

# Critical Infrastructure DNS Research Testbed

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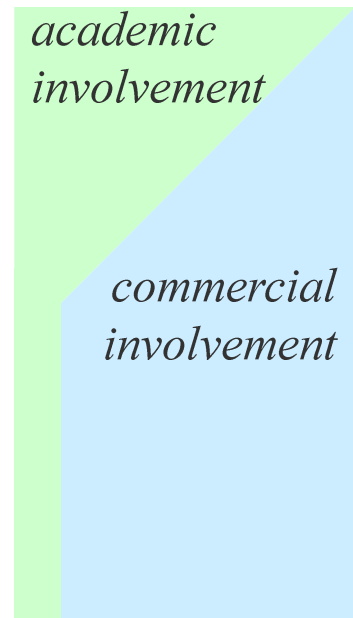
joint work with Terry Benzel<sup>1</sup>, Michael Elkins<sup>2</sup>,  
John Heidemann<sup>1</sup>, Yuri Pradkin<sup>1</sup>, Abdul Qadeer<sup>1</sup>

*1: University of Southern California/Information Sciences Institute*

*2: Parsons*

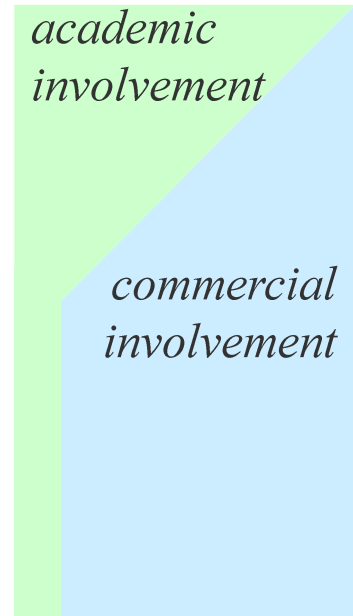
# Evolution of the DNS Ecosystem

- 1985: DNS starts in academia
- 1995: Internet commercialization
- 1998: ICANN
- 2004: new TLDs
- 2016: NTIA transition



# Changing Roles

- 1985: academic: applied research
- 1995: transition to “make it real”
- 2005: academia lacks perspective to contribute



*can we benefit from complementary roles?*

# Results: Difficult Evolution Problem

- Advancing the DNS and DNSSEC is difficult
  - Protocol changes (e.g. NSEC5, DANE, ...)
  - Code innovation (e.g. new server code)
  - Hardware changes (e.g. hardware-based dnssec)
- Safe experimentation on real traffic is difficult
  - Mirroring vs live feeds
  - Privacy concerns
- Thus: Internet naming research has stagnated

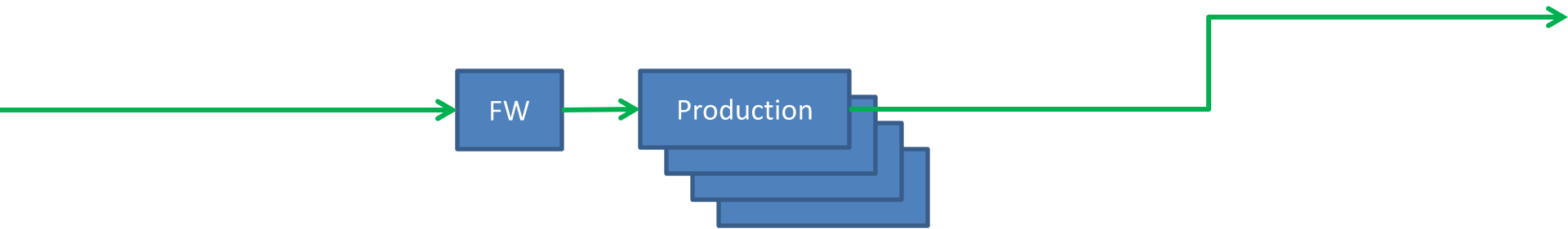
# Our Solution: A Testbed Married With Operations

- Internet infrastructure at USC/ISI
  - DNS's B-Root
  - Other zones and protocols
- Hardware for conducting experiments
- Software for collecting research traffic
- Software for analyzing and comparing traffic
  - Operational vs Testbed
- Software for replaying and retesting

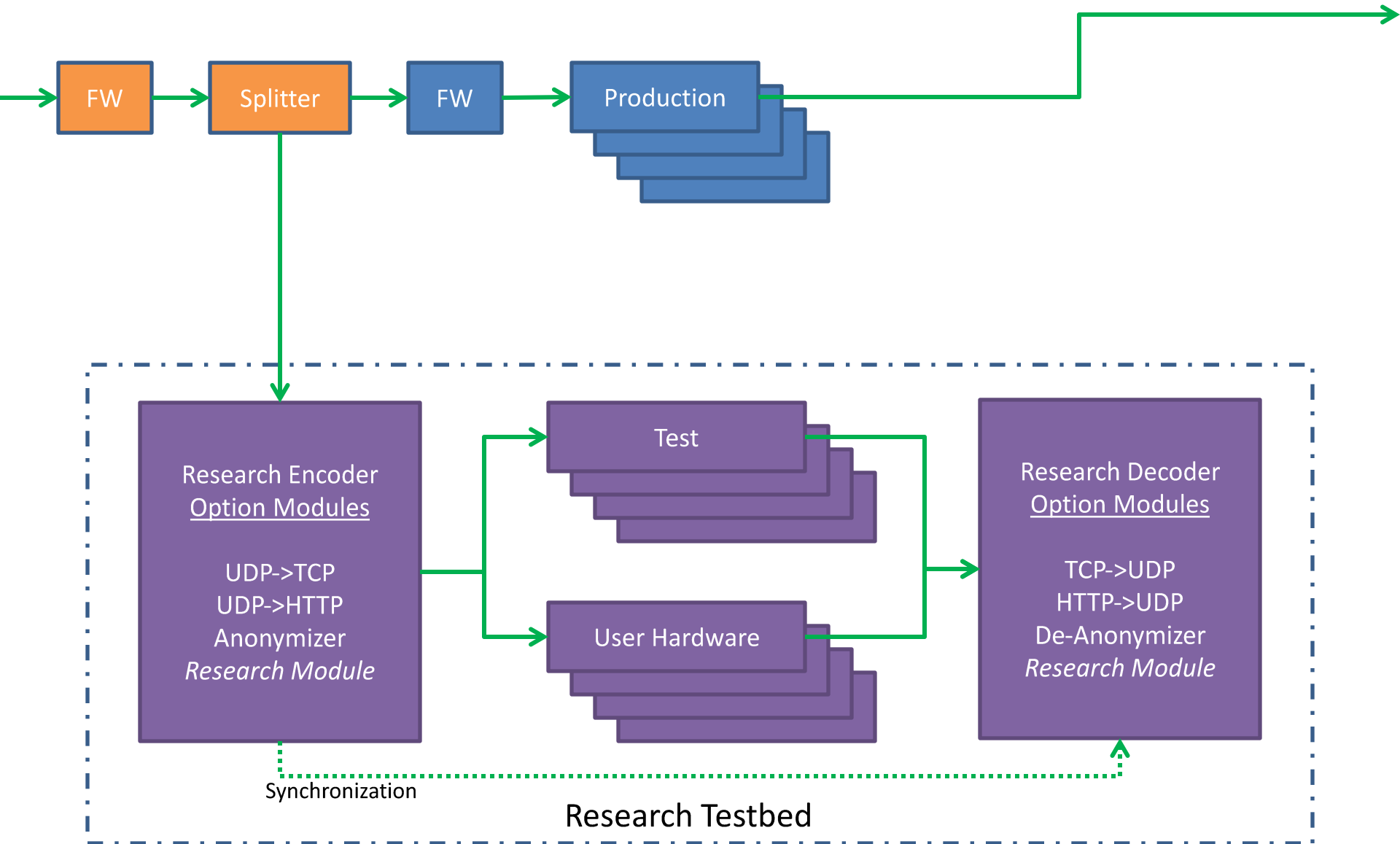
# Our Expected Architecture

The following diagrams depict  
our current high-level architectural plans

# Typical Operational DNS Service

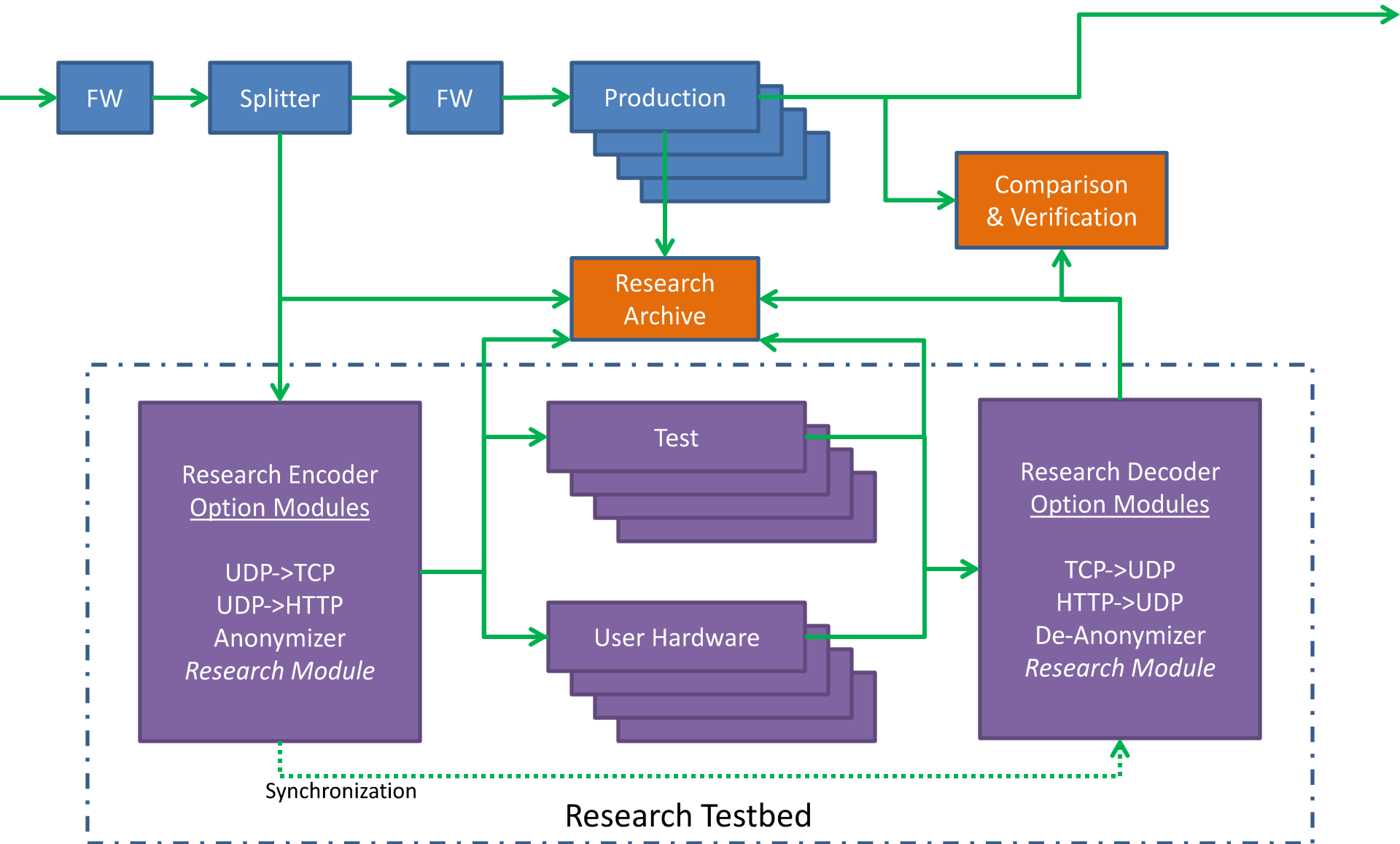


# Adding a Parallel Testbed

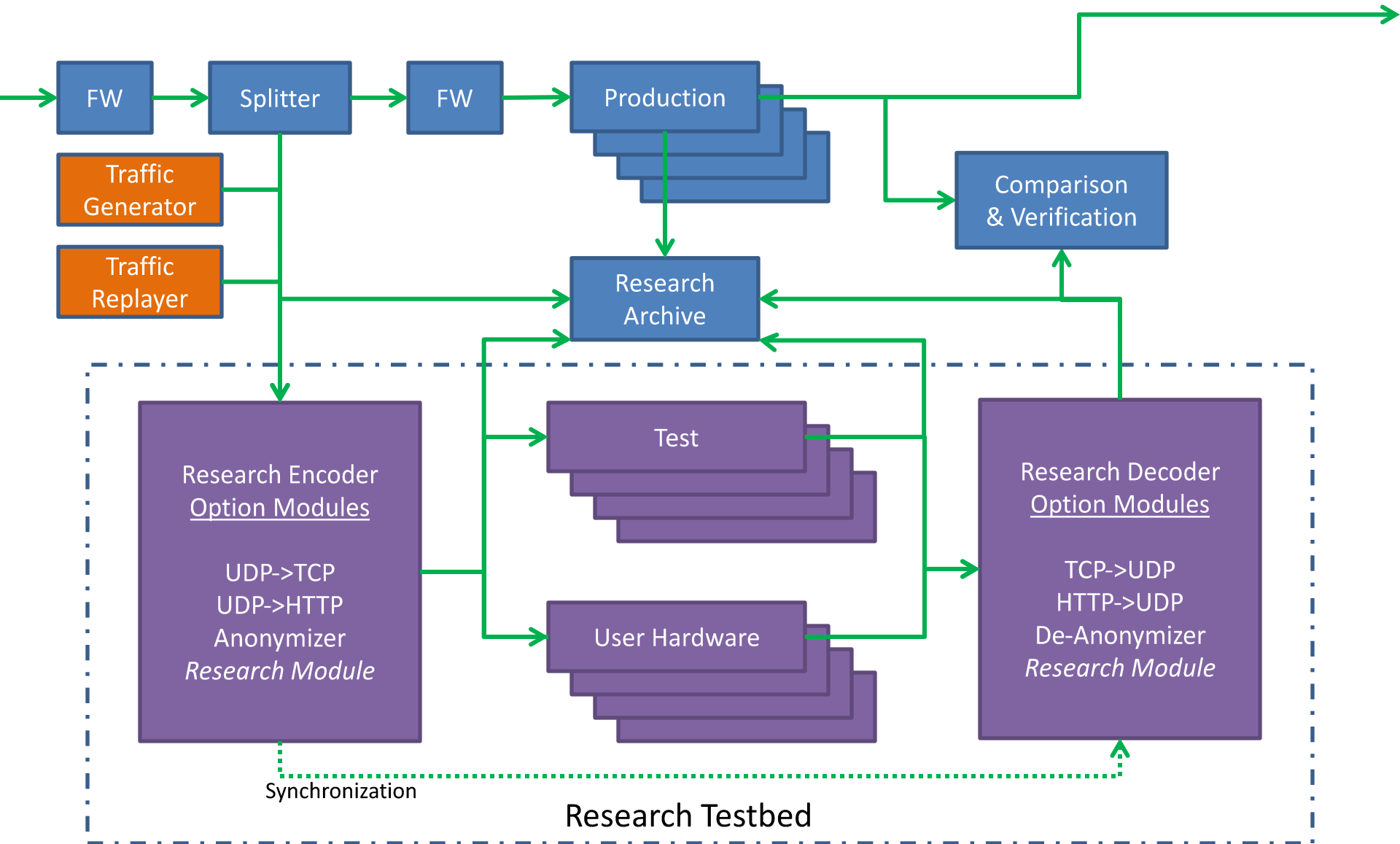




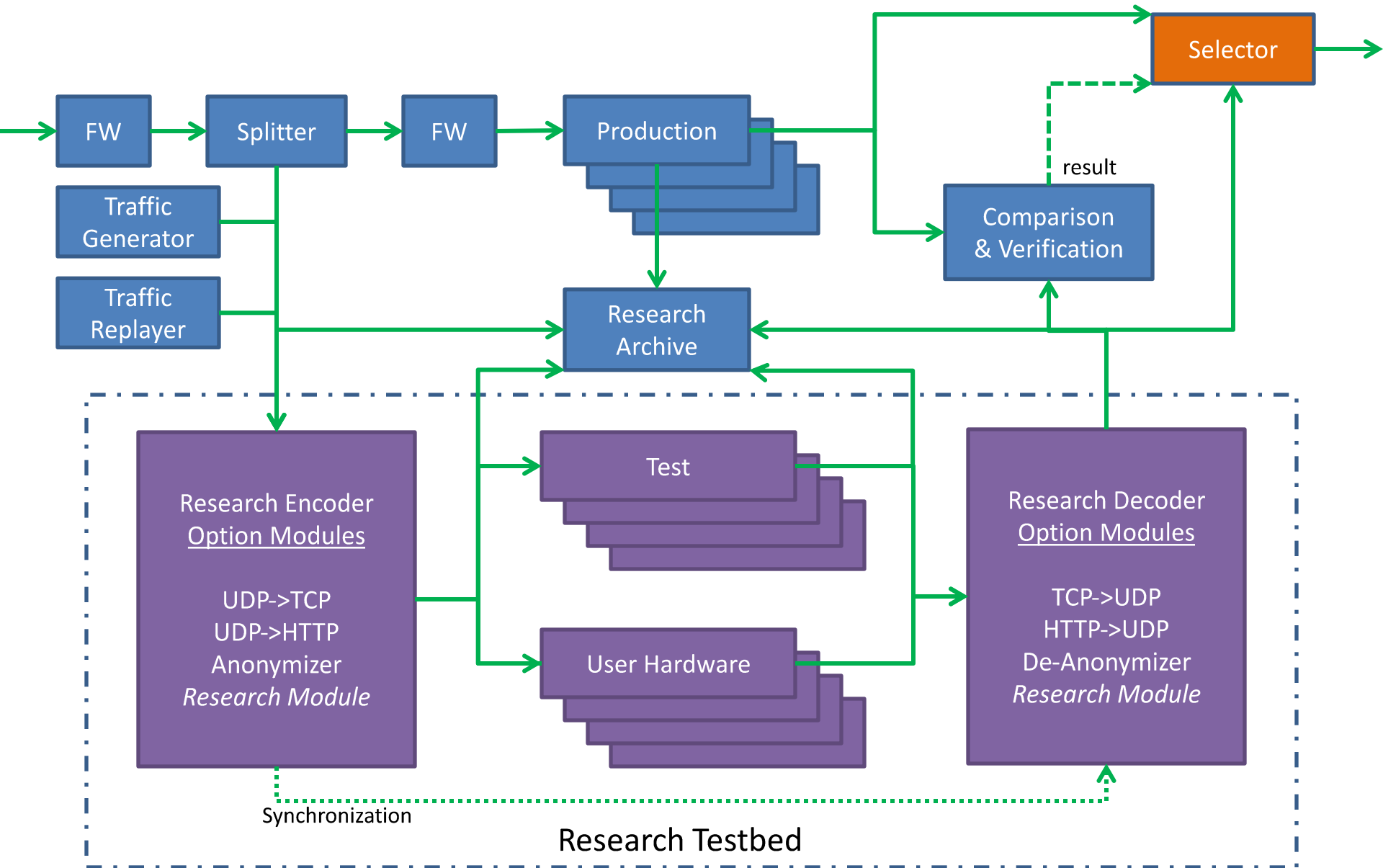
# Adding Comparison and Validation



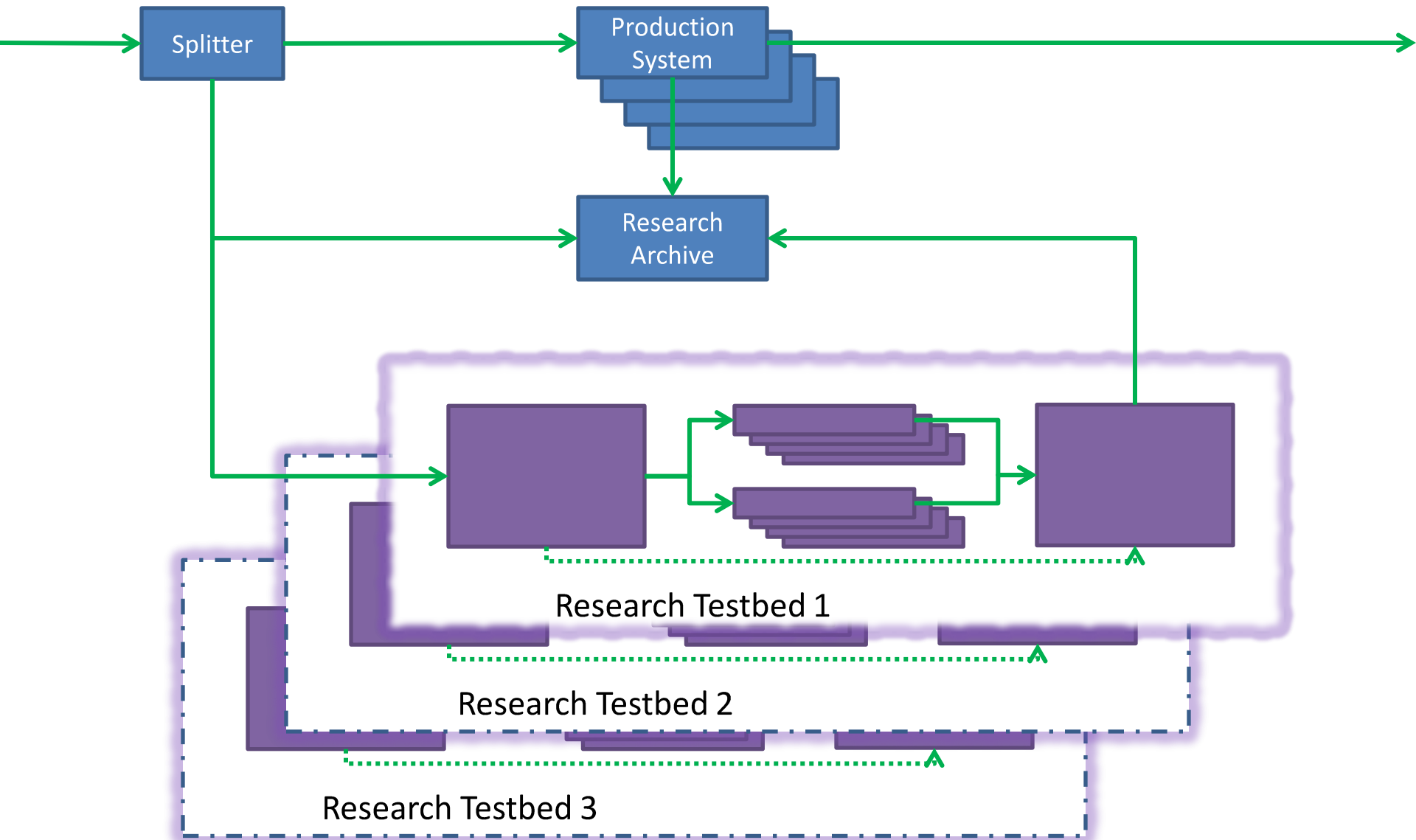
# Other Data Sources



# Transition Testing



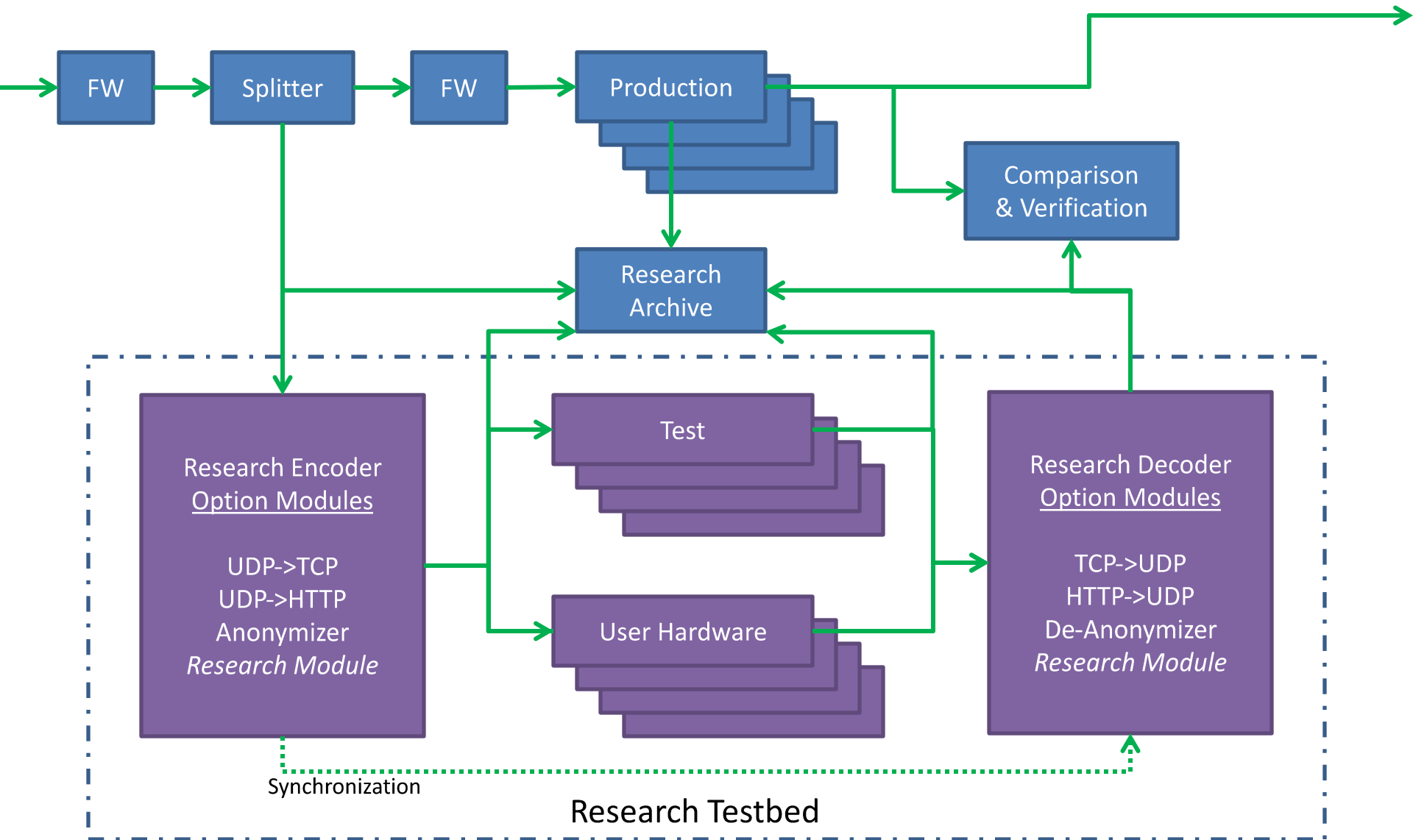
# Parallel Research Support



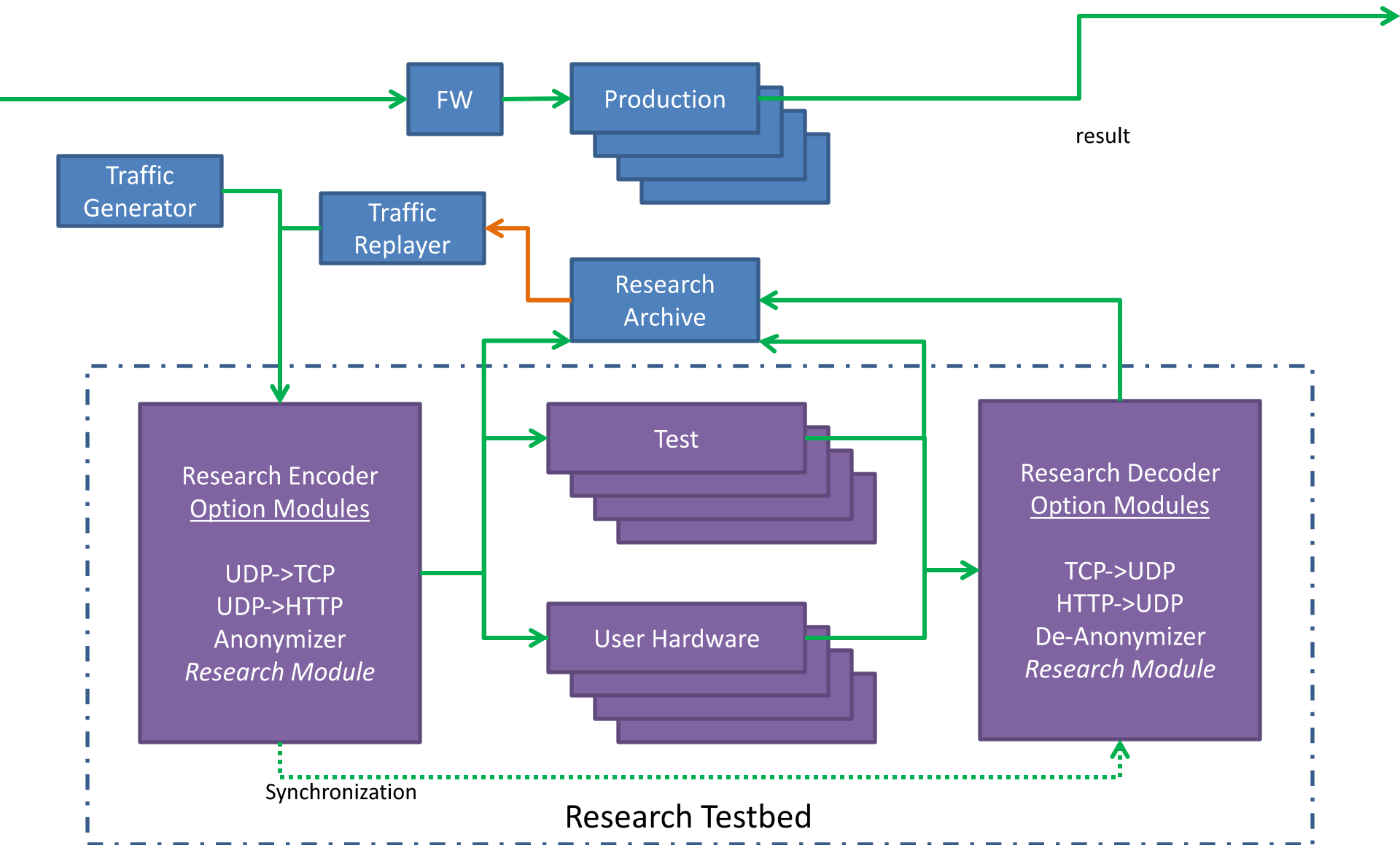
# Example Usage Configurations

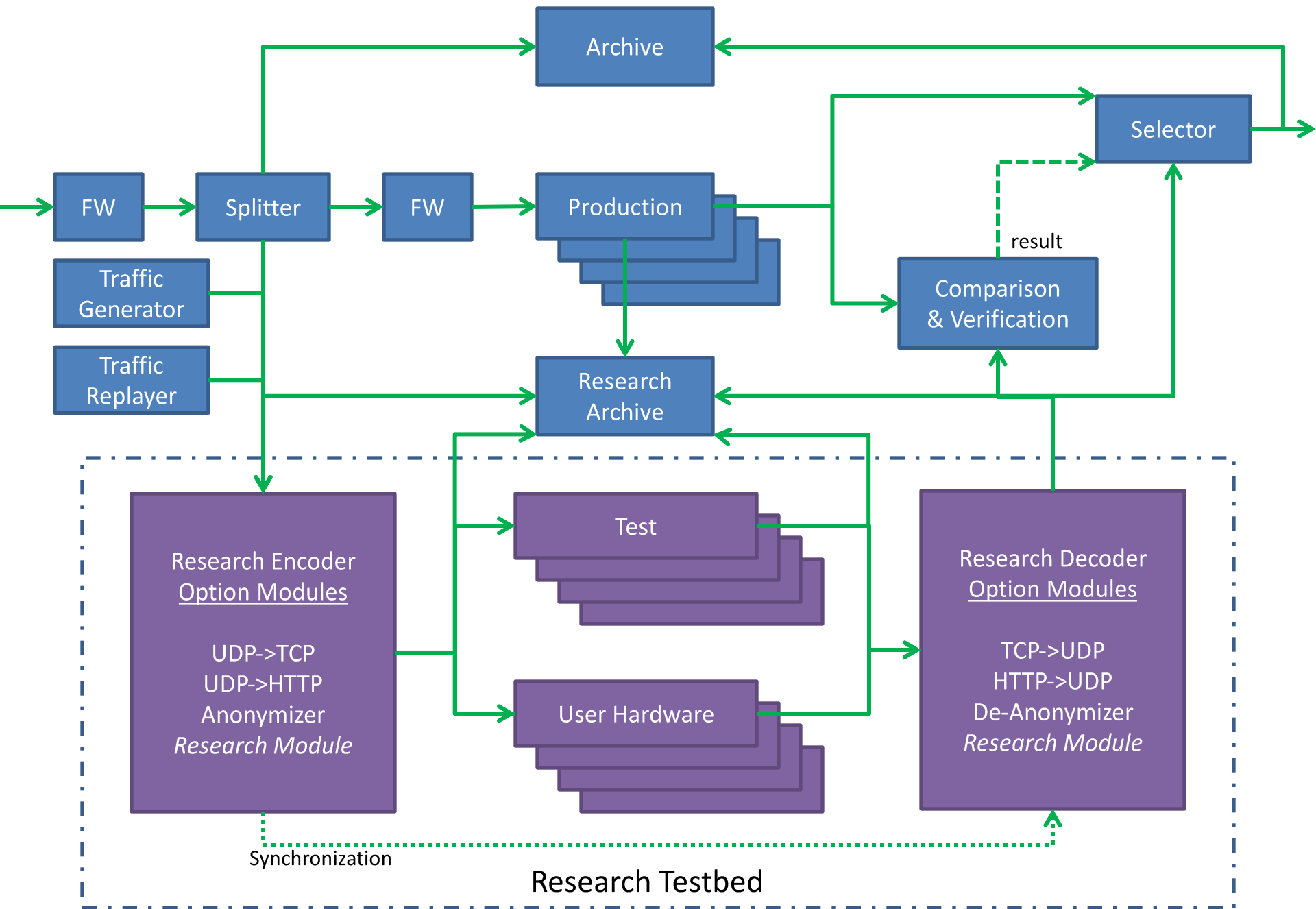
- Run in parallel
- Replay and generated traffic
  - Tuning and adaptation
- User zones hosted at the testbed
- Protocol conversions and testing
- Address based operational/test separation

# Run in Parallel: Root or User Zones



# Replay and Generated Traffic







# Safe Experimentation

- Goal: testing new tires on a running car
  - Critical infrastructure **cannot fail**
  - But, research means *trying new things*
- Approach: new research infrastructure for...
  - experimenters *evaluate real traffic*
  - then *compare* experimental vs. production outputs
  - *path to production* after testing with automatic fail “out”
- Result: testing new things, safely

# Community and Research Building

- A new research community
  - Outreach to broader research communities
  - Re-engaging academia
  - Outreach to operational communities
- Broaden the naming research agenda
  - Looking for input and feedback!
- New open-source software
  - For use by both researchers and operators

# Overall Benefits

- Rekindle and grow academic involvement
- Accelerate innovation
  - new uses
  - more rapid evolution
- Collaboration with academia, industry, governments and NGOs

# Timeline

- Now:
  - Gather Requirements
  - Funding
  - Community and collaborators
- Soon:
  - Hardware and software
  - Open to researchers for experimentation

# Join Us

- **Looking for feedback**
  - <http://ant.isi.edu/researchroot>
  - Join our mailing list
  - Send us ideas, suggestions, feedback
  - **And use cases!!!**
  
- Join the community and attend our workshops