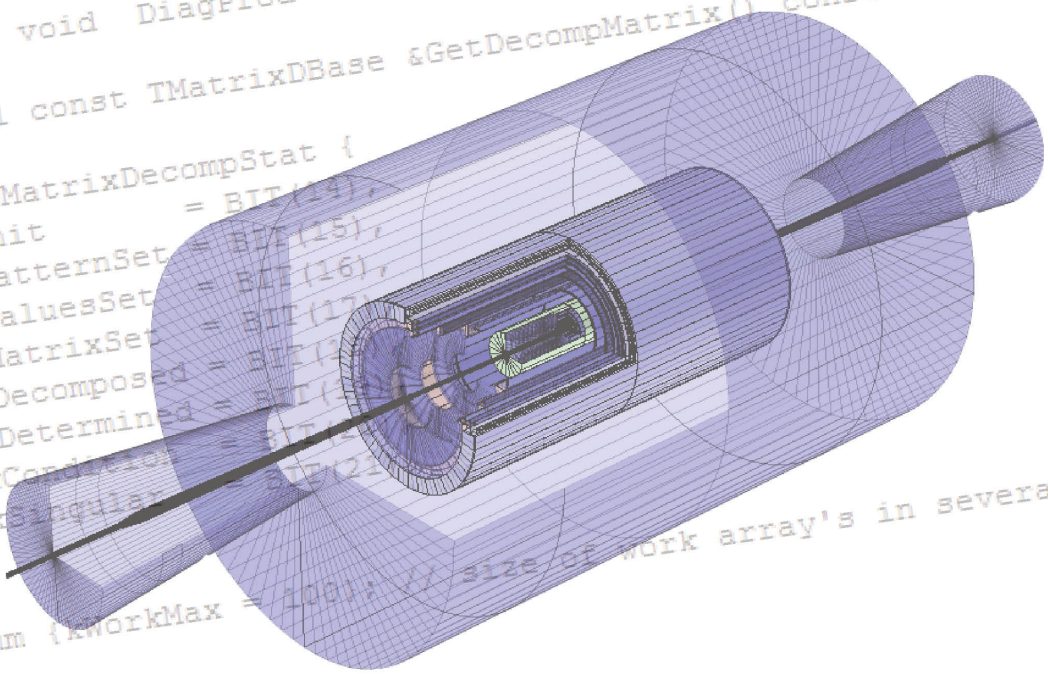


SCREENING WEEK REPORT ROOT TECHNOLOGY

```
public TObject  
d :  
e_t fTol;  
e_t fDet1;  
le_t fDet2;  
le_t fCondition;  
t fRowLwb;  
t fColLwb;  
ResetStatus() { for (Int_t i = 14; i < 22; i++) Reset  
Hager (Double_t& est, Int_t iter=5);  
void DiagProd (const TVectorD &diag, Double_t tol, Double_
```

```
virtual const TMatrixDBase &GetDecompMatrix() const = 0;  
enum EMatrixDecompStat {  
kInit = BIT(14),  
kPatternSet = BIT(15),  
kValuesSet = BIT(16),  
kMatrixSet = BIT(17),  
kDecomposed = BIT(18),  
kDetermined = BIT(19),  
kCondition = BIT(20),  
kSingular = BIT(21),  
};  
enum {kWorkMax = 100}; // size of work array's in several routi
```

```
public :  
TDecompBase();  
TDecompBase(const TDecompBase &another);  
virtual ~TDecompBase() {};  
inline Double_t GetTol () const { return fTol; }  
inline Double_t GetDet1 () const { return fDet1; }  
inline Double_t GetDet2 () const { return fDet2; }  
inline Double_t GetCondition () const { return fCondition; }  
virtual Int_t GetNrows () const = 0;  
virtual Int_t GetNcols () const = 0;  
Int_t GetRowLwb () const { return fRowLwb; }  
Int_t GetColLwb () const { return fColLwb; }  
inline Double_t SetTol (Double_t tol)
```



Eldri Coll Mossige, Øyvind Vesbøstad,
Petter Jacob Jacobsen, Line Magnussen

This report is a result of the MoU between NTNU School of Entrepreneurship (NSE) and the Knowledge & Technology Transfer (KTT) department at CERN. The report is a study of the technological opportunities and commercial potential of a technology from CERN, and was created by the students of NSE during the NSE Screening Week 2009 at CERN. In addition to this report, the students held a presentation on the same topic.

The technology was presented to the students Monday November 9th, with a deadline Thursday, November 12th. The presentation was held the following Friday.

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Summary

When dealing with the data results generated by CERN's particle collider, there is a need to handle and analyse immensely large data sets. For this reason, CERN has developed ROOT, an open source framework with all the functionality needed for this type of work. ROOT is freely available online and has been downloaded more than 550.000 times, mostly by physicists but also by commercial users such as financial institutions and insurance companies. Regardless, with the open source license and the secrecy in these sectors, it has proved difficult to find an adequate business model for commercializing ROOT. There are trends pointing towards ever increasing data volumes so there could be a further need for ROOT at a later point of time, this should be followed up by KTT. Due to the difficulties in discovering commercial potential there is a switch of focus midway in this report. In the second part we have focused on opportunities for enhancing the impact and outreach of ROOT, and what value this can generate for CERN.

Introducing ROOT in educational institutions will make competence in ROOT more general, and consequently make physics students worldwide familiar with CERN. Thus CERN's recruitment base will be expanded. A larger ROOT user group also implies more people giving feedback on the applications.

However, ROOT as it is today, is not suitable for educational purposes for 1st year physics students. Therefore, our proposition is that the development team makes a graphical user interface (ROOT educational edition) that presents the ROOT framework in a pedagogical way in order to lower the threshold for using ROOT in education. The ROOT educational edition can be promoted and distributed through the already existing network of ROOT utilisers who work in universities all over the world.

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Introduction

The alternatives for commercializing ROOT are hard to carry out. We consider the process for finding the conclusion to be relevant; therefore these alternatives are described in detail in the first section.

In the second section an alternative regarding educational purposes is described. This is a non-commercial solution, but relevant for CERN's overall goals. They state that CERN shall be an open organisation working for its technology to become as widespread as possible.

Product

Product description

ROOT is an object-oriented, C++ based framework which can be implemented to efficiently analyze large amounts of data. It is used by most high energy physics experiments in the world and has been downloaded 550 000 times since 1997. ROOT saves, accesses and processes data, and shows graphical results.¹

ROOT is built up of modules and users can choose the modules of their interest. Each module is specialized for a certain purpose and they range from mathematics to visualization. The users interact with ROOT writing complementary code and analytical algorithms.

By using ROOT the researcher saves time and effort handling the results from experiments through the analysing process. See also Appendix A.

IPR

ROOT is not patentable, and is available under the open source LGPL license. This means that every improvement to the code has to be distributed under the same conditions as the original. However, it is possible to write programs which interact with ROOT by dynamic linking. The resulting program can then be distributed under conditions defined by the copyright holder, as long as no direct changes are made to the licensed source code. In commercializing open source, dual licensing is often used to segregate the market; this cannot be made effective in retrospect, and is also not wanted by the programming team. It is possible, for whoever wishes it, to develop programs, routines and tools based on the license, as long as it is for internal use. In other words, the limitations in the license are only valid in case of commercial distribution.²

¹ <http://root.cern.ch>

² <http://www.gnu.org/licenses/lgpl.html>; Martin Stok NTNU TT; Martin Bekkelund, Friprogsenteret

Height of innovation

The ROOT framework has a large set of functions with different innovation heights, some of which are unique on a world scale. The framework is used by many top universities. All in all we consider the innovation height to be high.

Area of application

ROOT is a flexible framework which is adequate for data handling in relation to flight planning systems, insurance, stock market, pharmaceutical research, medical imaging, telecom, aerospace research, defense, oil, IT and different simulations. The majority of these sectors have developers in-house who have the competence needed for building their own interfaces.³

Another alternative area of application lies in the future where ROOT might be used for streaming software.

Market

Trends

The volumes of data handled by analysts are more than doubled every year.⁴ With increasing speed in multi core systems, this trend is likely to continue. In modern companies, knowledge based management systems are also gaining more importance as tools for rational decision making with data warehouses as a key component. Due to these trends the demand for systems with the capability to handle large data volumes is increasing.

Customer benefit

Root has a wide range of functions. ROOT's most important customer benefit, which also is why it was created, is the time savings in handling extreme volumes of data. The need for ROOT has emerged through CERN's particle physics research which creates data volumes in the range of 15 Petabyte annually⁵. It's also a benefit for many current users that the source code is open, so that they have the possibility to implement the ROOT functions they need for internal use. To sum up ROOT gives

- A wide range of functionality
- Time savings (equal cost savings) when handling large data volumes
- Easy to implement additional functionality (if adequate competence in-house)

³ Contact log: Håvard Sandvik

⁴ Julian Stuhler, Triton Consulting Ltd

⁵ Contact log: Axel Neumann

Substitutes and Competitors

Substitutes for ROOT will differ according to the different functionality wanted. For the numerical mathematics tools, Matlab is a well known commercial software package. For the implementation of databases and database management systems, there are countless variations of both open source and closed source commercial systems, with or without service offerings. None of these alternatives have the same capabilities in handling the extreme data volumes created by the CERN nuclear experiments that ROOT possesses.

The interpreter part is also said to be unique by the programming team.

There are some frameworks for handling sets of data which have some of the ROOT functionalities, but none with all the functionalities that ROOT supports.

In advanced finance modeling, Excel with C++ macros linked to external libraries is also being used.

Organization

Because of the Open Source philosophy, the development team receives contributions from users worldwide that write patches, report bugs and come with suggestions for improvement.

Thirteen people are currently employed at CERN to develop the ROOT framework. Two of them have been hired due to their contributions and feedback to the development team.

The development team consists of individuals highly educated within physics, computer science and other relevant disciplines.

ROOT's development team is dedicated, but have no intention or interest in commercializing ROOT. Some of them even believe that a commercialized ROOT would be a problem for the prioritizing of further development and customer service. The development team sees a potential commercialization possible only through an autonomous business unit.

The developers of ROOT are located at CERN. A competence intense start-up is dependent on getting a good agreement with the developers at CERN because of the complexity of the framework.

Business models

As pointed out earlier, the ROOT framework is distributed on an open source license without any economic compensation. Still, there is some widely used business models used in commercializing open source software.

The different possible business models are compared and linked to ROOT and CERN below.

Sell support services

One commonly used business model is to provide services to support the users of the software in question. However, we have not succeeded to reach the potential customers for this model. There are indications of commercial users in finance and insurance, specifically in the analytical departments thereof. These departments are secretive and hard to get through to. Also, due to the strong link analytical algorithms and data warehousing have to competitive advantage, the finance and insurance institutions are not willing to outsource these capabilities. It would probably be possible for members of the programming team to create a consultancy spin-off and get customers, based on their unique competence and through their network. However, the current growth potential in such a start-up seems limited, and losing parts of their key competence is clearly no good solution for CERN.

Proprietary components

As pointed out in the IPR-section, it is possible to develop programs which are dynamically linking to the ROOT framework. This can for example be a GUI (graphical user interface). There have also been problems revealing a specific demand for this. One idea could be to develop an educational package with an introduction to ROOT's functionality, data sets to which the students can develop analyzing routines and algorithms, complete with instructions on how to take further advantage of ROOT's strengths.

Dual licensing

Dual licensing is used for segregating for example commercial from academic usage. Due to the LGPL license under which ROOT is distributed, it is not possible to start dual licensing in retrospect so a change now would only apply to future upgrades. The development crew does not wish to limit the license in any way either.

Advertising

As the volume of users and downloads increases, the economic potential for marketing increases to the same proportion. ROOT is a high-technology product aimed at researchers. In order to maintain credibility, advertisements must be discrete. The fact that the framework lacks a GUI narrows the possibilities. A recommendation in this area could be to include discrete information about exchange programs, fellow program and employment options on the ROOT homepage. This advertising could create synergies and enhance the value of ROOT usage for CERN.

Conclusion

The conclusion to our analysis has been gathered in a SWOT.

S Unique functionality Used by most particle physicist worldwide User driven development CERN's credibility Downloaded over 500000 times	W Licensing terms Bugs in interface Lack of GUI Development team have no intention in commercializing ROOT
O Trends in increasing data volumes Substitutes very expensive Universities eager to use new technology	T Limited market Commercial users (want to) have competence in-house Commercial spin off, competence driven Advertising must be discrete

Out of the possibilities mentioned, it has already been argued that most of them are not easily feasible. The bold points in the SWOT-analysis are the main reasons for the difficulty in commercializing ROOT.

In the proprietary components section, the possibility of creating an educational package as an introduction to ROOT is mentioned. After giving this some consideration and analysis, we conclude that this is an exciting idea, but that the commercial potential is confined. A GUI for learning purposes can be made for universities teaching experimental physics, though, the market is limited. A GUI based on the current interface of ROOT will get the same bugs that the current interface is struggling with. A GUI controlling the framework directly will be a comprehensive job to build.⁶ Still, developing such a tool could be valuable to CERN in other ways than the purely economical.

⁶ Contact log: Axel Neumann

Enhancing ROOT's outreach and generating value

Background

CERN is a driving force within technological development. Several technological instances follow up on what CERN generates. To a further extent than most other technology transfer centers, KTT's mandate is to make technology available to the society rather than to make money for the institution. This is stated in the CERN convention from 1954: *"(...) the results of its experimental and theoretical work shall be published or otherwise made generally available."* With this mandate in mind, we have focused on possibilities for enhancing the impact and outreach of ROOT, and how this can create value to CERN.

In this context, the most obvious entrance is through educational institutions. Using ROOT in education, the physics students will learn to use the same tools that scientists are using in their work. In continuation, educational use of ROOT is the main focus.

Trends

The switching from the diploma model to bachelor/master system was agreed upon in the Bologna accord of the European Union, and it entails changes in the organization of the study programmes at all European universities. One of the changes that have come as a result of the Bologna process is that the universities are to implement more practical subjects in the first three years of several fields of study in order to make the bachelors more fitted for work life. As a direct result of this, some universities (such as University of Bonn and UCL) have already initiated programming courses in their physics education.⁷

Need/benefits

Educational institutions' point of view

It is important for universities and other educational institutions to be up to date on technology. Having systems and methods used in research incorporated in educational courses, can raise the standard and reputation of the university and its students. The students will also gain relevant experience for possible subsequent researching. Many of the systems that are used for educational purposes today are expensive and only to a little extent used by physicists (e.g. Matlab).

CERN's point of view

CERN's most important asset is brain power. Recruitment of top students and researchers is essential. The common practice in European universities today is that only students who discover a need to use ROOT through their thesis work, get to know the framework. ROOT is thus reserved for particularly interested students. It would be profitable for CERN if ROOT were taught to young physics students from their 1st or 2nd year of study. Introducing ROOT and its scope in such an early

⁷ Contact log: Duc Bao Ta

stage will make competence in ROOT more general, and consequently CERN more known for students worldwide. This again, will broaden CERN's recruitment base.

ROOT's user group is an important source of feedback for CERN and many of the users are also contributors. This implies that CERN has interest in spreading ROOT to as many users as possible.

Challenge

The current ROOT interface is text based and controlled by C++, which 1st and 2nd year students haven't yet learned. Additionally, the interface has a few bugs, which makes it inadequate in educational contexts. A researcher at the University of Karlsruhe (who wishes to be anonymous)⁸ says that he sincerely hopes that teaching of ROOT in compulsory courses will not happen at his university. This, he says, is due to the many bugs in the interface. He acknowledges ROOT as an extremely powerful tool, but wishes it far away from physics education because the students may learn bad practices in coding.

Solution

A way to meet these challenges is to develop a new comprehensible and improved GUI. It will be an interface that targets 1st grade physics students, with the intention to introduce them to ROOT as early in their study as possible. Since first grade students don't know the C++ language, the interface will lower the threshold to use ROOT for educational purposes.

⁸ Contact log: University of Karlsruhe

Strategy

Development

Design, psychology and teaching are not core competences at CERN, and our suggestion is that CERN establishes a team to develop the technical features of the GUI, and that they hire in consultants to build the educational structure and to design the interface to make it adequate for educational purposes.

ROOT educational edition will be open source like ROOT, and can be downloaded from CERN's home page. If the CERN management can be convinced that the ROOT Educational Edition will create value to CERN, they may also be convinced to finance the project. Other sources of funding might be CERN's marketing department for recruitment.

Distribution

ROOT is already in use at universities worldwide for research purposes. Many of the users are also contributors to ROOT. CERN can make use of these relations and create a scheme where they introduce ROOT's educational edition to the researchers at the universities, and encourage them to promote it to their departments and try to incorporate it in their courses, even to make it compulsory. The timing may be just right as the Bologna accord requires European universities to incorporate some practical subjects in the first three years of their educations.⁹ In physics educational programs, programming courses are quite commonly implemented in order to comply with this requirement.

Conclusion

The focus in section 2 has been to create value for CERN by reaching out to a larger user mass with ROOT through implementing it in educational programmes.

Currently, there exists no explicit demand for the ROOT framework for educational purposes in universities on undergraduate levels. Still, we have revealed that an educational edition of ROOT can complement physics programmes and simultaneously create value for CERN.

If students get in touch with CERN's technology in an early phase of their studies this will create interest for future employment or cooperation and ensure a recruitment base of students familiar with CERN research and technology. The Bologna process requires European universities to incorporate more practical subjects in their programmes. This also applies to physics, and we find that ROOT educational edition could be a good alternative. Because of the bugs in ROOT's interface, and the lack of programming skills on physics undergraduate level, a GUI must be developed in order to get admittance into undergraduate physics education. The development and distribution of ROOT educational edition could be an interesting project for NTNU's School of Entrepreneurship.

⁹ Contact log: Duc Bao Ta

Appendix A

Below, you can find a quick overview of the ROOT framework ("Gentle introduction"), which is summarized here:

- **Save data.** You can save your data (and any C++ object) in a compressed binary form in a ROOT file. The object format is also saved in the same file. ROOT provides a data structure that is extremely powerful for fast access of huge amounts of data - orders of magnitude faster than any database.
- **Access data.** Data saved into one or several ROOT files can be accessed from your PC, from the web and from large-scale file delivery systems used e.g. in the GRID. ROOT trees spread over several files can be chained and accessed as a unique object, allowing for loops over huge amounts of data.
- **Process data.** Powerful mathematical and statistical tools are provided to operate on your data. The full power of a C++ application and of parallel processing is available for any kind of data manipulation. Data can also be generated following any statistical distribution, making it possible to simulate complex systems.
- **Show results.** Results are best shown with histograms, scatter plots, fitting functions, etc. ROOT graphics may be adjusted real-time by few mouse clicks. High-quality plots can be saved in PDF or other format.
- **Interactive or built application.** You can use the CINT C++ interpreter or Python for your interactive sessions and to write macros, or compile your program to run at full speed. In both cases, you can also create a GUI.

Source: <http://root.cern.ch>

Date	Name and contact info	ES ref	Info	Further contacts
10.11	Svein and Vegar	All	<p>How to make money on ROOT? What kind of license in on ROOT. How much money you can earn depends on how easy it is to download. GPL-license is the most hardcore. Important to find out how many people who are working on the framework, if people around the world can personally make changes to ROOT. Would recommend us to build further on the existing program, making it easy for businesses with huge amount of data and with lack of computer-knowledge. We have to find out what potential customers are forced to do over and over again concerning analysing. Should check out the Apache-license.</p> <p>Might sell: Software as a service Support. Teaching and upgrading.</p>	
10.11	Svein-Olaf Hvasshovd, NTNU, +4773593440	Øyvind	Has taught "Big datastructures". Thinks that the oil industry might need this kind of tools.	
10.11	Martin Bekkelund, Friprogsenteret, +4793055510	Øyvind	Interested in helping, but needs to know more about the technology and more time to help. It is normal to build "packages" with support and installation included.	
10.11	Meteorologisk institutt. IT-avdelingen. +4722963118	Line	Call back at 12.12	
10.11	Tommy Dahlen	Petter	Traveling	
10.11	Martin Bekkelund	Petter	<p>LGPL is quite similar to GPL, the difference is the possibility to link to a LGPL library (dynamic linking) without having to distribute your program under a LGPL license (which is the case with GPL). With any Open Source program, you are free to sell a program that is under a (L)GPL license, but it is then possible for others to make changes, and sell the result (in other words, the copyright law still applies for Open Source, but is limited to some extent by the different licenses. It is a possibility to use something called a dual license (we have to gather more information about this one) but it is probably not possible to differentiate for example universities from users with commercial interests. There are no specific standardised licenses for closed source software.</p>	
10.11	Jonas Follesø, senior	Eldri	ROOT =high performance computing. Problem domain: research and	Arnstein Ressem (used to

	developer, capgemini		<p>science, weather forecast, oil & gas industry (operators such as Schlumberger and EMGS). Trade patterns - business intelligence (SGL server). Vital is using data warehouses to predict customer behavior, life expectancy etc. This system is on the same level/similar to ROOT. Vital has a self-developed, pretty simple calculation tool which gathers needed information from tables.</p> <p>Schlumberger and EMGS are offering these solutions to the oil industry -e.g for analysing seismic data. They gather enormous amounts of seismic data, make an enormous data matrix which they in turn want to visualize. Voxelvision has made a framework to do this (not open source), and Schlumberger had Petrel and needed an additional calculation tool --> bought Voxelvision. EMGS, Geomatikk AS.</p>	<p>work for Voxelvision, currently working for EMGS).email: aresse@gmail.com, LinkedIn profile: http://no.linkedin.com/in/arsteinresse.</p> <p>Dan Vasaru (used to work for Voxelvision and Schlumberger, currently working for ATMEL) email: dvasaru@gmail.com. LinkedIn: http://no.linkedin.com/pub/dan-vasaru/0/7a7/459</p> <p>Tore Ottesen - used to work for Voxelvision and Schlumberger, currently working for Weatherford Petroleum Consultants). email: tore.ottesen@gmail.com. LinkedIn: http://no.linkedin.com/pub/tore-ottesen/b/b74/713</p>
10.11	Halvor Lie, Marintek, 004773595828	Øyvind	Using unix-systems. Their data are 50Hz during some ours per test with up to hundred channels. Does not immediate see the need, but would not reject it either.	Trond Sollie, 73595939 Tijatian Butana, 73595963
10.11	Bengt Pedersen, Statoil, 004791349381	Øyvind	In a meeting. Sending e-mail.	
10.11	Meteorologisk institutt Trond Mikkelsen. +47 22963252 The Norwegian	Line	We should really talk to Michael, but he is not present. Grid computer set. Saving geographical areas, the computer set reproduces/analyses the data and retrieving it. The size of the data varies, it depends on the dissolution. In 1950 they saved 12 Tb. WDB (weather and water	

	Meteorological Institute		Database) has a few problems, but not bigger than one can overcome. It is now really important that the data lies on a local computer and not on a network. The performance will then degenerate. Earlier it took up to 5-10 seconds to retrieve the data.	
			They haven't considered it, because they were content with WDB. WDB were made because it did not exist a solution to their problem.	
			If ROOT could do what they needed, and developed further than they have. They would not mind changing solution.	
10.11	NTNU TT Sondre Jacobsen SSB + 4721094590	Line	Has not been working on these projects, try Martin Stok Really not interested in any framework. They had their own developed system that they were very satisfied with. Did NOT want anything else	Martin Stok, 48180185
10.11	Brønnøysund registeret +4775007509	Line	Closed	
10.11	UIO+4722855050	Line	Everything is being registered in a huge database. All these databases are being synchronized during the night. Data in this relation is everything from personal studies, subjects R&D.	ID-CEO Lars Oftedal +4722852520
10.11	NAV +4721070000		Closed	
10.11	Tor E. Aune, 917 49 332 Daglig leder Geomatikk IKT AS	Eldri	Answering machine	
10.11	Powel ASA Norway (Trondheim) Tel: +47 73 80 45 00 Headquarter	Eldri	direct number for (?) 47 73 80 45 44 - busy in meeting until 15.30	
10.11	If (fra utlandet) +47 980 02400 Sentralbord	Eldri	All employees have left for the day	
10.11	Storebrand Sentralbord tlf: +47 22315050	Eldri	left a message - hoping to be called tomorrow	
10.11	Norsk Gallup +47 91 11 16 00	Eldri	Very helpful until she understands I'm a student. Refuses to transfer me, have to send an e-mail at info@tns-gallup.no	
10.11	NTNU TT, Martin Stok 48180185	Petter	It is probably not possible to change a LGPL-license into a more proprietary one. Should look at building services and programs around the library. Possible customers: Weather forecast, Norsk regnesentral, oil industry, element methods.	

10.11	SPSS: 23 10 31 20 Produktsjef Inger Tvenning (evt produktsjef solutions Kjetil Eikeland)	Eldri	Busy in a meeting - call back tomorrow	
10.11	Tom Are Røsting Powel ASA Norway (Trondheim) Tel: +47 73 80 45 44	Eldri	Powel uses an open source database system, Oracle. Based on Oracle, they develop/ad on their own software, which they sell to their customers. The customers pay for both the Oracle license and the Powel license. Type of data: time series, components, electric utility, topologies and so on. Customers: power plants They make programming systems for planning, control, maintenance of power systems, nets, applications that handle the power market. Will never happen that Powel change their software.	Can call again tomorrow
10.11	Cern, Axel Naumann	Petter	<i>Hi Petter!</i>	

Petter Jacob Jacobsen wrote on 11/10/2009 03:17 PM:

just some short questions. Have I understood it right that regardless of the contributions to ROOT from externals, CERN is still copyright holder, and have the ability to change the license as they please?

*Only for future versions. The versions up and until today are LGPLed and can continue to be used that way. Any possible change in license would only be relevant for *future* versions.*

And secondly, do you have contact information to someone using ROOT for commercial purposes?

Sure! But I'd like to know what for :-) Can we chat about that?

Have you ever considered a dual license in which you segregate commercial and academic usage?

Yes, and we rejected it because we'd like to convince people to feed their improvements back. Also we're not after making money ;-) And

the last reason is that if we'd do that we would have the additional ambiguity who we'd have to serve better: CERN or paying customers? So it's not that easy...

(...)

10.11	Michael Bruneforth, UNESCO Institute for Statistics. Programme Specialist, Education Indicators and Data Analysis Section	Eldri	<p>The UNESCO-UIS mainly collects data from member states that are already aggregated to the country level. You can find the questionnaire we submit to countries at http://www.uis.unesco.org/surveys/education</p> <p>As you will see, the amount of data is small but highly aggregated. Our problems are therefore not handling the small amount of data but to ensure quality and compliance to the definitions by countries.</p> <p>We use MS-EXCEL, MS-SQL and other standard software for processing.</p> <p>I doubt our issues are anyhow close the data handling issues you are interested in.</p> <p>If you are interested in agencies handling large amount of education data, you could contact the team at the International association for the evaluation of educational outcomes (IEA). They handle micro level data: http://www.iea-dpc.de/iea_dpc_home.html?&L=1</p> <p>Best regards,</p> <p>Michael Bruneforth</p>
10.11	Dottie Turner, Deborah Thomson Filer, Irene Mirageas, Steve Bardige,Robert Callery, Corporate analyst relations Bill Loughlin, Steve O'Brien +001 508-293-7855, +001 508-293-xxxx	Eldri	<p>They're all busy at the North America Analyst Summit, and will be back on the 12th of November. Got through to Andrea Rocha (on Dottie Turner's phone) can send her an email on rocha_andrea@emc.com</p>
10.11	AIG +001 (210) 737-7800	Eldri	<p>Will have someone call me up. Didn't happen.</p>

10.11	MIT 001-617-253-1000	Line	Put me through to Mechanical Engineering	Artificial intelligence department
10.11	MIT +1-617-253-4600 A.I	Line	Could not answer my questions.	Electrical Engineering and Computer science
10.11	MIT +1-617-253-5851 Electrical Engineering and Computer science	Line	Passed me on to MIT Laboratory for Computer Science	
10.11	MIT +1-617-253-1101 Educational Technology (Ed Tech) Consultants	Line	Could not answer my questions	
10.11	JP Morgan Chase +1-212-270-6000	Line	I had to have a valid contact person, because the IT department was restricted.	
10.11	FM Global +001 401-275-3000 Headquarters	Eldri	It's 4.30 p.m over there, and people are about to leave for the day. Closed tomorrow, welcome to call again Thursday morning anytime from 7.30 a.m.	
10.11	Allstate Insurance Daniel Ayala company, +001 (210) 977-9187	Eldri	Doesn't have time to talk to me, is in the middle of his report of some kind	
10.11	Allstate Insurance company, +001 (210) 681-4494 Albert Dovalina	Eldri	NOT interested - busy handling clients, doesn't want me to call them	
10.11	Jonas Follesø, senior developer, capgemini	Eldri	<p>It is true that VITAL (Norwegian insurance company) has had a couple of challenges regarding ajourholding of Posten's (Norway's biggest deposit pension company) pension scheme. Ajourholding implies monthly regulation of salaries, inscription of new employees, etc. It could actually take up to 96 hours (!) in the beginning, but now it takes only 3-4 hours. The problems were not caused by complicated data analysis, but a badly designed database system.</p> <p>I mentioned the way a product from Microsoft I think is a bit "same street" (albeit probably very different) - http://www.solverfoundation.com/About.aspx - Although I have no experience with this - but it sounds that type of problem domain finance institutions can use ROOT (or Solver foundation)</p>	

			to solve.
11.11	Tom Are Røsting Powel ASA Norway (Trondheim) Tel: +47 73 80 45 44	Eldri	<p>Busy in a meeting, send an email to tar@powel.no</p> <p>1. Which a license is under the oracle? Oracle is the world's most widely used and well-known database. The operating license + 22% annual maintenance</p> <p>2. How can they serve money on oracle? Or on the open source-based application / framework in general? We do not have to develop this yourself, saving both time and money</p> <p>3. Is it your customers who pay for oracle license - and pay them as well to use the program that the deputy has been built on oracle? Customers pay for Oracle and the software we have built. We are talking about millions of program lines for the custom-built code</p> <p>4. What must they pay for the products? It depends on the size of the customer. This is an area that I will not comment further</p> <p>5. Which other software or frameworks do you know about, which is optimized for handling large amounts of data? Most who are targets oil industry</p> <p>6. Which programming language do you use? We use c #, c, c + +, pl-sql, sql,</p>
11.11	Arnstein Ressem (former employee, Voxelvision), 92608367	Eldri	<p>LGPL - grey area whether you can make money on it or not. The "ad-on" must be independent from the open source framework - dynamic linking. Windows DLL = example on a dynamic library. Voxelvision's</p>

			product is called Gigawiz (written in c++) = calculation server for seismic data. Signal production, interpreting. Heavy calculations done on cluster machines (OS Linux). Weather simulations, chemistry research (DNA, etc), car/flight simulations, reservoir simulations (=the next step after seismic data) are other areas where large amounts of data is produced.	
11.11	Dan Vasaru (former employee, Voxelvision) 40043109	Eldri	Answering machine	
11.11	Tore Ottesen (former employee, Voxelvision) 90288477	Eldri	Doesn't have time to talk	
11.11	Kjetil Eikeland, SPSS (switchboard 23 10 31 20) Product manager	Eldri	SPSS is a part of the IBM concern, and is offering tools for statistical calculations, and he claims that the limiting factor for how large amounts of data can be handled is OS and computer hardware, not their tools. Type of data: customer databases for banks, insurance companies, etc. All universities and colleges in Norway have SPSS products, also used for biological research. Largest customer group = academics. Switching costs depend on what system the company had initially.	
11.11	Jens Ivar Jørdre, ex UiB, 90121974	Øyvind	Used ROOT about 5 years ago. Used it to analyse data and to visualize. Alternatively he would use MatLab or Matematica, but these tools are slower on huge datasets. TAW is also a tool written in FORTRAN. Old professors are using FORTRAN while young ones are C++ users.	Gaute Øvrebekk, UiB
11.11	BBS +47 22898989 Svein Haug	Line	Have a few million transfers a day, but not the same huge amount that ROOT was able to handle. Not that relevant for BBS. Should rather try with geological context.	
11.11	Hansen, Snorre. NTNU +47 73593416	Line	It would take a lot to remove MatLab from the curriculum. But are constantly working to implement new up to date software in IKT. "If ROOT is something that CERN is using, it is definitely interesting for us to take it into use". He would tips his colleagues about it, and wanted more information.	
11.11	Axel Naumann, CERN, Developer ROOT	Petter	It has proved itself to be very hard to reach any possible customers for a spin off, so in parallel to that, we have started analyzing the value ROOT has for CERN (besides the technical benefits) and the possibilities to further increase this value.	

So again some questions;)

Are there more than you (on the programming team) who have been recruited based on the contributions to ROOTs development?

There are two people on the programming team who have been recruited because of contributions to the ROOT framework

Do you think we could reach out to new markets by providing a GUI to (some parts of) ROOT?

We probably could, but it is hard to develop something that fits all ROOTs functionality. The ones in need for some of the functionality are better of developing their own GUI. This is probably something that could be done within the universities

Have you ever considered using ROOT for educational purposes on high school and undergraduate level. The mathtools, visualization and simulation parts could probably be very interesting to physics students, don't you think?

It has been done to some extent, but sounds very interesting but increase this focus. It is strength for CERN that people recruited know ROOT and are also familiar with C++ programming. The idea of using ROOT not only for physicist but also other engineering disciplines, in analyzing and visualization of data.

I think that this way we could reach more people with CERN technology and it would also have a great marketing (recruitment) value for CERN!:)

I agree

11.11	Utrecht University, (+31)31 30 253 91 11 Sentralbord Prof.dr. Nick van Eijndhoven	Eldri	Not answering
11.11	Sibylle Petrak +49 - 441 -	Eldri	Not answering

	233 698 61 Universitet i Oldenburg		
11.11	Roberto Pesce 0039 010 353 6468 University of Genoa, Italy	Eldri	Not in the office - don't know whether he will be there later today, can try again later if I wish
11.11	Duc Bao Ta +49 (0)228 73-6354 Universitetet i Bonn	Eldri	<p>University of Bonn are using ROOT for educational purposes already. They have special programming courses for physicist students, where ROOT is mainly used. Doesn't know any other universities using ROOT for educational purposes officially, but estimates that many teach it unofficially in high energy physics.</p> <p>Uni Bonn started using ROOT in courses 1-1,5 years ago, when they switched from the German Diploma model to the bachelor/master model. The latter model requires them to incorporate some courses related to physics that are really not physics. There were no requirements for physics student to learn programming before. He has a long list with things that need to be improved when it comes to ROOT, but still says that it's working for him. Especially, he considers the interface to python language insufficient. The data model is not consistent - some variable types are not python compatible. Can call him back in case of any further questions, or send an email to TA@physik.uni-bonn.de</p>
11.11	Vincent Roberfroid +32 10/45 44 02 UCL (Belgium)	Eldri	<p>Does no longer work at the UCL - working in a Belgian enterprise computing for banks, not using ROOT.</p> <p>UCL uses ROOT for research, and they also teach ROOT to their students. He started to work with ROOT in his research work in 98, and UCL incorporated it in their teaching some 3 years ago - because most people doing research are using it, and it was considered sensible to include. Have created a small application that the students use to get an overview over particle physics. They can analyse results from lab experiments.</p> <p>Not compulsory for their physics students to learn C++, those who learn it, have to teach it to themselves, unfortunately. Can call back in case of any more questions.</p>
11.11	Kristina Ehrhardt 0049 7071 29 74451 Tübingen Germany	Eldri	Tübingen does not teach ROOT in their courses, and they don't have compulsory computational courses - programming is taught on the run - knowledge is passed on from generation to generation. Does not

			<p>think that it will be incorporated in the education in the near future due to budget limits. She did some programming courses (voluntary) herself while studying, and recommends it to all her students. Does not consider it a problem that students don't know programming languages, the problem is that they don't know the concept of programming -the thinking about how the problem is to be solved. This step is omitted in many cases. Software engineering courses independent of programme packages and programme languages is what she thinks should be taught.</p> <p>She is not too happy with root - many bugs and problems, some horrible artifacts. She tries to avoid using it where she can, still she sticks to it because she needs it in some cases. She can reprogram some applications, but it takes a long time. Tries at one point to contribute to the development - suggest improvements etc. She likes the programme QT better - it is a pretty expensive programme, but she has found far lesser bugs in this programme. Can call her back, or send her an email on ehrhardt@pit.physik.uni-tuebingen.de</p>
11.11	Nicola Galante +49 (0)89 32354289	Eldri	Not in the office
	Max Planck Institut für physik, Germany		
11.11	Norbert Braun +49 (221) 470-3617 Institute for Nuclear Physics University of Cologne	Eldri	Norbert is not in the office - but I ask the person that answered the phone. University of Cologne doesn't have a compulsory computing course for their physics students, though they do have the option to take an information technology or computer science course to learn programming. University has switched from German Diploma model to bachelor/master model sometime the last 2-3 years. ROOT is used in research, but not in teaching. Some students teach themselves when working with their thesis - and maybe compulsory programming courses with ROOT introductions will come in the future - could be a good idea - but he doesn't know what the university's plans are.
11.11	Riccardo Di Sipio +39 051 209 10 35 University of Bologna, Italy	Eldri	Can try later today or tomorrow. Tried to ask the student who answered the phone, but he was not very good in English.
11.11	Dr. Otto Schaile Phone:	Eldri	LMU is not using ROOT for educational purposes directly, but they do

	+49 89 289 14070 Department fuer Physik, LMU Muenchen		from time to time give introductory lectures in ROOT when the students that wish to use ROOT in their thesis work ask for it. LMU offer C++ courses (not compulsory, any student can take them), and ROOT is sometimes used there as examples. He has developed a ROOT package himself, and thinks it might be a good idea to teach ROOT to the students, but he does not think that the university will use ROOT in their teaching in the future. Can call him back in case of more questions.
11.11	Danilo Piparo (+49)(0)721 608 3369 UNI Karlsruhe	Eldri	Danilo is not there, but I speak to the guy answering the phone. Doesn't want me to mention his name. Uni Karlsruhe offer ROOT courses (by volunteers) for the practical parts of the education. ROOT is included in a data analysis course which was made compulsory for physicists last semester. Learning coding and C++ has been compulsory for about 10 years, and the ROOT course came 5 years ago, but was not compulsory then. He hopes that ROOT will NOT be compulsory in his university in the future, because it has so many bugs and bad practices for coding which can lead to students learning coding in a wrong way. Easy to walk into a one-way route and get stuck - can't get out again. Takes a long time to figure out what went wrong and unexpected things happen. ROOT is a very powerful framework, and it can do amazing things, but he's missing a straight forward way of using it, a good GUI. He suggests a complete rewriting of the programme (these last sentences make up the reason why he doesn't want me to mention his name)
11.11	Conor Fitzpatrick +44 7811 141 365 MPhys student specialising in Experimental Physics at the University of Edinburgh	Eldri	Answer machine
11.11	Sara	Line and Øyvind	Sara has been working with the lab exercises in the university in Stockholm. They are using COMSOL SCRIPT which is a Matlab "ripoff". She thinks it is possible to use ROOT instead if either the students were learning C++ earlier, or if there were build an "easy-to-use" interface for ROOT. ROOT is the only tool for particle physicist. And it should be suitable for other physicists too. The researchers are not using Matlab.

11.11	Axel	All	The Developing Team is not good at: design, academic psychology and teaching. They can cover the technical by the developing of GUI, they need a better interface. Would be good if the product didn't come from the ROOT team, it should be driven form an outside team.
11.11	Håvard Sandvik, finance models, Citibank	Øyvind	Working with finance models in Citibank, London. Has a background from astrophysics, and are surprised that he hadn't heard about ROOT before. They had challenges with huge datasets back then and wondered why they didn't collaborate with CERN. Thinks ROOT seems like an interesting technology, but in his field they are working with too small data sets. Within algorithmic or high frequent trading it might be more relevant if the saving process is efficient enough. In their work they are using Excel and macros written in C++ and linked to external libraries with dll files.
12.11	Duc Bao Ta +49 (0)228 73-6354 University of Bonn	Eldri	<p>Hi Eldri Coll,</p> <p>the switch from Diploma to Bachelor/Master was agree upon in the bologna accord of the European union, so in the coming years all European universities will have switched (some already did) to the B/M system, though every university and every faculty can decide when to switch and there are some special exceptions (like law). The Bachelor degree should enable the students to apply for a job in the industry right away. Hence they will need some "soft skills" among them are skills such as giving presentations and also some basic programming (at least for science and technical subjects). All the German universities offer such soft skill courses and programming is a quite common one. What programming language and tool is taught is not common among the universities. It is a coincidence that at our university C++ and ROOT is taught, because the course it held by a lecturer that is also a particle physicist and he knows C++ and ROOT.</p> <p>I hope was able to help you.</p> <p>Best regards, Duc</p>

			P.S.: I would be interested where to find the outcome of your survey, if the results should be become public.
12.11	Snorre Hansen, NTNU	Line	100 civil engineering, 40 bachelor and 20 teacher students at NTNU. NTNU has agreements with suppliers of software, and the different institutes cannot buy software themselves.
12.11	Helge Matisen, purchasing department, NTNU	Line	Away