Overview
This research is conducted within the larger NSF project Named Data Networking (NDN) which implements an inter-campus collaboration with 10 US campuses lead by CENS. Such collaborative research wants to create the Internet of the Future, replacing today focus on where – addresses and hosts – with what – the content that users and application care about.

At CENS and REMAP (REMAP is a joint collaboration research center between the UCLA Engineering School and UCLA School of Theater, Film and TV) we’ll develop 3 (or more) applications as use case using the new network approach. Instrumented environment and participatory sensing are the two broader fields of investigation that describe the research context and link to past and ongoing activities at CENS.

Within the 3-year plan, the goal is to have a video conference application, a lighting control application and a Personal Data Cloud (PDC) system running over the NDN testbed (which connects the involved campuses) and by doing so to have addressed conceptual and technical issues that the new approach challenges us.

Approach
Many internet applications will expand requiring always more network resources in order to provide high definition content, sensing and control and a consistent substrate to implement the Internet of Things. The buildings of the future will require control systems able to scale complexity and optimize data network traffic. International collaborations between corporations are developing standards that will push intelligence in appliances and devices at levels far beyond today’s requirements.

One of the research challenges is to define a naming paradigm, perhaps a well defined grammar that is able to generate name hierarchies and suggest specific algorithms to parse and operate with the naming.

Background studies on Building Management Systems (BMS) highlight the relationship between physical space and systems in buildings. Based on a RESTful architecture scheme, the project Integrated Sensor Stream Storage System (IS4) [4] has been taken as a reference to build the name-space hierarchy for our approach.

The team members want the project results to have impact also outside of the academia. To do so several approaches are initiated, among those: create a visual representation through an architectural lighting installation, that will support the communication of the results to a broader audience. Data for the project will be provided by UCLA F&M through the UCLA BMS.

Another aspect regards the collaboration with corporation that are working actively and already gave a strong impact on the development of actual systems in the above mentioned fields. Particularly a conversation on media rich communication for environment has been initiate with Crestron, even if the company will have a more passive role since their interest on not divulging their methods and technologies. Another attempt is in process thanks to contacts at Siemens AG, which is a sponsor of CO2morrow (AM past project in EU).

Such research process involves many participants and includes great deal of integration and communication between the parts so to maintain a cohesive path. To support the process that traces a common path back from multiple investigation interests, integration of works, open questions until the final unifying goals, I’m remotely attending Tarek
UIUC groups’ application meetings and I also integrate security protocol requirements from UCI into the design of the lighting application.

**Systems Description**

**AUDIO CONFERENCE TOOL (to be expanded to video) student: Zenkai Zhu**  
An audio conference tool that is able to discover all existing conferences and allows rendezvous where participants can find each other and they can be enumerated over the network. It is based on the Mumble application and extended to be able to run over NDN.

Focus on: implement and run the conference tool over the testbed sites.

**PERSONAL DATA CLOUD (PDC) student: Derek Takeda**  
It is a privacy oriented structured application for storing data from various self monitoring devices (such as mobile phones). It is a cloud-inspired NDN based version on the Personal Data Vault (PDV).

Focus on: implementation of PDC over the NDN testbed, replication of data across multiple PDV under a granular Access Control List, data encryption.

**LIGHTING SYSTEM (to be expanded for BMS) Student: Chenni Qian**  
It uses and integrates lighting control and building management system principles. The lighting interface is based on a Linux embedded network system (Gumstix) to be coupled with Philips lighting controllers and LED fixtures.

Focus: integration of lighting control and building control over NDN testbed.

**NDN INTEGRATION WITH BUILDING MANAGEMENT SYSTEM (BMS)**  
Focus: to receive and send over NDN testbed data streams related to resource consumption and production, Heating, Ventilating, and Air Conditioning (HVAC) from the UCLA BMS with support from UCLA Facilities & Management.

**Accomplishments**  
First stage definition of the syntax rules to create naming addresses, in regard of Functional Recommendations for Internet Resource Locators”, RFC 1736, and Functional Requirements for Uniform Resource Names, RFC 1737.

The design documents and communication protocols with recommended security protocol from UCI for the 3 applications is at a stage that students are developing initial prototypes.

**Future Directions**  
Research more background studies on naming in relationship to our NDN project and possible expansion regarding “Internet of things”.

Because of personal research interest my agenda includes development of a meaningful document on the cultural and perhaps social implication of the NDN approach.

Description of the naming in regards of: RFC 5234, as December 2010 the IETF provides definition language for communication protocols.

Specific milestones for the applications:

- **Mid-March**: requirements to receive data stream from UCLA BMS  
- **End-March**: Architectural Lighting should be able to distribute code and bootstrap new controllers out-of-the-box  
- **End of June**: integration BMS with NDN  
- **June**: The conference tool expands including video.  
- **End of July**: PDC Serve as back-end for UIUC applications
More specific milestones after August 2011 are in the overall NDN schedule from Jim Thorton “ndn-sched.pdf”. A
general milestone by the end of the year is to run an evaluation of the functionality of the application over the
testbed.