



Trilogy 2: Building the Liquid Net

At A Glance: Trilogy 2

Building the Liquid Net

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The Trilogy project aims to build a new Internet architecture based on the key concept of the liquid network. A liquid system should ideally allow resources including bandwidth, storage and processing to be used by any application, whether they are contributed by network operators, data centre operators or end-user systems

Main Objectives

In recent years the Internet has become a much more fluid system. Processing, storage, bandwidth and energy usage from different machines and different parts of the network are being pooled together. Examples of this trend include applications such as BitTorrent pull data from many other computers simultaneously, effectively pooling the upstream bandwidth (and storage) of many machines to provide the best possible download performance. Other examples are protocols such as Multipath TCP transfer data across many paths from the same server simultaneously, pooling the capacity of the different network paths.

The main objective of Trilogy 2 is to **unlock the value inherent in joining up the pools of liquidity** in the Internet. The project will develop mature liquidity mechanisms addressing the underlying reasons why today liquidity fails to join up across providers, layers and resources.

Trilogy 2 will deliver mechanisms for creating liquidity across different types of resources, including **cross layer liquidity, cross provider liquidity and cross resource liquidity**. In addition, in order to allow the different stakeholders to be willing to create such liquid pools of resources, Trilogy 2 will also provide the means to **control the created liquidity through the means of incentives, information exchange and enforcement tools**.

Finally, Trilogy 2 will use the novel liquidity mechanisms to enable a set of compelling use cases targeting **mobile devices and ISP's network infrastructure**.

Trilogy 2 will unlock the value inherent in joining up the pools of liquidity

Technical Approach

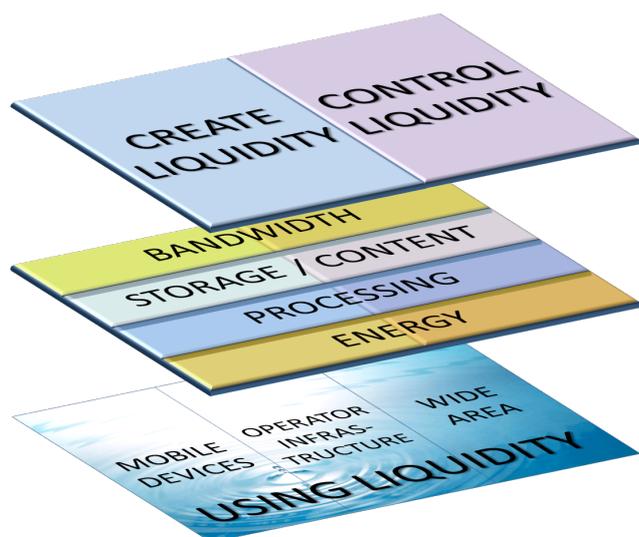
In order to create the Liquid Internet, Trilogy 2 will aim to create different types of liquidity:

Cross-provider liquidity: existing liquidity has limited scope as it usually happens within a single administrative domain. Most of the limitations are technological and not administrative. One of Trilogy 2 main objectives is to create pooling techniques for bandwidth, processing, storage and energy that are applicable to a wider range of scenarios.

Cross-layer liquidity: lower-layer functions such as broadband remote access servers, routers, switches and firewalls are rapidly becoming available as software that can run on generic hardware rather than as dedicated network appliances. These lower layers were traditionally the more stable substrate on which higher layer liquidity operated.

There is now the opportunity to shift the foundations as part of the optimisation of the higher layers, in place of continual excessive rearrangement at the higher layers. This requires liquidity to be joined up across the layers, typically requiring different stakeholders from different cultures to find a common framework to interwork.

Cross-resource liquidity: creating larger single-resource pools and controlling them is a worthy goal, but the big benefits will come when applications can dynamically trade-off between different resource types in the wide area to improve their performance. Trilogy 2 will create an Internet that gives applications the ability to create resource pools and dynamically trade between resources in the wide-area.



Key Issues

The key issues that Trilogy 2 will tackle are:

1. Develop a unified architecture for the Internet for generalized resource pooling and trading between different types of resources including bandwidth, processing storage and energy in a scalable, dynamic, autonomous and robust manner to local operational and business requirements.
2. Research, develop, implement and evaluate new technical solutions for the creation of resource pools and trading off between them, in the areas of bandwidth, storage, processing and energy.
3. Research, develop and evaluate mechanisms to control the created liquidity. Liquidity needs to be controlled, in order to be able to isolate different tenants, to make quality of service guarantees and to trade off resources in an economically efficient manner.
4. Implement and perform validation trials of the proposed architecture and mechanisms for specific use cases such as mobile scenarios, network-as-a-service and data centres.

Expected Impact

We aim to implement applications in different parts of the Internet in order to showcase both the benefits that can be had from liquidity and the generality of basic mechanisms that enable resource pooling:

- Mobile devices badly need liquidity to extend battery life, reduce download delays and provide a seamless mobile network experience.
- Service provider networks can create processing, storage and bandwidth pools that will allow them to replace expensive network processing elements (such as BRAS or DPI functionality) with software running on commodity hardware, reducing supplier lock-in and the associated costs.
- Collaborative applications such as online gaming or videoconferencing can use operator-provider liquidity to dynamically “move” servers to areas closer to the endpoints, optimizing end-to-end delays.
- Collaborative Cloud Systems can enable resource sharing and reselling of resources amongst cloud service providers to encourage secondary markets and innovative enterprises to emerge with fast access to massive scale resources.