

# Beyond task-oriented perspectives: **The IoT as experience infrastructure.**

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# School of Theater, Film & Television?

Authoring has changed

**Stories and Experiences**

are now created with **Systems**

that are built on **Architectures**

# How to support tomorrow's experiences?

Media-rich, instrumented, loosely coupled

## Distributed

- Computation, storage, display, interface – “*things*”;
- Across space, time, device, service, author.

## Interwoven

- Composite, dynamic assembly rather than single artifact;
- With objects, buildings, processes, people.

## Participatory

- Collaborative authorship, commentary, remixing;
- Experiential choice and interaction.

## Multi-scale

- Personal, family, community, urban, global.
- In time as well as space.

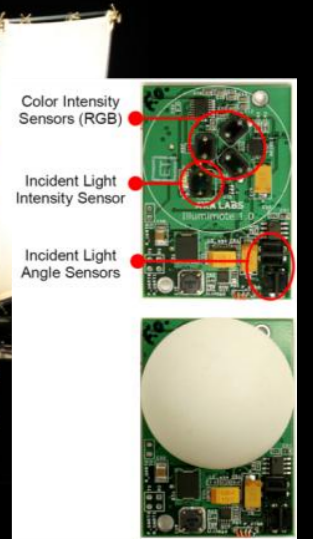
# What I do (somewhat)



Sensing systems in live performance.



Advanced media production.



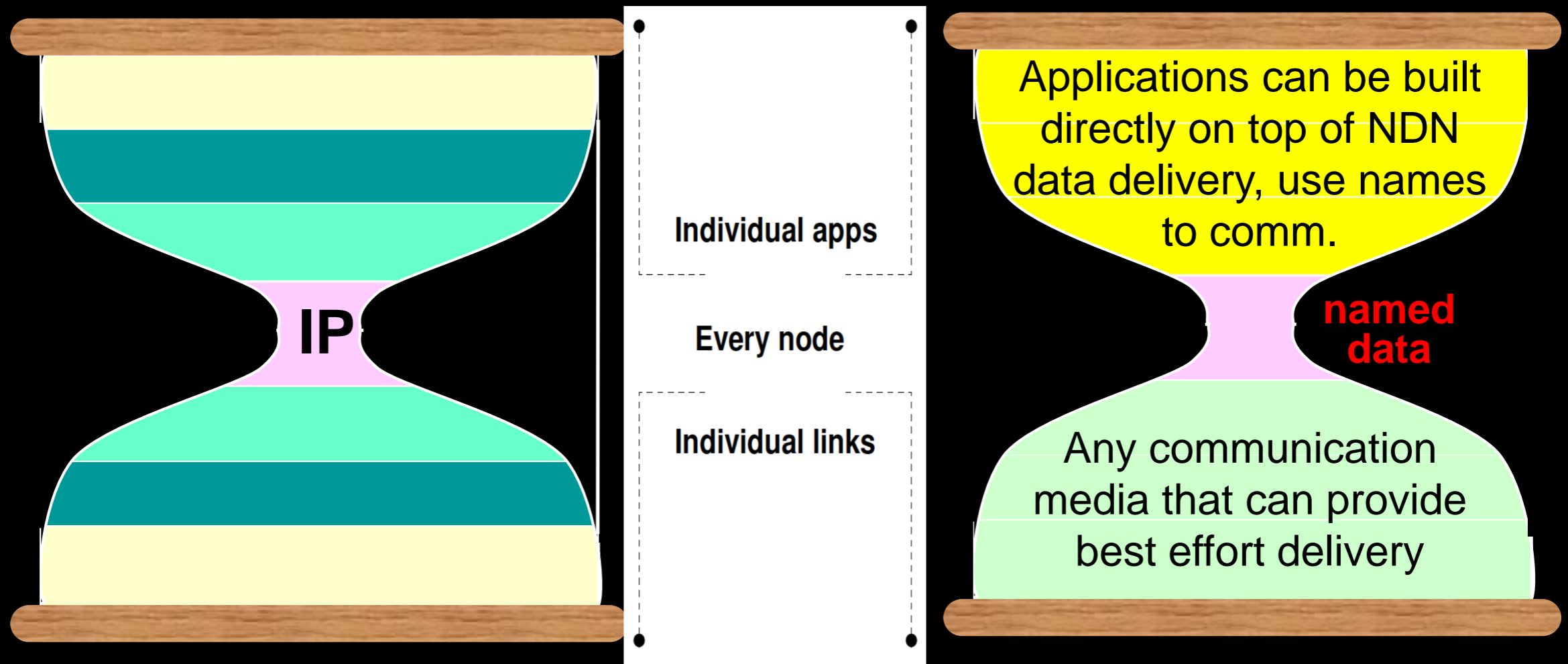
Community-focused media.



Interactive media in the built environment.

# Named data networking

From host- to content-based addressing.



NDN moves the universal component in the Internet protocol stack from IP to *named data*.

# Named data networking

## “Interest” Packet:

/ucla.edu/facilities/boelter\_hall/3551/lights/overhead/intensity

/uiuc.edu/abdelzaher/media/talk.mov/<version>/<segment>

## “Data” Packet:

Application-defined payload

**Digital signature** (e.g., /ucla.edu/facilities/public\_key)

For more detailed examples, see the NDN and CCNx sites.

	Communication	Distribution
Naming	Endpoints	Stuff
Memory	Invisible, Limited	Explicit; Storage and wires equivalent
Security	Secure the process	Secure the stuff

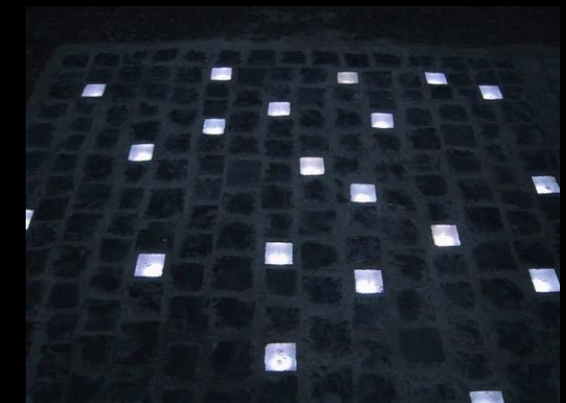
# From things... to places and experiences.



Reflective Display (Magink)



Place du Molard, Geneva



Krzysztof Wodiczko



Rundle Lantern, Adelaide



3M Mini Projector

# Integration of physical space + media

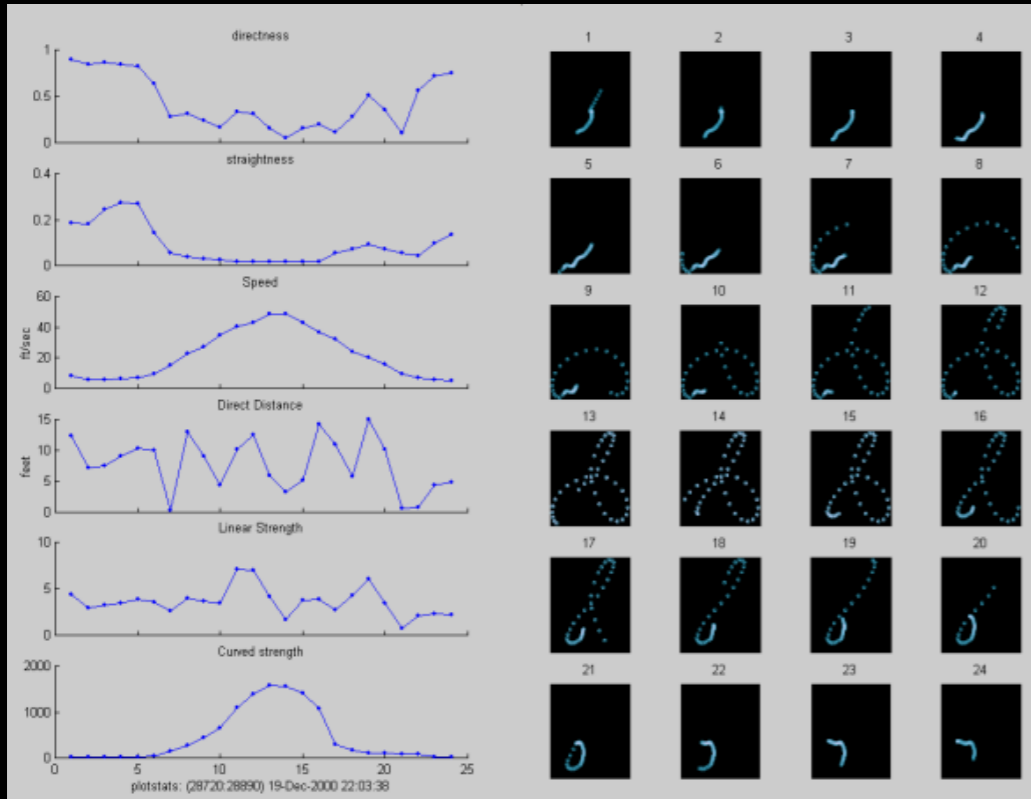
Consider our “experience” of the urban environment.

Space is now shaped by systems of media, sensors, and computing as well as physical construction. The internet is experience infrastructure.



How does network architecture influence (and support) the design and operation of experiences in these places?





# Lessons - Kolo

NSF and NEA funded middleware for interactive systems called Kolo.

Demonstrated the ***empowering nature of name-based addressability and control*** as a starting point for authorship.

It also clarified a need for *distributed state management*, especially for systems where sensory experience mattered, as well as a desire to *author by example* that is still unfulfilled.

J. Burke, J. Friedman, E. Mendelowitz, H. Park, M. B. Srivastava. "**Embedding expression: Pervasive computing architecture for art and entertainment.**" *Journal of Pervasive and Mobile Computing* 2(1):1-36, 2006.

E. Mendelowitz and J. Burke. "**A distributed control system and scripting language for 'interactivity' in live performance.**" First International Workshop on Entertainment Computing, Makuhari, Japan, May 17-19, 2002.

# Proposal: Think about *Authoring*

e.g., Adapting the Cognitive Dimensions Framework

**Abstraction gradient:** Balance abstraction-hungry/-hating

**Closeness of mapping:** Minimize 'programming games'

Consistency

**Diffuseness** (conciseness): Reduce code length

Error-proneness

**Hard mental operations:** Limit out-of-band (pencil & paper) work

Hidden dependencies

**Premature commitment:** Increase improvisation and responsiveness

**Progressive evaluation:** Support partially complete systems

Role expressiveness:

**Secondary notation:** Integrate design-time knowledge into code

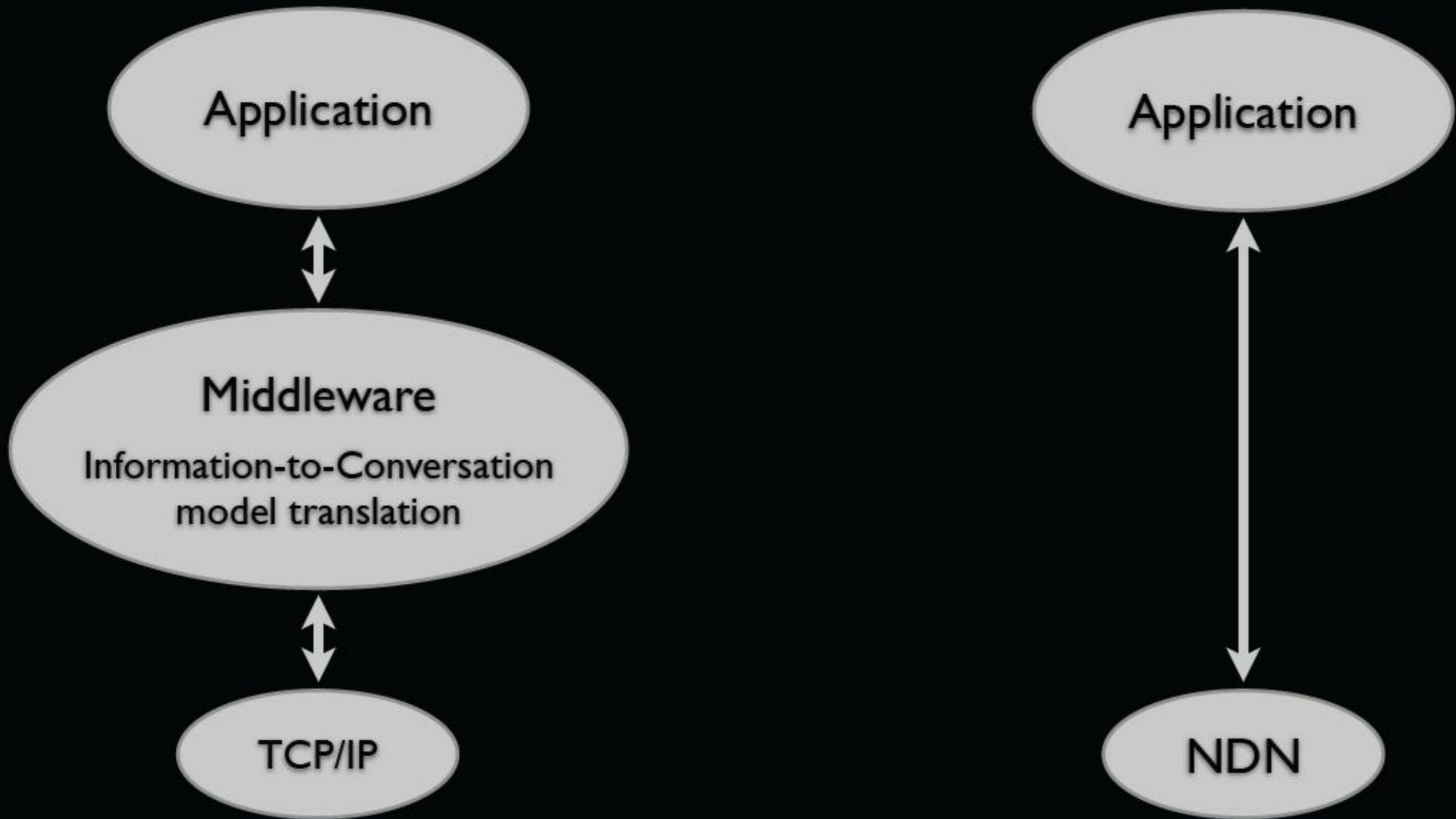
**Viscosity:** Reduce effort involved in making changes

**Visibility:** Aid debugging of concurrent and distributed operations

Green, T. R. G. and Petre, M.

*Usability Analysis of Visual Programming Environments: A Cognitive Dimensions Framework.*

Journal of Visual Languages and Computing 7, 2, 1996, p. 131-174



# Example – Architectural Lighting



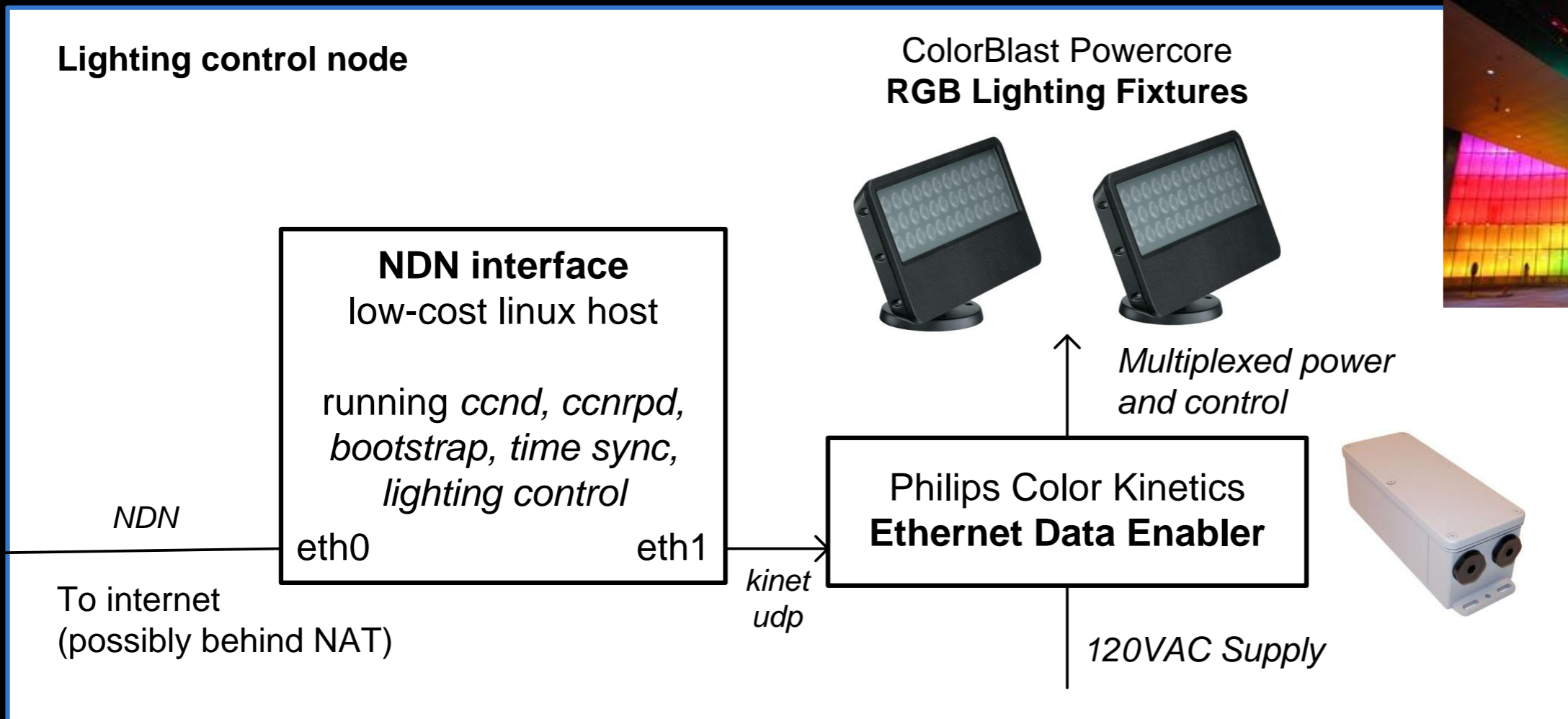
# Application-Specific Naming Strategies

- Controller-independent addressing (by fixture)
- Controller-based addressing
- Physical location
- Region of Responsibility
- “Function”
- **Designer-driven** (ie, not system-assigned names)
- Challenge of grouping

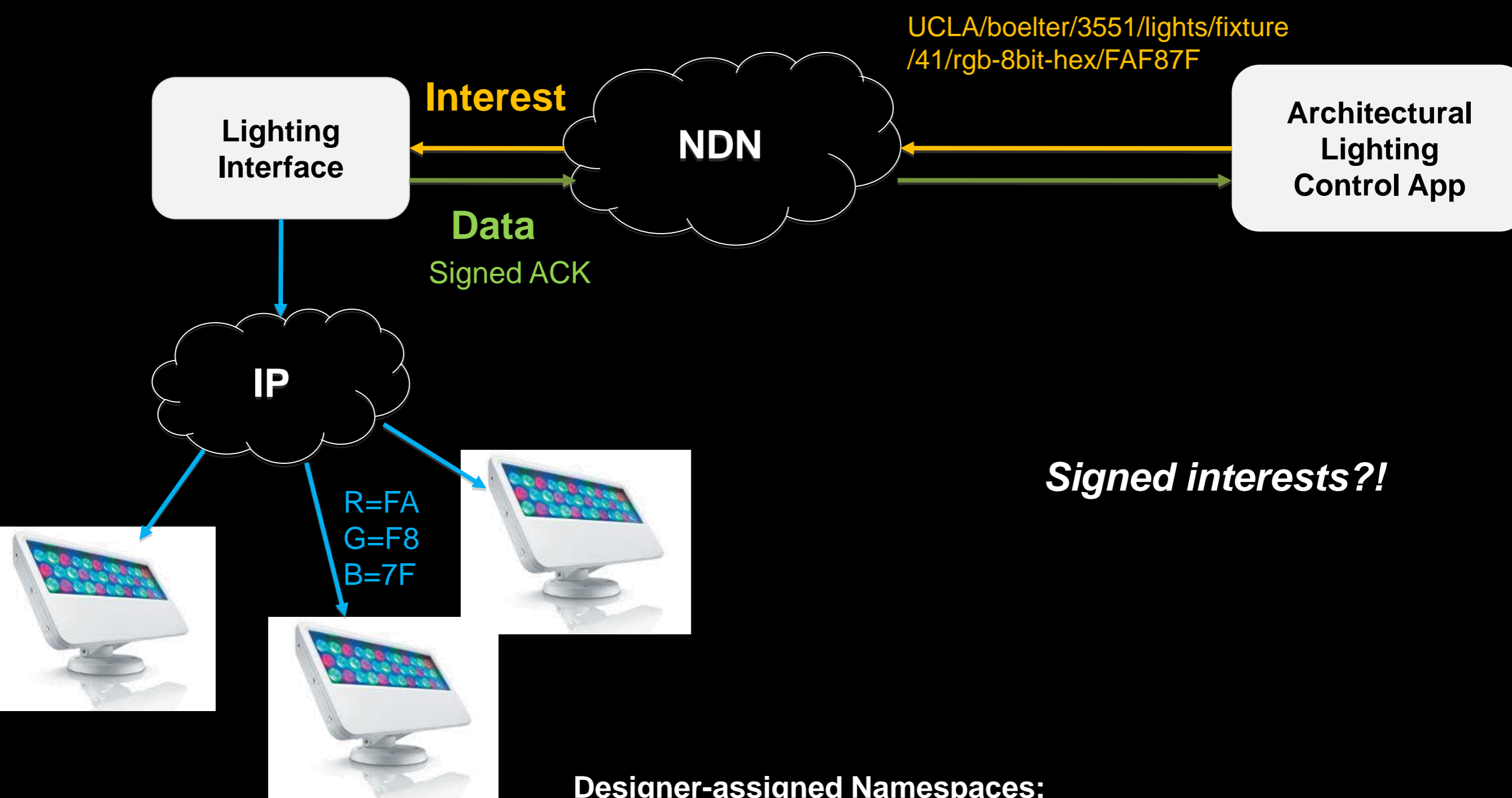
There is a fair amount of work on data naming & addressing in embedded systems, in particular, for Building Management Systems (BMS) and Supervisory Control and Data Acquisition (SCADA). For example, IS4 by Ortiz and Culler (2010), “A System for Managing Physical Data in Buildings.”



# NDN Lighting Building Block



**Bootstrap with manufacturer-supplied names broadcast locally.  
Use a shared secret (barcode-on-the-box) to configure.  
Support **multiple application-defined names**, and **verified clients using NDN per-packet signatures** with different ACLS.**



***Signed interests?!***

**Designer-assigned Namespaces:**  
 /ucla.edu/boelter/3551/lights/fixture/...  
 /ucla.edu/cens/lights/walls/east/...

**Manufacturer-assigned Namespace:**  
 /local/broadcast/light/00-50-56-C0-00-08



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