

ULICE WP 3

„Biologically based expert system for individualised patient allocation“

Michael Baumann
Wolfgang Enghardt
Uwe Just

*OncoRay – Center for Radiation Research in Oncology,
Medizinische Fakultät Carl Gustav Carus, Dresden, Germany*

Goal: Development of a software prototype to support the evaluation of radiation treatments with different radiation modalities, with two different orientations:

1. Research: Multiparameter analysis for comparison of different treatments
2. Clinical application:
 - Optimization of patient allocation
 - Optimization of existing resources (hadron therapy centers)

Conclusion of the literature research in

WP 3.1 (TUD): Evaluation of the world-wide radiobiological data base for rational decision making in prescription of different hadron beams

The current available data on the effect to tumors and normal tissues of different beam qualities defined the approach for the software tool

Current, **retrospective information is not sufficient** for setting up a systematic for patient selection

Not only tumor but also normal tissue has to be included in the analysis, therefore the basis must be **treatment planning** information

Modified goal

Development of a software tool

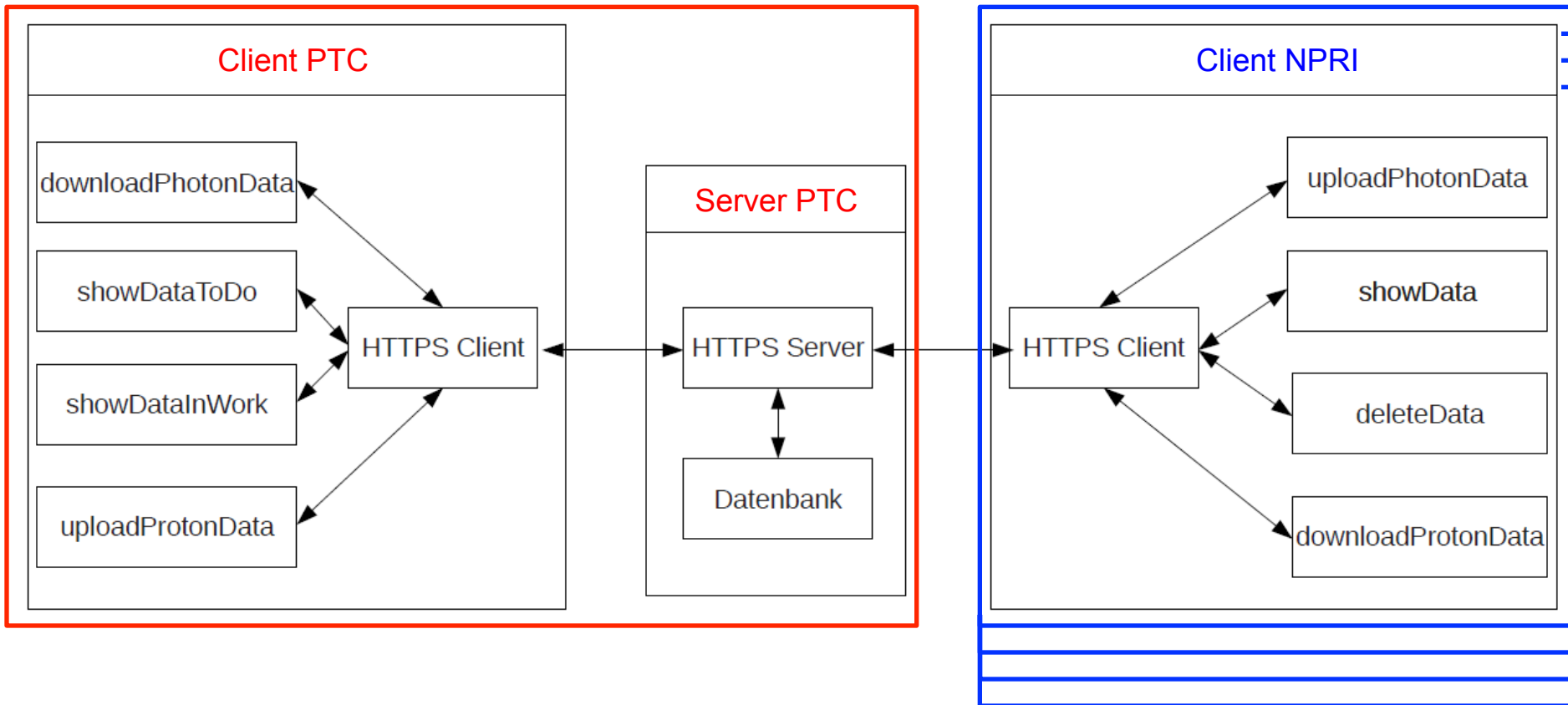
- Support of identification of patients expecting maximum benefit from PT
- Active participation of “non particle” radiooncology institutions (NPRI) in the therapy decision process
- Support of referring of patients from NPRI to particle therapy centers (PTC)
- Supports the installation of networks between NPRI and PTC

Plan calculation and comparison tool (step 1)

- Particle plan calculation exclusively in PTC
- Therapy decision in NPRI

Implementation of TCP and NTCP models for prediction of outcome (step 2)

The IT-solution (U. Just, K. Roth)



The IT-solution: Implementation details (I)

Requirements:

- License free (open source software products)
- Standardized
- Simple
- Safe

Solutions:

- Programming language: Python
 - Object oriented high-level language
 - Compatible with usual OS (Windows, Mac OS X, Linux)
 - Standard libraries for network communication
 - Interface to SQL data base language
 - Interface to C++ library Qt⁵ for graphical programming
- Data base management: MySQL
 - Based on SQL (Structured Query Language)

The IT-solution: Implementation details (II)

Pseudonymization and encryption:

- Pseudonymization:
 - Individual patient data not transferred to PTC
 - Transfer of unique patient identifiers (UID)
- Encryption of UID
 - Advanced Encryption Standard (AES)

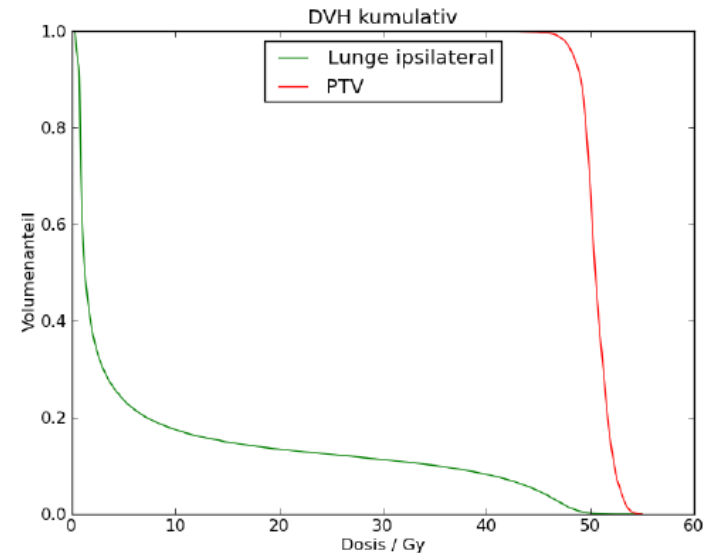
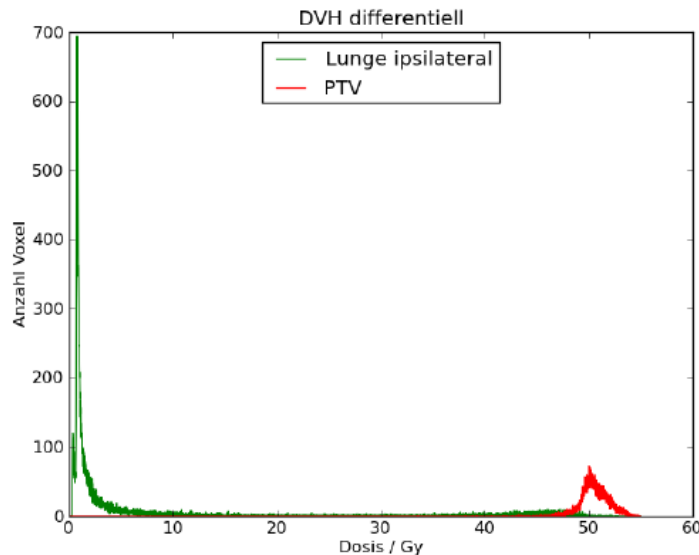
Data transfer protocol:

- DICOM objects and data structures (CT data, RT-Struct, RT-Plan, RT-Dose)
- Hypertext transfer protocol secure (HTTPS)

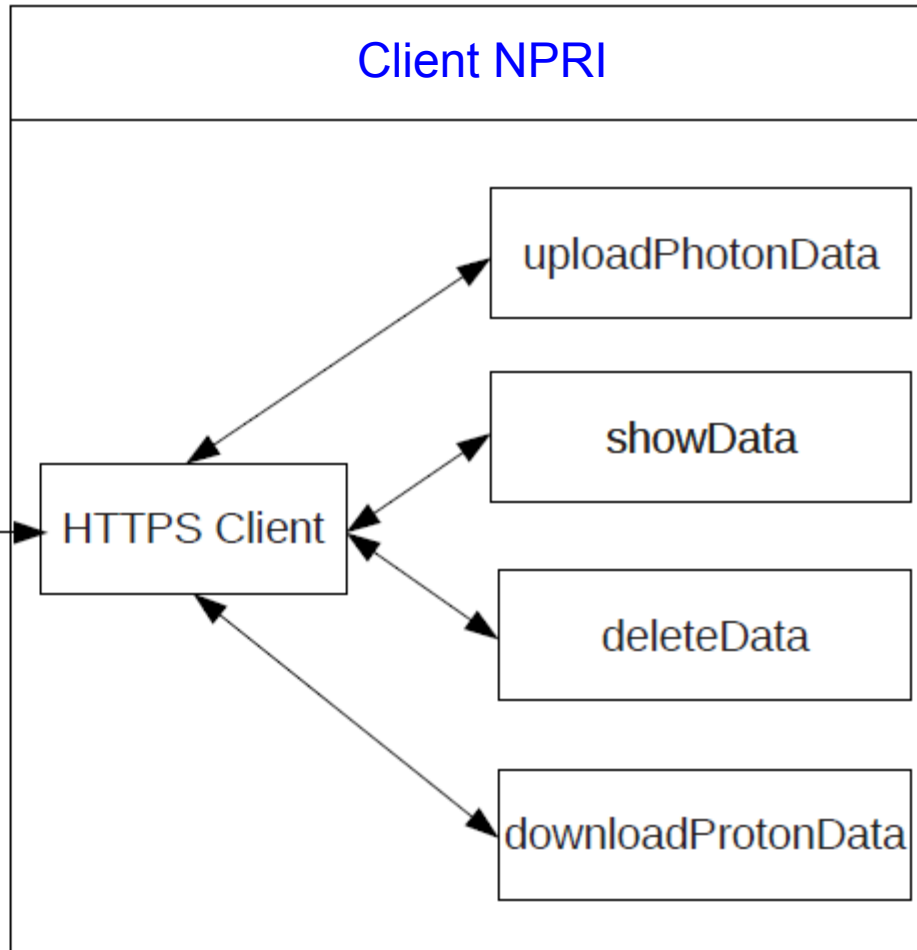
The IT-solution: Implementation details (III)

Simplicity and Safety:

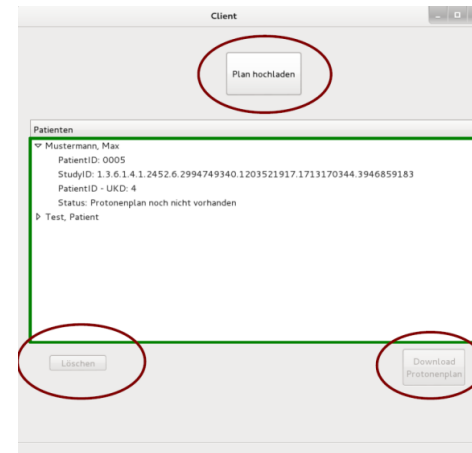
- Plan evaluation at NPRI:
 - By means of the **existing photon TPS** (p-TP → template of the X-TP)
 - DVH calculation from data base (without TPS)
- Prevention for using the proton plan at photon machines
 - No device and beam parameters transferred



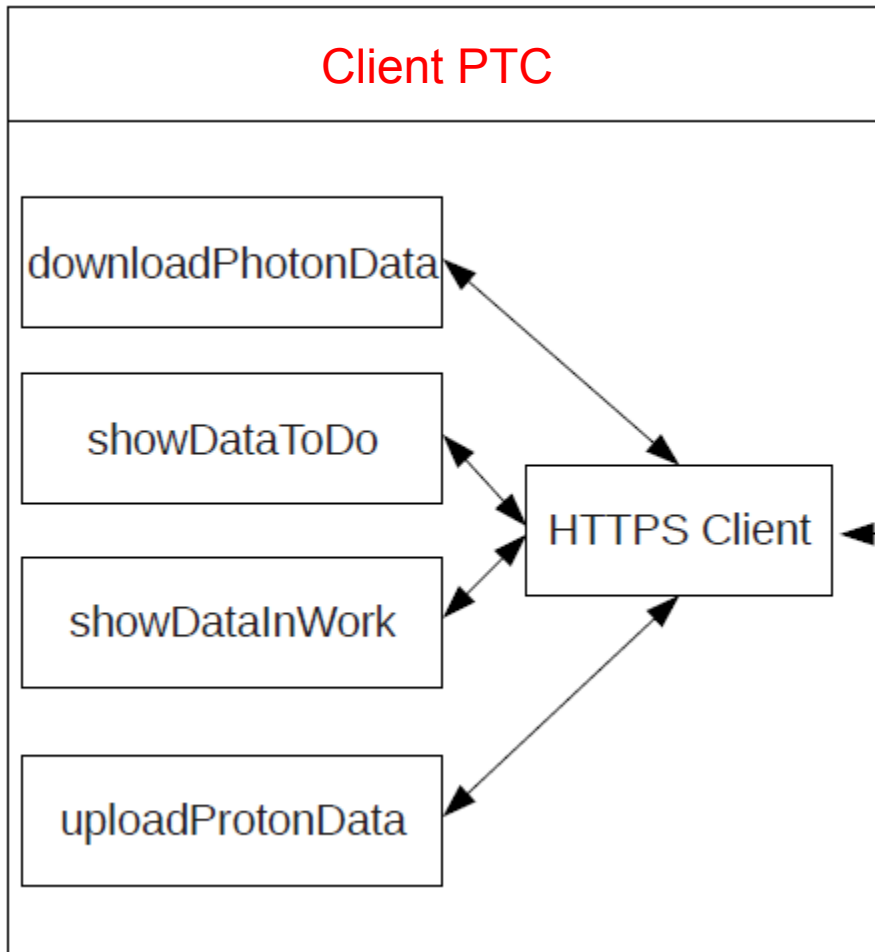
Functionality Client NPRI



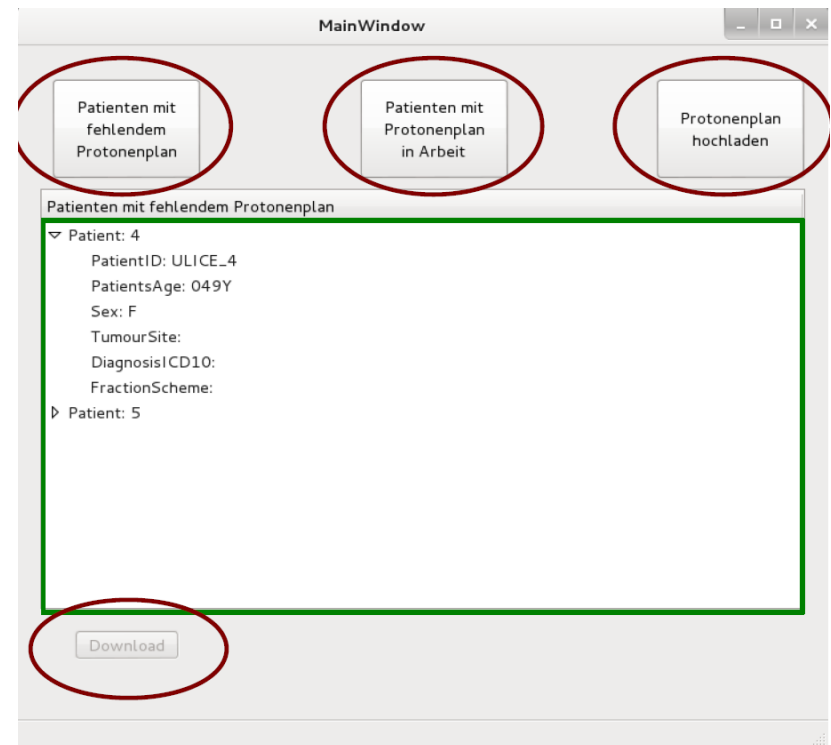
- Upload of photon TP data to PTC server
 - Pseudonymization
 - Encryption, decryption
 - Key management
 - Data integrity tests
- Display of uploaded data
- Deletion of uploaded data
- Download of particle TP data from server
 - Re-pseudonymization



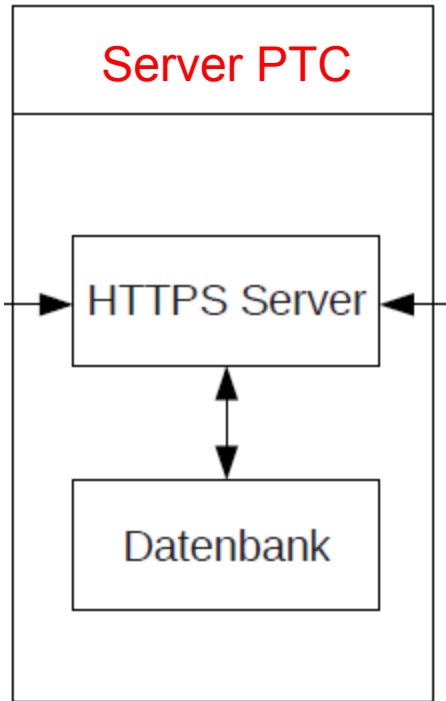
Functionality Client PTC



- Status display
- Download of X-plan from server
- Upload of p-plans to server



Functionality Server PTC



- Storage of X-TP:
Folder: NPRI\Patient_UID
- Data base management
- Storage and formatting of p-TP
- Data management
- DVH calculations

Results

- System fully tested and operational at OncoRay
- p-TPS: Oncentra Masterplan Protons
- Compatibility with X-TPS
 - Oncentra **Masterplan** External Beam
 - Varian **Eclipse**
- Incompatible with Philips **Pinnacle**:
 - TPS incapable of re-importing RT-Dose-Objects
 - Philips: future versions of **Pinnacle** will have this performance
- Open for the implementation of biological models on the server
 - Verification by implementation of DVH calculations
- Implemented relational database
 - Storage of clinical data feasible
 - Follow up, therapy results

Conclusions

- Web based system for supporting a cooperative decision on patient allocation to PT **technically feasible**
- Design requirements met
- Key step for a successful completion of ULICE WP3
 - Investigate and solve compatibility with other TPS (photons, particles)
 - Implementation of biological models
 - Beta-testers from the ULICE community kindly requested (spring 2013)

