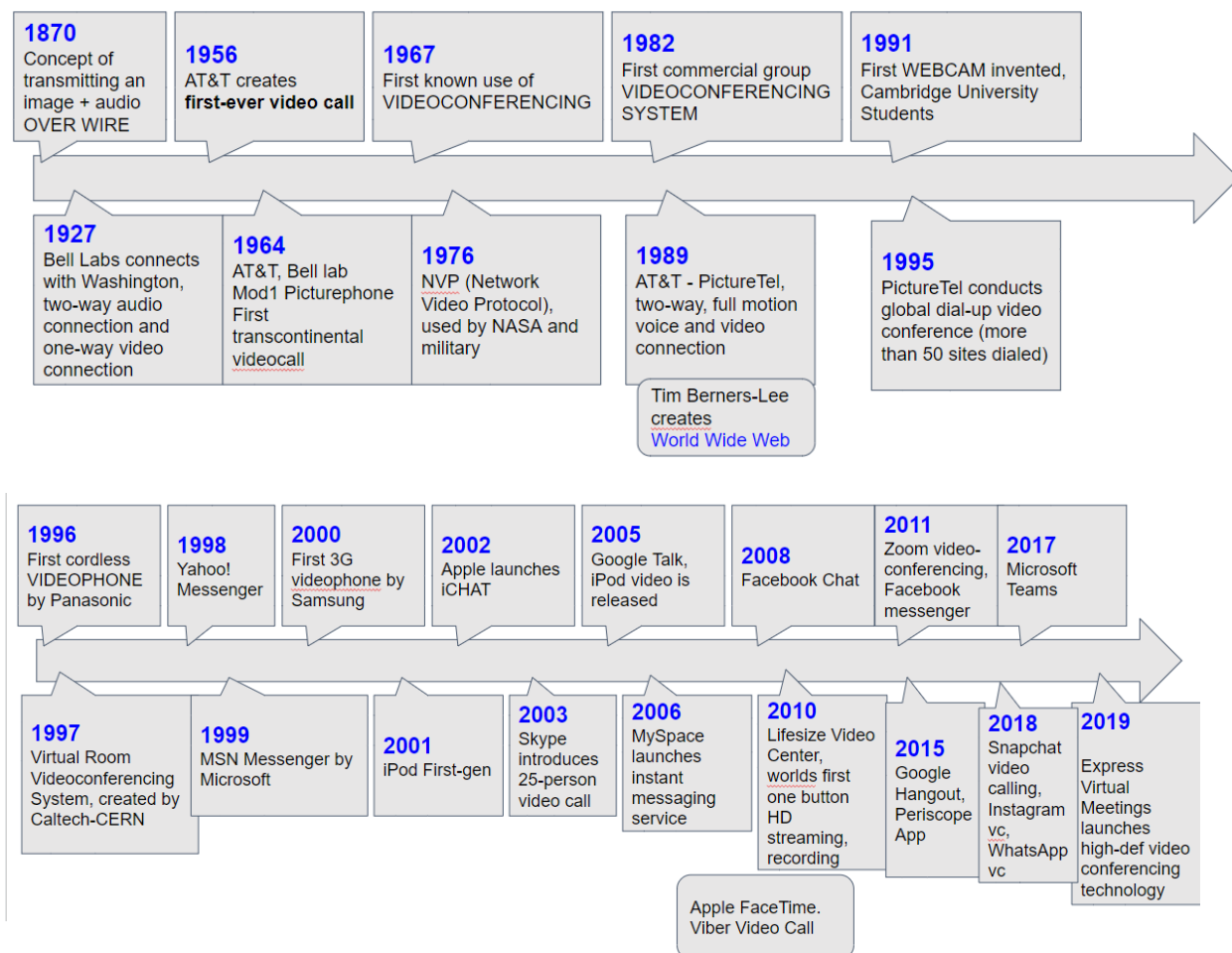

**Picture 1 – Timeline: Development of virtual collaboration and videoconferencing tool**

2. CVE ARCIHECTURES

The consistency model influences deeply the programming model of the application. One classification is introduced in based on several criteria, like centralized/distributed architecture, type of replication, and performance and consistency properties. Four types of consistency models were described, covering the most frequently used CVE architectures:

- **Centralized primaries**
- All primary replicas of each data item reside on the same computer called server.
- Advantages: complete server control over the scene
- Disadvantages: performance is limited by the server computer
- **Distributed primaries**
- Primary replicas are distributed among the computers.
- Advantages: high performance and scalability
- Disadvantages: difficult programming model, weaker consistency
- Used in: Distributed Interactive Simulation (DIS), Repo-3D, DIV, DOOM

- **Data ownership**
- Primaries are allowed to migrate among the computers. This approach is often called system with transferable data ownership.
- Advantages: more flexibility compared to Distributed Primaries
- Disadvantages: high amount of ownership requests may limit the system performance
- Used in: MASSIVE-3/HIVEK, Blue-c, CIAO, SPLINE

- **Active replication**
- Active replication uses peer-to-peer approach while all replicas are equal. Usually, atomic broadcast is used to deliver updates to all of them, thus they are kept synchronized.
- Advantages: complete scene synchronization (equal scene content on all computers)
- Disadvantages: the performance is limited by the slowest computer in the system
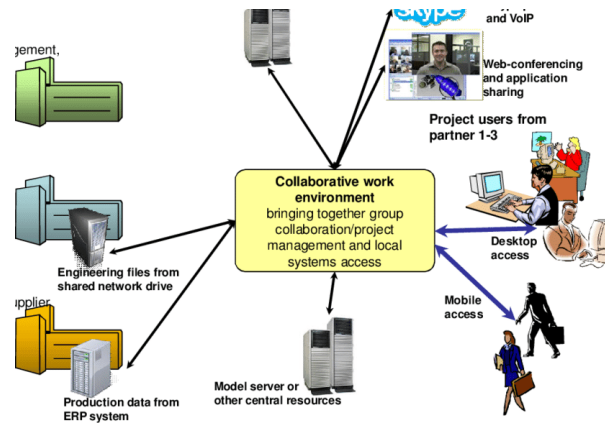
Picture 2 – Usage scenarios for Collaborative Work Enviroment
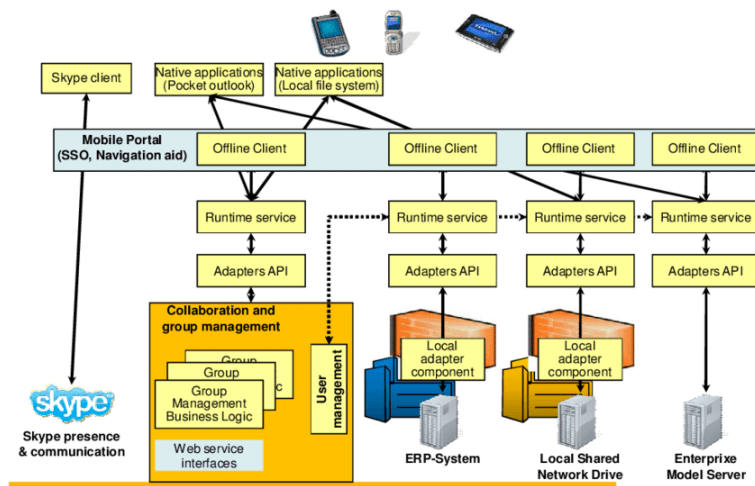
Picture 3 – Mobile and Offline architecture

3. Examples of CVE

The examples are trying to cover just the most important areas to show the overview of CVE domains. Collaboration and interaction: – military simulations: VR Group, DIS – engineering software: CollabCAD, CoCAD, CyberCAD – network games: DOOM, Age of Empires, Couter-strike – interactive groupware: EVO, videoconferences Computer workload distribution: – distributed rendering: Toy Story, Distributed Radiance – distributed simulations: DIS, weather prediction, NASA simulations
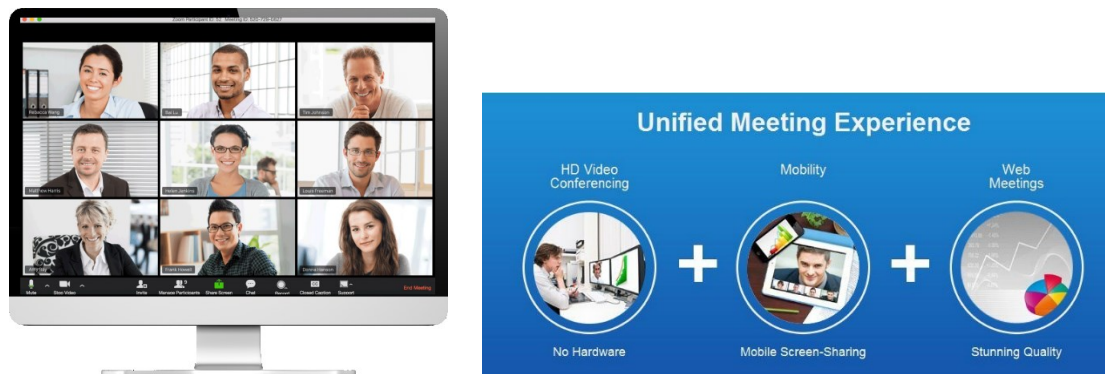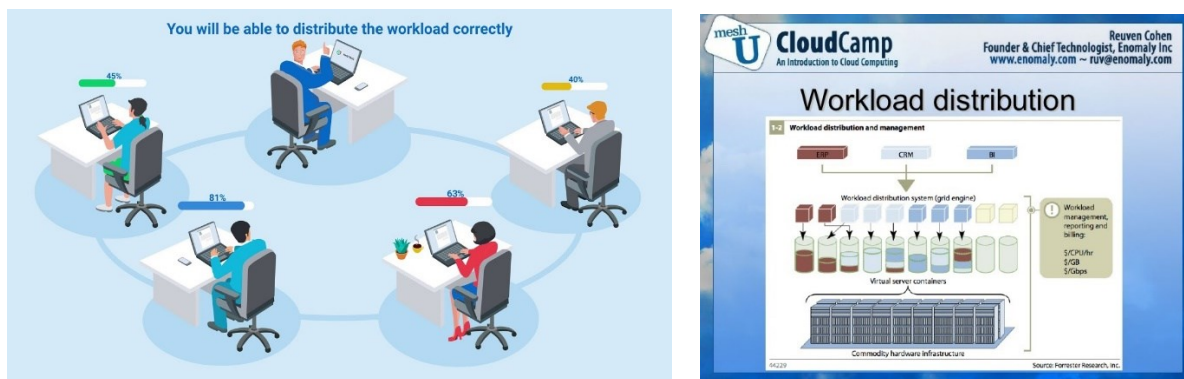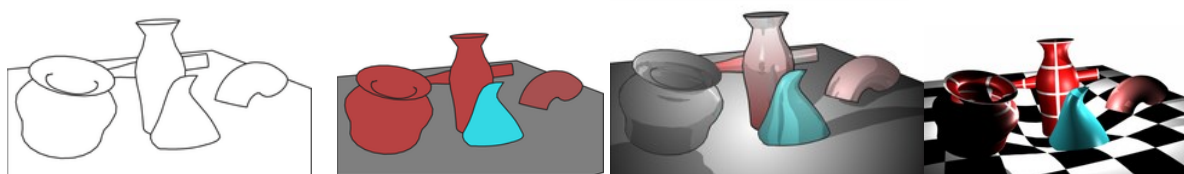

Picture 4 – Video Conference

Picture 5 – Live chat software

Picture 6 – Distributed simulation

Picture 7– Computer Workload Distribution

Picture 8 – Rendering

Sources

Web pages

Collaborative virtual environment. En.wikipedia.org. (2020). Retrieved 2 Ferburay 2020, from https://en.wikipedia.org/wiki/Collaborative_virtual_environment.

Books

Pečiva, J. (2020). *Active Transactions in Collaborative Virtual Environments*. Jan Pečiva Brno University of Technology Faculty of Information Technology Brno.

Video gradivo

VCE:

https://www.youtube.com/watch?v=OnQEecNfmuY