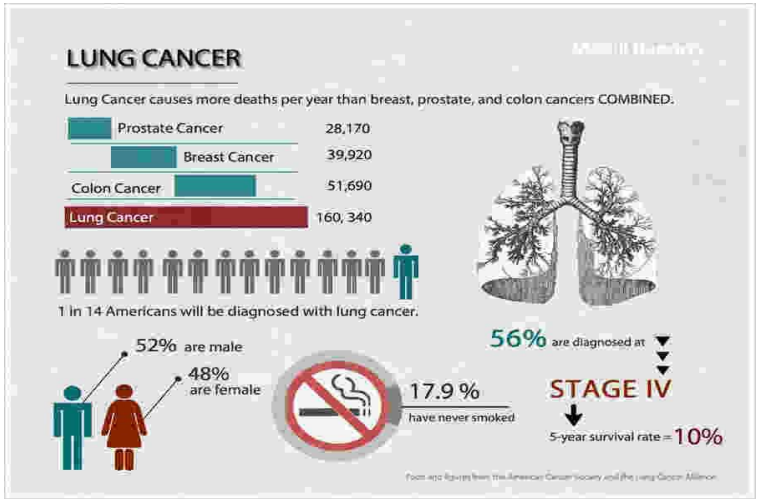
Clinical validation of the M5L lung Computer-Assisted Detection system

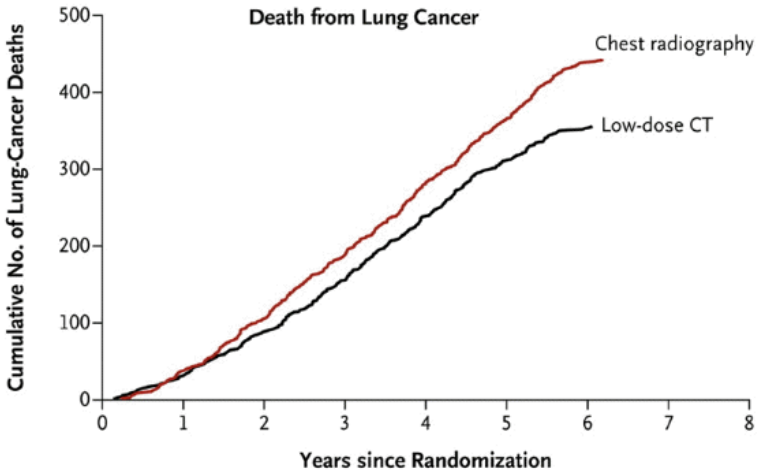
E. Lopez Torres[1,2], A. Traverso[3,1], S. Bagnasco[1], C. Bracco[4], D. Campanella[5], M.E. Fantacci[6,7], S. Lusso[1], D. Regge[5], M. Saletta[1], M. Stasi[4,1], S. Vallero[1], L. Vassallo[5], P. Cerello[1]

[1] INFN, Sezione di Torino, Torino, Italy
[2] CEADEN, Havana, Cuba.
[3] Physics Department, Polytechnic University of Torino, Torino, Italy.
[4] Medical Physics Unit, Candiolo Cancer Institute-FPO, Candiolo, Italy.
[5] Radiology Unit, Candiolo Cancer Institute-FPO, Candiolo, Italy.
[6] Physics Department, University of Pisa, Pisa, Italy.
[7] INFN, Sezione di Pisa, Pisa, Italy

Geneva, 15-19 February 2016

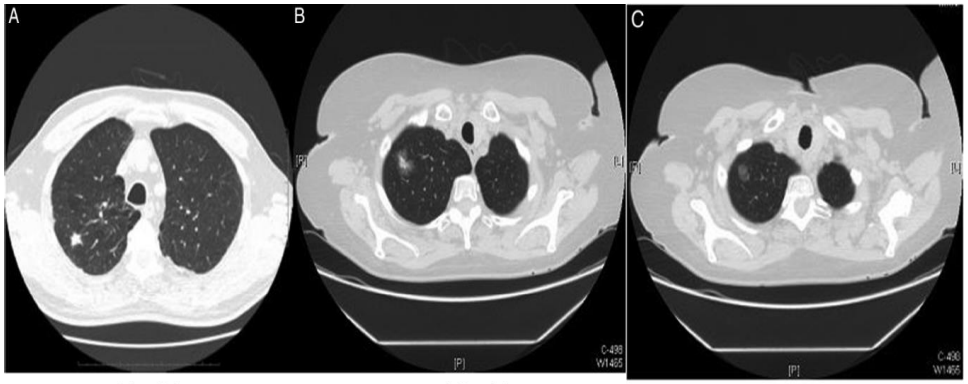
Lung Cancer





- Many lung cancers are detected in late-stage, when the probability of survival is low
- Low-dose chest CT screening trials reduce mortality
- Screening high risk individuals for lung cancer with low-dose CT scans is now being implemented in the United States and other countries will likely follow

Automated Detection of Lung Cancer



- The **detection** of **pulmonary nodules** is a very time-consuming / **difficult task** for radiologists:
  - Poor contrast / noisy images
  - Large number of 'slices' to be analysed

- **Computer Aided Detection** (CAD) algorithms for the automated detection of pulmonary nodules

- **CAD increases the performance of radiologists**
- **combining different CAD** algorithms **increases** the **sensitivity**

CAD: status and challenges

Despite proven benefits, the usage of CAD in clinical practice has not spread (yet)

CAD: status

Stand-alone workstations with high SW license cost

Dedicated HW + **Static** Computing **resources**

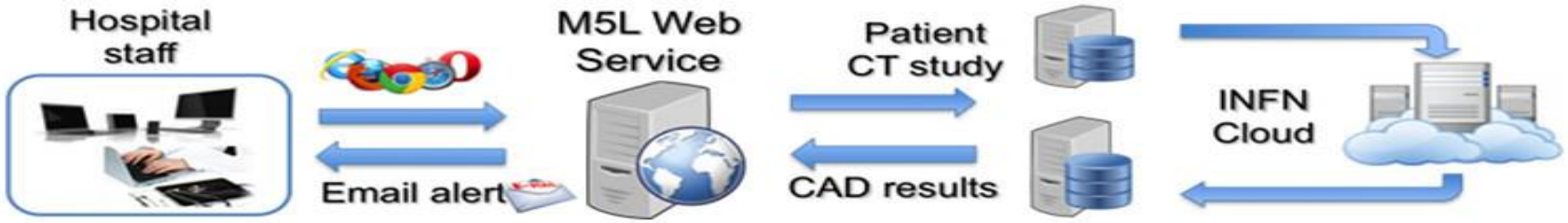
Difficulty to share medical results between radiologists of different medical facilities

CAD: prospects

CAD results available **without** requiring **any HW/SW** installation

Sharing medical annotations between several medical facilities + **Combining several CADs**

M5L on-demand lung CAD service



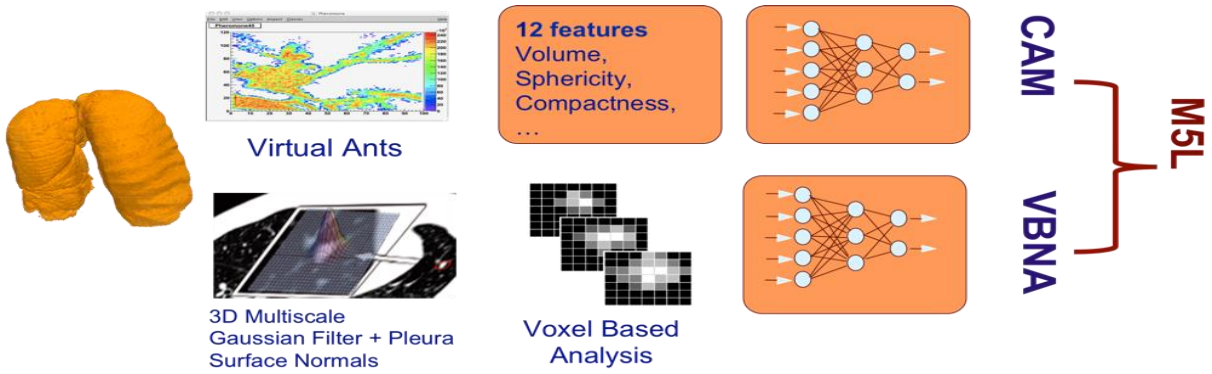
three functional blocks

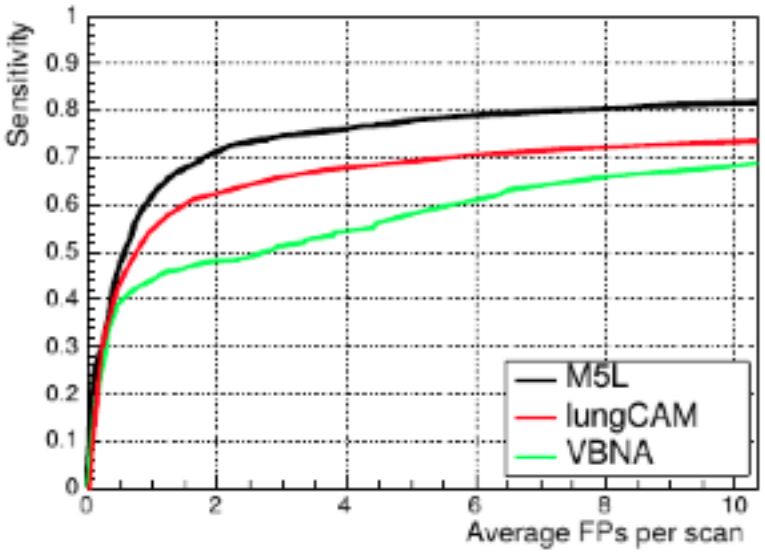
Web front-end for CT submission, access to CAD results, review, on-line medical annotations

Cloud back-end for image analysis

Combination of independent CAD systems
for the automated detection of pulmonary nodules

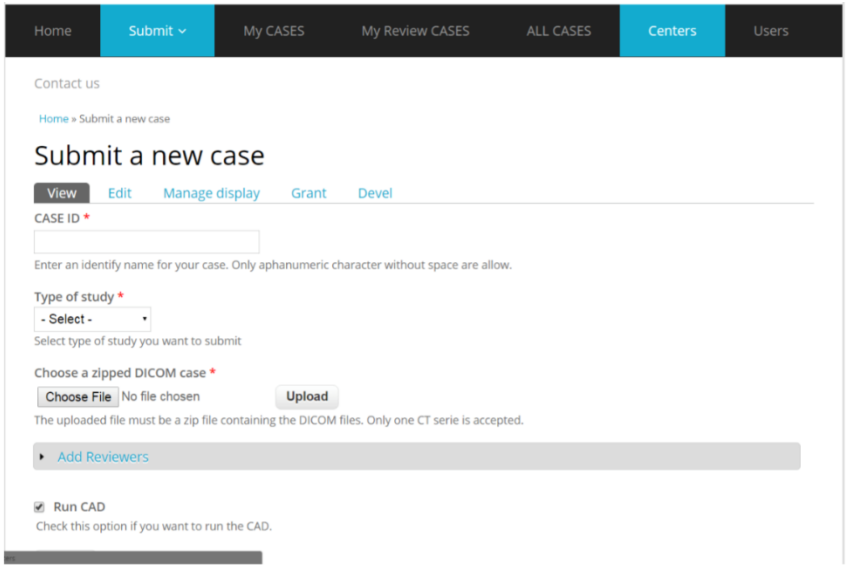
M5L: large scale validation

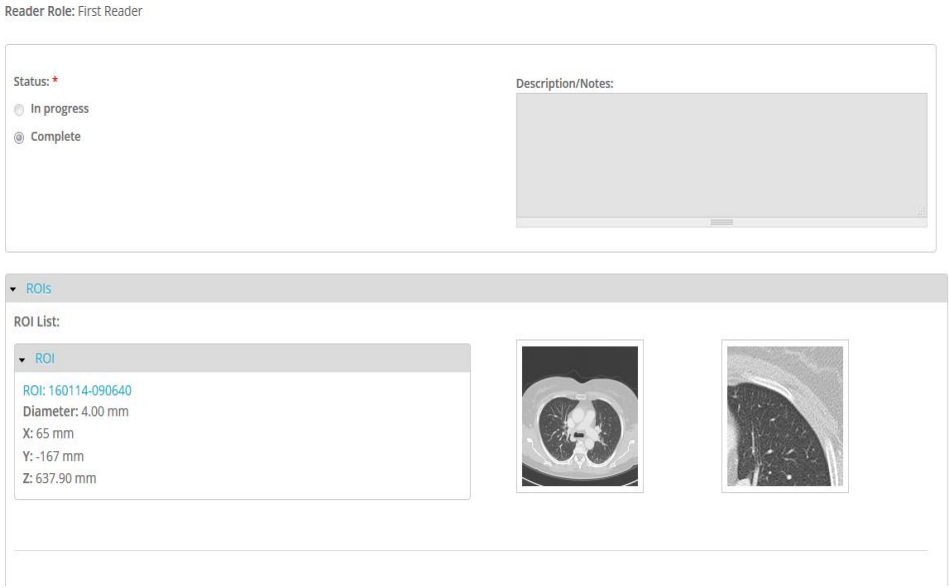




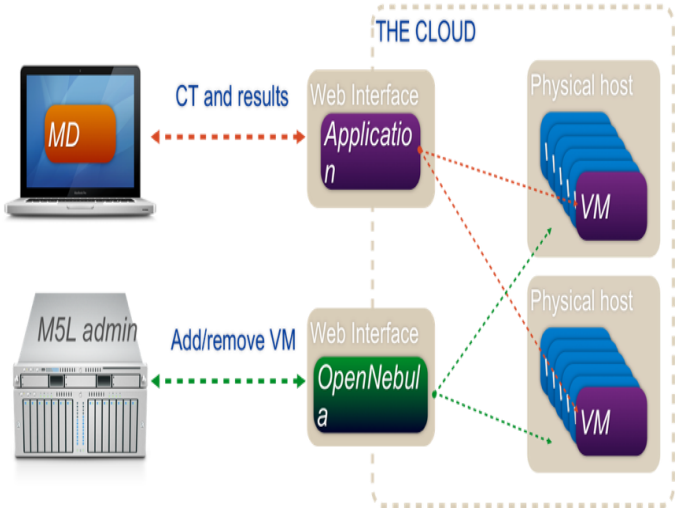
- Validation on **1043** CT scans from **3** independent datasets, including the full LIDC/IDRI
- Results consistent across data-sets
- sensitivity of about 80% in the 4-8 FP findings per scan range

Web front-end: m5l.to.infn.it





Cloud back-end @ INFN Computing Centre



- **Infrastructure As A Service**: resources allocated according to user requests

- **SW as a Service**: CAD algorithms computed by virtual machines

- **Virtual Machines (VM)** nodes are instantiated in real-time according to the required computing power

- **no HW/SW requirements to users**
- **combine multiple CADs, leading to an increase of the performance**

Clinical Validation / **preliminary**

Collaboration with the Radiology Department of IRCCS Candiolo (Italy)

- every day CT scans of oncological patients under-going staging or re-staging are submitted to M5L
- three radiologists independently annotate the CTs (**first-reader mode**)
- CAD results are made available to radiologists for review (**second-reader mode**) only after the first-reading annotation was completed
- Goal: dataset of about 1000 scans

	RAD0	RAD1	RAD2	RAD0&RAD1&RAD2	RAD0&CAD	RAD1&CAD	RAD2&CAD	RAD0&RAD1&RAD2&CAD
Nodules	35	38	19	17	38	41	30	36
FP/SCAN	3.25	4.02	3.4	3.6				
Sensitivity	**90%**	**86%**	**90%**	**89%**	**91%**	**87%**	**94%**	**95%**
TP added by CAD (relative %)	3 (9%)	3 (8%)	11 (58%)	9	-	-	-	-
FN	4	6	2	2	4	6	2	2

We would be pleased to increase our network of users: **m5l.to.infn.it**