Collaborative technologies for deaf students education

Eva Hladká

Fakulty of Informatics, MU
and
CESNET

21. dubna 2015

Lecture content

- Introduction
- Technology overview
  - High quality videoconferencing – UltraGrid
  - Network support – CoUniverse
- Technology utilisation – CoUnSiL
- First experiences
- Conclusion
- Acknowledgments

Introduction

- Teiresias – Support Center for students with special needs
  - contact person Mgr. Lukáš Másilko
- At Masaryk University at whole 67 students deaf or hearing-impaired
  - (PřF 5, PrF5, ESF 5, LF 3, FSS 1, FSpS 1, PdF 28, FF 14, FI 7)
  - 33 students in category B1 (hearing-impaired, users of spoken language)
  - 34 students in category B2 (deaf, users of sign language)

Introduction

- Education of B2, but partly B1 students – need of interpretation
- Lectures interpretation – need of special interpreters
- Problems with accesibility and availability of interpreters
- Interpreters reachability via virtual presence
- Special type of videoconferencing concerned mostly to the non verbal communication
  - Non verbal communication – video
  - High resolution video
  - Both sides communication
    - Teacher via interpreter to students
    - Student's questions to teacher via interpreter

Lecture with interpreter

Technology

- Need of high resolution video for non verbal communication
- Low latency for synchronous communication
- Solution: UltraGrid
  - Developed in Sitola since 2005
  - Available source code for potential modifications and extensions
  - Running on commodity hardware

UltraGrid

- Platform for high-quality interactive video transmissions
  - high resolution video: HD, 4K, 8K
  - as low latency as possible on commodity hardware
  - commodity equipment
    - Linux, Mac, Windows
    - Common GPUs and video capture cards
  - open-source software, dual BSD/GPL license
    - UltraGrid itself is BSD-licensed, may become "GPL infected" (e.g., x264)
  - picks up where common videoconferencing ends
    - 10 Mbps – 10 Gbps (or more)

Who Is UltraGrid For?

- "Power users"
  - scientific visualizations
  - medicine: X-ray imagery, cardiology, pathology
  - education: remote lecturing
  - arts, cinematography, broadcasting
  - collaborative environments: multi-point operation
  - many others

Applications of UltraGrid

Advanced videoconferencing

Applications of UltraGrid

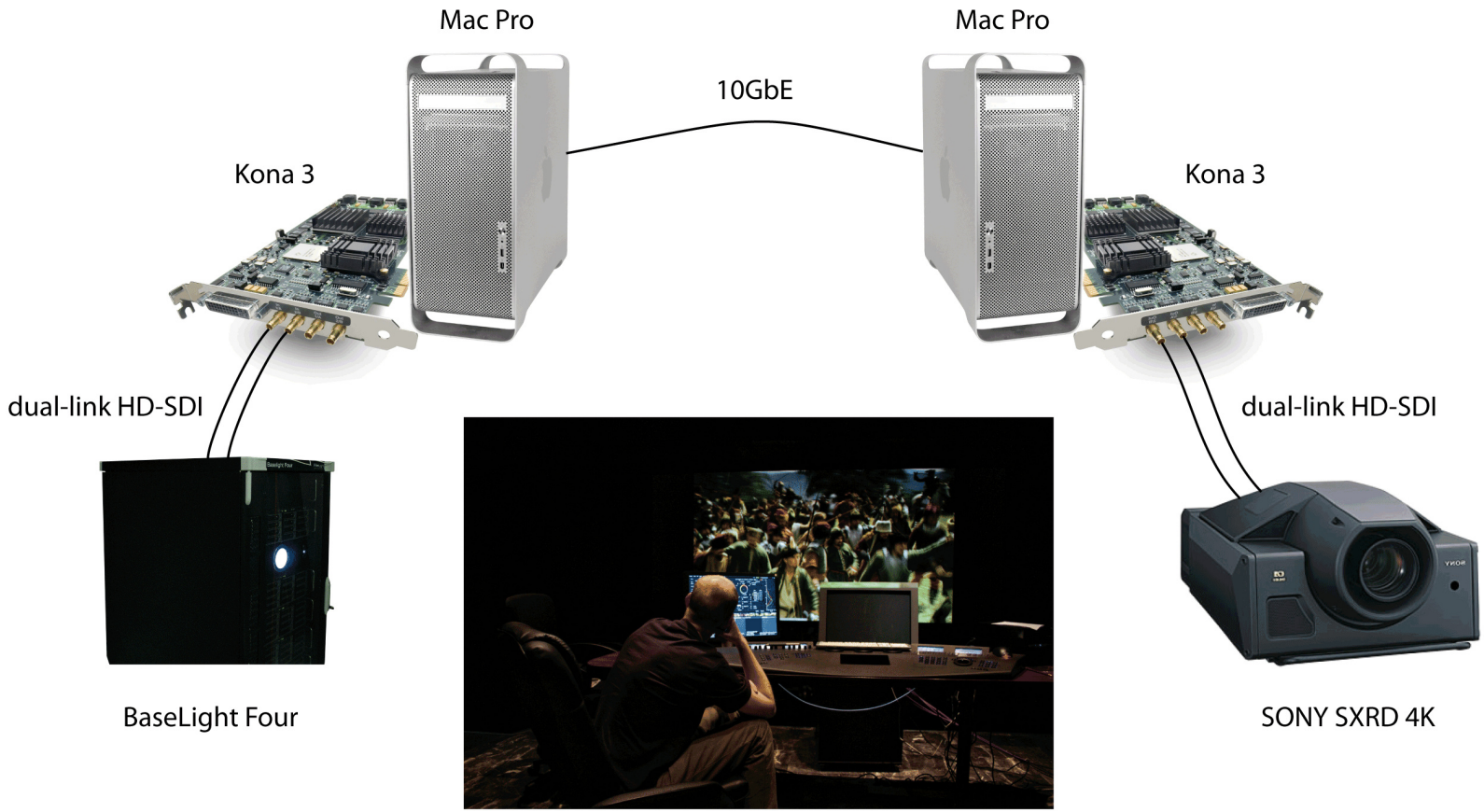
Scientific visualization

Applications of UltraGrid

Remote education

Applications of UltraGrid

Postproduction in cinematography



History of UltraGrid

- History of Development
  - 2002–2004: ISI EAST (720p)
  - 2005–2012: CESNET (Frame Rate 1080i)
  - 2006–2008: forks by KISTI (GUI, AJA KONA) and i2cat (SAGE)
  - 2013: i2cat starts contributing to the common codebase maintained by CESNET
- Some milestones
  - 2002: 720p
  - 2005: 1080i, multipoint
  - 2007: CPU compression, self-organization, optical multicast
  - 2008: 2K/4K
  - 2011: GPU compression
  - 2012: 8K

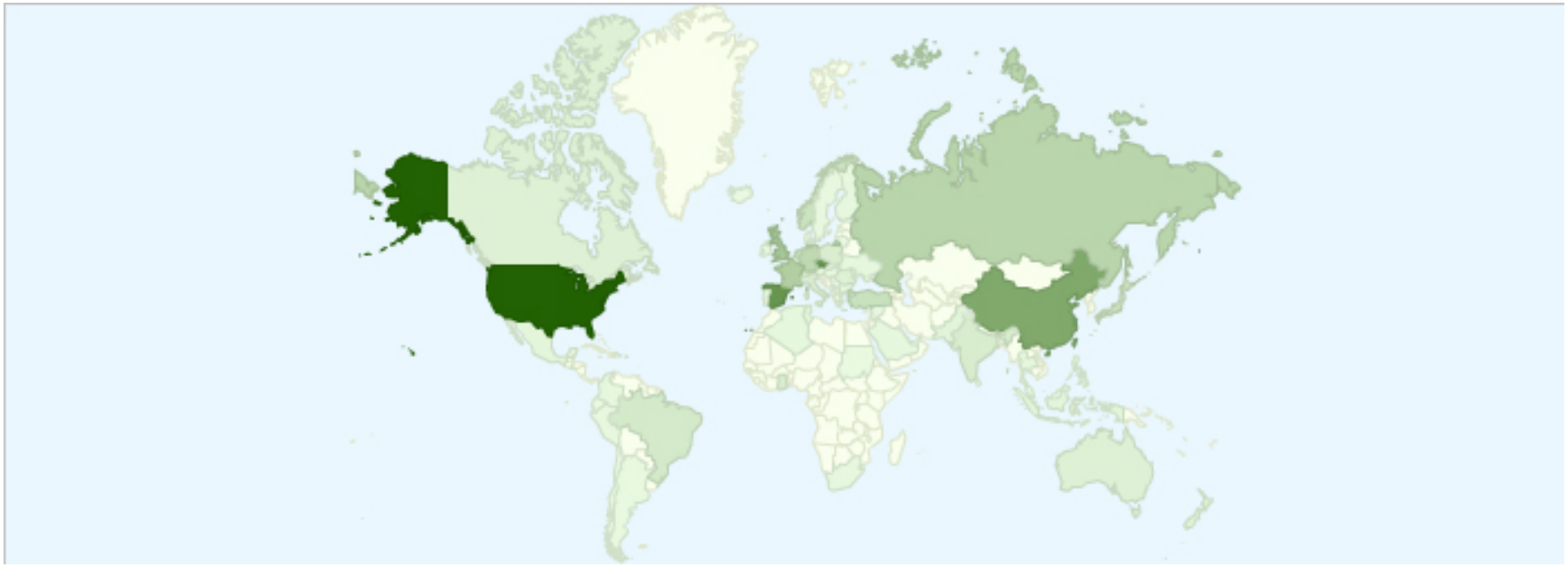
World Firsts . . .

- 2005 – Multi-Point Uncompressed HD
- 2007 – Self-Organizing Multi-Point Uncompressed/Compressed HD
- 2011 – 2011 – GPU-JPEG Transatlantic 4K
- 2012 – GPU-JPEG Transatlantic Multi-Point 8K
- 2013 – UltraGrid + CoUniverse + inter-domain bandwidth on demand

Features of UltraGrid

- Supported video formats: HD, 2K, 4K, 8K
- Uncompressed or low-latency compression
- Video input: capture cards HD/3G/6G-SDI, SDI, HDMI
- Video output: playback cards HD/3G/6G-SDI, SDI, HDMI, SAGE
- Synchronization of audio with video
- Simple GUI
- Network transmission format – extended RTP

UltraGrid – Users Worldwide



- Installations around the world:
  - Czech Republic (universities and university hospitals), USA (UCSD, UMich, UIC, Internet2, NLM/NIH, NorthwesternU, . . .), Spain (i2cat, UPM), Portugal (FCCN), Netherlands (SARA), Poland (PSNC), Korea (KISTI), Russia, Germany (H-BRS), Japan (AIST),. . .

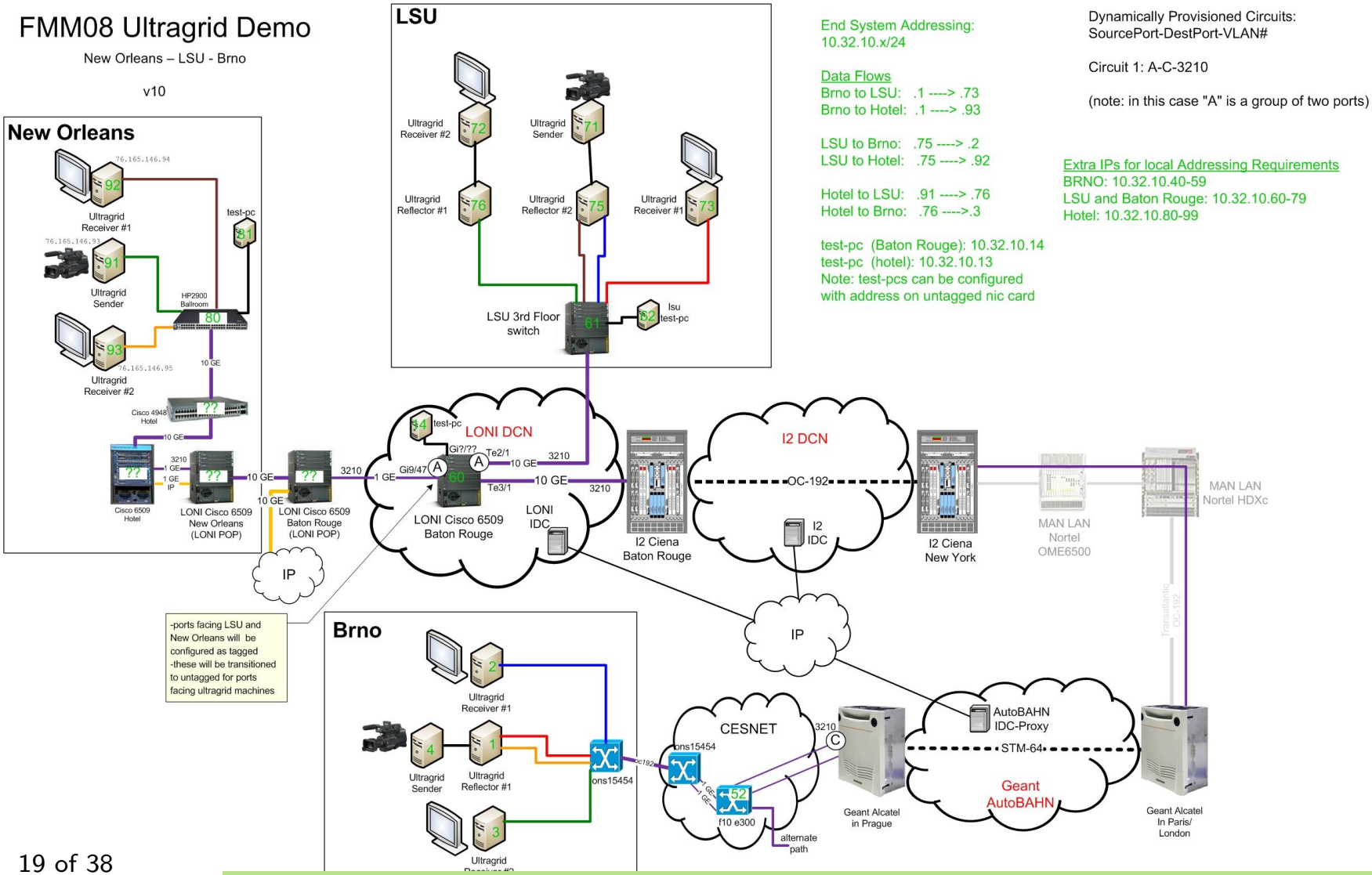
Technology

- UltraGrid – high demand on data transportation
  - bandwidth, throughput, delay, jitter ...
  - in best effort network?
  - need orchestration of network sources
- Solution: CoUniverse

CoUniverse – motivation

- Bandwidth demands comparable to network link speeds (10 GbE) requires careful planing and configuration of infrastructure
- Usually large number of components needed to build the environment (SW, computer and network resources)
  - each one of them needs to be configured
  - hard to orchestrate them manually to build the desired environment
- Virtually no adaptivity to changing application and network conditions
  - virtually impossible to cope with network events manually

CoUniverse – motivation



End System Addressing:
10.32.10.x/24

Data Flows
Brno to LSU: .1 ----> .73
Brno to Hotel: .1 ----> .93

LSU to Brno: .75 ----> .2
LSU to Hotel: .75 ----> .92

Hotel to LSU: .91 ----> .76
Hotel to Brno: .76 ---->.3

test-pc (Baton Rouge): 10.32.10.14
test-pc (hotel): 10.32.10.13
Note: test-pcs can be configured with address on untagged nic card

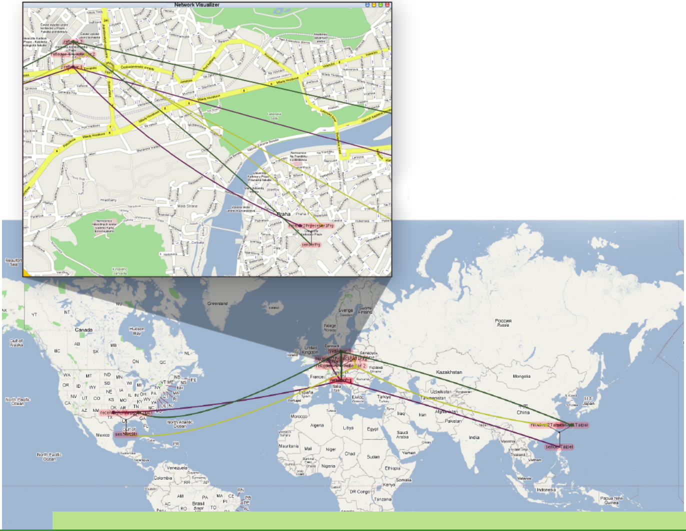
Dynamically Provisioned Circuits:
SourcePort-DestPort-VLAN#

Circuit 1: A-C-3210

(note: in this case "A" is a group of two ports)

Extra IPs for local Addressing Requirements
BRNO: 10.32.10.40-59
LSU and Baton Rouge: 10.32.10.60-79
Hotel: 10.32.10.80-99

CoUniverse


Network Visualizer
Praha
Greenland
Canada
Hudson Bay
Mexico
Россия Russia
Kazakhstan
Mongolia
China
India
Japan
France
Italia
España
Algeria
Libya
Egypt
Brasil
Venezuela
Colombia
Indonesia
DR Congo

CoUniverse Overview

- Middleware aimed on self-organization and orchestration of applications to build ad-hoc environments for real-time data transmissions on top of physical networking infrastructure
- Support for legacy applications producing streams with bitrate comparable to capacity of the network links
- Continuous adaptation to changing networking infrastructure
- User-empowered approach where possible

CoUniverse Building Blocks

- Network nodes running CoUniverse peers organized into network sites
- Network organization
  - based on local information only (user-empowered approach)
    - node information: name, site, GPS coordinates for visualization
    - interfaces: IP addresses, identification of networks
    - applications/senders: available formats, bitrates, qualities
    - applications/receivers: available formats, requested source sites
  - end-to-end view of networking infrastructure
- Monitoring
- Application Group Controller (AGC)
  - maintains representation of the network topology
  - plans media streams transmissions
  - indirectly controls the network resources

Self-organization in CoUniverse

- Media streams planning:
  - plan transmissions of media streams produced by media applications over particular network links
  - planning based on constraint programming
  - planning of media streams using bandwidth close to physical link capacity is hard
- Automated configuration and invocation of the orchestrated environment components
- Resilience:
  - ability to react to changes/failures in the network infrastructure, media applications etc.
  - achieved by monitoring, infrastructure changes and/or failures lead to new media streams plan

CoUniverse – summary

- Aim on real-world applications, environments and problems
- CoUniverse orchestrated applications
- Users do not need to know anything about their circuit network (only the endpoint name)
- Successful demonstrations
  - ESCC/Internet2 Joint Techs Workshop
  - Spring 2009 Internet2 Member Meeting

CoUnSiL

- Necessary assumptions fulfilled
  - UltraGrid – high video quality videoconferencing system
  - CoUniverse – solution for network support
- Special features for interpreted teaching needed
  - roles support (student, teacher, interpreter)
  - dynamic adaptation for students connecting and disconnecting
  - support for speech allocation
  - different windows decomposition for different roles

CoUnSiL – Principals

- CoUniverse creates P2P network above the connected end-stations
  - individual UltraGrid transmissions are setup and teared according to client's end-station request
- Library WDDMAN (GUI objects manipulation) replaces videoconferencing windows

CoUnSiL – User friendliness

- CoUniverse is developed for general use – complicated setup
  - for specific usage setup with practically all setings predefined
  - Start of the system on one Click
- Messages in P2P network iare enlarged by the information about the role
- It is possible to add new roles simply
- UltraGrid applications starts automatically, when new participant connects/disconects

Support of speech allocation

- Non usual feature for videoconferencing system, kind of moderating
- Implemented by extension of CoUniverse (not UltraGrid)
  - new type of P2P messages for asking and allocating speech
- Highlight windows with active users (UltraGrid)

Testing

- Testing with future users – photos
- Questionnaires and group discussion with users after the test – feedback
- Testing
  - demand quality of video
  - users interface
- Implementation of users feedback

Testing


decentralizovaná správa
rychlá adaptace na nový stav topologie sítě
spolehlivost
řízení toku dat – ochrana proti zahlcení
Luděk Matyska a Eva Hladká (FI MU)

Testing

Testing


datovým tokum
decentralizovaná správa
rychlá adaptace na nový stav topologie sítě
spolehlivost
řízení toku dat – ochrana proti zahlcení

Testing

Conclusions

- CoUnSiL - sytem for remote interpretation to sign language combine
  - UltraGrid – videoconferencing with high quality video
  - CoUniverse – self organizing collaborative support
  - WDDMan – library for GUI manipulation
  - implementation of roles
- Prototype implementation, tests with users, users feedback
- Project MUNI33/022014, 1.4. 2014 – 31.12. 2014

Future work

- Follow–up project of FR CESNET just accepted
- Phased CoUnSiL implementation to the education process on MU
- Implementation of next features
  - shared presentation, shared whiteboard
  - analysis for mobile platforms support
- Publication of results achieved

Thanks

- FI a ÚVT MU, CESNET, Teiresias
- Petr Holub and all UltraGrid developers
- Miloš Liška, Pavel Troubil a Hana Rudová and all participating on CoUniverse developing
- Vit Rusňák, Peter Novák, Jaromír Kala and others working on CoUnSiL
- ...

Marek Eben:

"Totiž to, co vyhovuje postiženým, vyhovuje i nám. Oni vlastně potřebují luxus. Před časem jsme si řekli, že Markéta by měla mít elektricky polohovatelný rošt v posteli, aby se lépe dostala na vozík a zpět. Přišli jsme do obchodu, kde mají dvoulůžka, ovládání na záda, na nohy, na kolena, nekloužete dolů. To se mi líbilo. Říkal jsem si, tak ona bude mít polohování a já ne, to budu zelenej závistí každý večer! Já chci také dva elektromotory! A tak máme doma čtyři elektromotory a nacvičili jsme moc hezké sestavy. Jeden jede nahorů, druhý dolů, taková spartakiáda, moc pěkné. Je to značka Ason a výborně slouží. Markétě to pomůže a já nezávidím."

Thank you for your attention.