

## VIRTUAL CAMPUSES SUPPORTED BY NOVEL EFFICIENT KNOWLEDGE SHARING

1 Arnt Richard Rørvik, 2 Per Atle Eliassen, 3 Jan Erik Garshol, 4 Trude Eikebrokk 5 Gry Ane Vikanes Lavik

<sup>1</sup>Norwegian university of science and technology (NTNU), Dept. of strategy and control, Trondheim, [arnt.r.rorvik@ntnu.no](mailto:arnt.r.rorvik@ntnu.no)

<sup>2</sup> Norwegian university of science and technology (NTNU), Dept. of strategy and control, Trondheim, [per.atle.eliassen@ntnu.no](mailto:per.atle.eliassen@ntnu.no)

<sup>3</sup> Unit - The Norwegian Directorate for ICT and Joint Services in Higher Education and Research, [jan.erik.garshol@unit.no](mailto:jan.erik.garshol@unit.no)

<sup>4</sup> Oslo Metropolitan University (OsloMet), University Library, [Trude.Eikebrokk@oslomet.no](mailto:Trude.Eikebrokk@oslomet.no)

<sup>5</sup> University of Bergen, Learning Lab, [Gry.Lavik@uib.no](mailto:Gry.Lavik@uib.no)

### Keywords

Virtual campus, knowledge sharing, learning resources, static and dynamic learning resources, metadata, open access integration, intra system access, cross platform, inter system access, restricted resources protection, learning object repository, source integrations, productivity focus, application system integration, LMS/eLS/eAS/SIS.

## 1. SUMMARY

Virtual campuses need efficient, user-friendly and seamless creation, search and consumption of open access and internal (restricted access) knowledge resources.

Today's workflows typically create knowledge resources such as learning objects using standalone tools, subsequently publishing them separately to internal and external knowledge stores. Loss of productivity is an obvious disadvantage, due to manual re-entries, file copying and versioning woes across sources and destinations. Resources published in one or more Internet accessible systems are often lacking study information system (SIS) furnished metadata. Add to this differing metadata schemes and manual entries of storage systems and publishing targets. The resulting cumbersome and non-intuitive workflow and lack of relation between related resources published more than one place, hampers the production and sharing of resources.

NTNU and BIBSYS (now Unit) cooperated in bridging this gap in the DLR effort, taking care of both internal (eLS/LMS/eAS etc.) and open access publishing, while offering high productivity features. DLR has evolved from a simple open source tool with learning technology interoperability (LTI) support of eLSs, into a high-productivity tool facilitating both open and restricted access resources, with a uniform high productivity user interface experience with support for eLS-specific features. Multi-author versioning (in a forking fashion) can be supported, in addition to active resources (code checking, digital twins, simulators etc.) and single click automatic open publishing with a palette of preconfigured licenses (Cc etc.), DOI's generated automatically and with optional moderation of open access publishing, to one or more open access systems. NTNU and BIBSYS have sponsored the initial development, with the Norwegian Business School (BI), and Oslo Metropolitan University (OsloMet) as well as the university of Bergen joining in to develop this as a vital learning object platform (LOR). The presentations of DLR will discuss some central use cases and features.

## VIRTUAL CAMPUS SUPPORTED BY NOVEL EFFICIENT KNOWLEDGE SHARING

### The roots of Unit (Bibsys') DLR as sharing platform

DLR initially targeted open access learning resource sharing, with a simple user interface accessible from electronic learning systems (eLSs), stimulating open access publishing across different eLSs. The first iteration used Learning Technology Interoperability (LTI) 1.0 integration, primarily targeting Canvas eLS. Files could be uploaded to the DLR store, and Internet hyperlinks to resources could be entered along with descriptive data (metadata), such as title, subject etc. Metadata were using the Dublin core metadata scheme.

### Vital contributions to DLR's evolution

Lecturers and students craved for more productivity. Most wanted was *restricted access to internal resources*. Seemingly counterproductive to open access, restricted access actually helps publishers to use DLR as primary storage and publishing platform. This supports intuitive resource maturing, from internal to open. Once polished, internal resources in DLR are a check box and license selection away from open access, automatically assigning a permanent handle such as a DOI. Institutions can enable pre-publishing moderation. Copyright infringements and other open publishing mistakes are avoided.

Another much appreciated productivity feature is *direct publishing* from personal video sources such as Microsoft® Skype. The usual productivity cycle of recording, storing, uploading and enhancing with metadata is shortcut into one direct operation, with relevant metadata from the study information system (SIS) prefilled into the resource description.

Yet another feature is the option to co-write different versions of the learning resource. One author may start to develop a resource, let others contribute, co-exist in several versions, some being open and others with restricted access

Productivity support systems such as Mediasite® for video storage and streaming, Microsoft Office 365® and/or the Google counterpart is integrated, and any other sufficiently API-equipped productivity support system can be integrated likewise.

Storage of entire courses were also on the wish list, and the ability to define sequencing of learning resources as a resource in itself. Not all of these features are in full production yet, subject to approval among participating sponsors, but the underlying architecture fully supports these and other productivity features.

On the institutional level, productivity tools such as integration of automatic publishing of lecture recordings along with information about lecturer, subject etc. furnished by the SIS, were added. Active resources such as simulators, digital twins, questionnaires, comms tools etc. are easily added, and may interact with conditional release mechanisms in eLSs.

### Strategic concerns and architectural benefits

Participating institutions wanted DLR to support easy replacement of eLSs, storage systems and even DLR itself. The owner of higher education institutions in Norway requires that data are created once-only, and only re-used elsewhere. DLR satisfies these requirements, placing itself at the middle tier, accessible from applications systems (eLS, eAs etc.) at the upper tier offering those flexible store and re-use functionality, pointing to actual storage at the lower tier. Any sufficiently API-equipped storage system can be used, and subsequently upgraded, restructured or even replaced without affecting the application systems. DLR takes care of any redirections. The application systems can more easily be replaced, since permanent learning resources primarily will be stored in DLR. DLR system can easily be replaced, without affecting the use of the resources in DLR.

### Sources and consumers

The Unit DLR can integrate with any knowledge source or consumer such as automatic video acquisition systems, cross-platform search and easy and highly integrable (re-) use of open access and restricted access knowledge resources. This is implemented using a mix of commercial and open source components, as illustrated in figure 1:

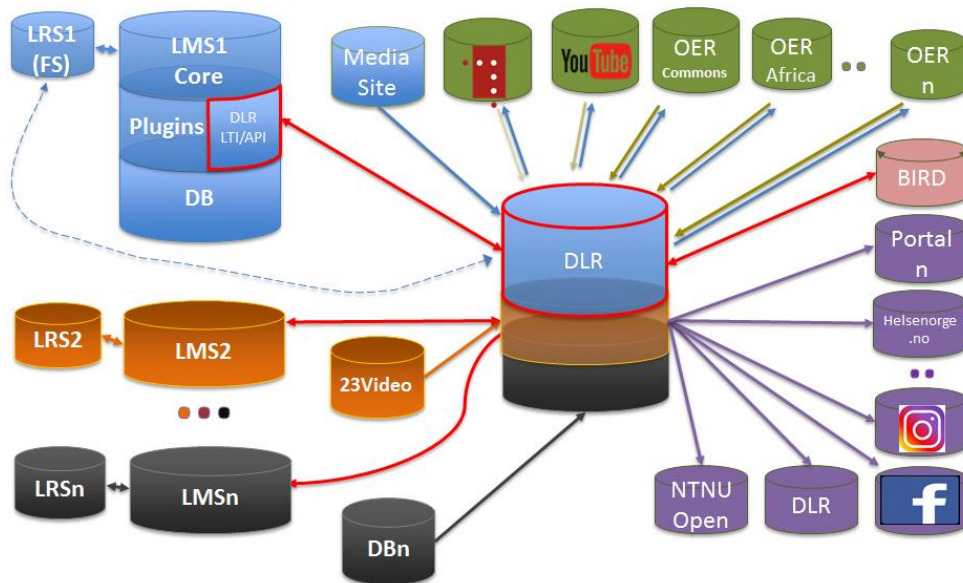


Figure 1: Future and present components of DLR implementation

The DLR is at the core, with three types of applications systems (eLS, eAs, LMS etc.) to the left, currently Blackboard Learn, Instructure Canvas, Open EdEx or Itslearning. The blue institution's application system uses LTI integration for DLR. This provides the application system with publishing, search and (re-) use of resources inside DLR. Native application system APIs can give tighter integration, ideally offering full daisy chainable search and storage integration, with publication, search and use of DLR material seamlessly available from within the applications system, seamlessly blending in with internally published material of the application system in question. Equally important, metadata (and even data) can be potentially be exchanged as illustrated with the connected green and purple boxes, such as the Norwegian National Library, YouTube, OER Common etc. in addition to portals and other information consumers and providers.

## USE CASES

The **Oslo Metropolitan University (OsloMet)** started using DLR in the spring of 2018, due to interest from educational resource producers as well as an institutional desire for efficiency and control in storing and sharing of educational resources. Once published, at one place, resources are used, shared and maintained in all forms and iterations. OsloMet now works with copyright, access issues and seamless integration between DLR and eLS (Canvas), and other educational software.

The **University of Bergen (UiB)** is considering DLR for LOR use, seeking a tool that supports storage, retrieval, publishing and sharing of a steadily increasing production of digital educational resources. Well-defined metadata are important, supporting easy content categorization, search and management, including sharing publicly or with a smaller group, with copyright handling. Interoperability with an open version of Canvas and the Communications content management system (CMS) is required.

## CONCLUSION

DLR is a completely application and storage system neutral second generation learning object repository (LOR), supporting third generation LOR functionality. It interfaces with application systems (eLSs/LMSs/eAs etc.) and storage systems using well-documented standards for interchange of data and metadata. DLR not only bridges open access and restricted access resources, but offers better productivity, thanks to its close integration with productivity systems such as video production systems. A simple and intuitive user interface is enhanced with information from the study information system (SIS), suggesting descriptive data when appropriate. The gap between internal resource production, consumption and open access is bridged, optionally interfacing with open educational resources and other learning resource consumers and producers. Any digital resource (even software) is supported. DLR handles licensing, and can even support commercial resources if required.

## 2. REFERENCES

Rørvik, A. R., NTNU webpage (2016 - 2019), <https://www.ntnu.no/blogger/lor-ved-ntnu/2016/05/25/hei-verden/>, *LOR at NTNU - visions of reuse and sharing*

## 3. AUTHORS' BIOGRAPHIES



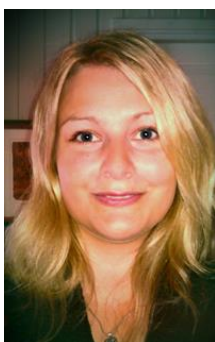
Arnt Richard Rørvik, senior engineer, has a civil engineering degree in cybernetics. He worked for three years as an assistant professor at the Nordland university college within a wide range of IT subjects including software system design, one and a half year at the Norwegian national library with programming and project management, nineteen years as computer systems executive for the in-house production of server- and network services in addition to project management, technology selection and strategic advisories at the university college of Sør-Trøndelag, as well as IS architecture functions, before starting at the NTNU in 2016 as a project manager dealing with the DLR system, and IT architect. He is a listed Togaf enterprise architect.



Per Atle Eliassen is IT Architect at the Norwegian University of Science and Technology, since 2015. Prior to this he has worked for over twenty years at some of the largest Norwegian banks and financial services groups - 5 years as a Business and IT Architect, 8 years as Executive Manager for IT departments and some 10 years as Project Manager. He has studied Business Economics at the Norwegian Business School and Master of Management studies at the Norwegian University of Science and Technology.



Jan Erik Garshol, senior adviser, at Unit - The Norwegian Directorate for ICT and Joint Services in Higher Education and Research the last 15 years. He has a cand. scient. degree from NTNU in information retrieval and neural networks. Unit coordinates national initiatives, and is responsible for high level ICT governance for research and higher education and offers a wide range of services for research and higher education.



Trude Eikebrokk is a head librarian and team leader for Digital Services at the Oslo Metropolitan University Library. She has a master's degree in Information and Library Science and has been working with Open Access and related projects since 2009. Currently she is the project manager for establishing a Learning Object Repository at OsloMet. Other interests are institutional repositories, Open Science, bibliometrics, AI and digital publishing in general.



Gry Ane Vikanes Lavik is project manager for AV-storage and learning object repository (LOR) at the Learning lab, University of Bergen, since January 2019. She has worked in the university sector since 2004, with scientific publication, teaching, study and research administration. She has a cand. philol degree in Philosophy from 2004.