A Critical Survey of Network Functions Virtualization (NfV)

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Introduction to the Research – About the team

- Lancaster University (LU)
  - Excellence in Economics and Computer Science, research-intensive British university.
  - Three year PhD program with a focus on the economic and technical aspects of Network Functions Virtualization - NfV.

- LU Team
  - PhD Supervisors:
    - Professor David Hutchinson
    - Dr Christopher Edwards
    - Dr Nicholas Race
  - Research Support
    - Chris Ford

- Academic Rationale
  - Opportunity to investigate a major gap in computer science and telecommunications research.
  - Provide useful data and evidence to industry and standards development organisations.

- My IETF Experience
  - IETF Participant and contributor since 2005. WG Secretary of ROLL, L3VPN, CCAMP and PCE.
  - Editor/author: RFC4687, RFC5557, RFC6006, RFC6007, RFC6163, RFC6639, RFC6805. Currently progressing 7 WG documents and 7 individual drafts.

Research – Network and Functions Virtualization

- Network operators have been independently researching network and function virtualization with hardware and software vendors for years.
  - Most concluded that industry cooperation would be required to provide the economy of scale for commercial deployment and operation.

- Will also require application of an innovation model to address:
  - Rising costs of technology development.
  - Shorter product lifecycles.
  - Greater distribution of knowledge.
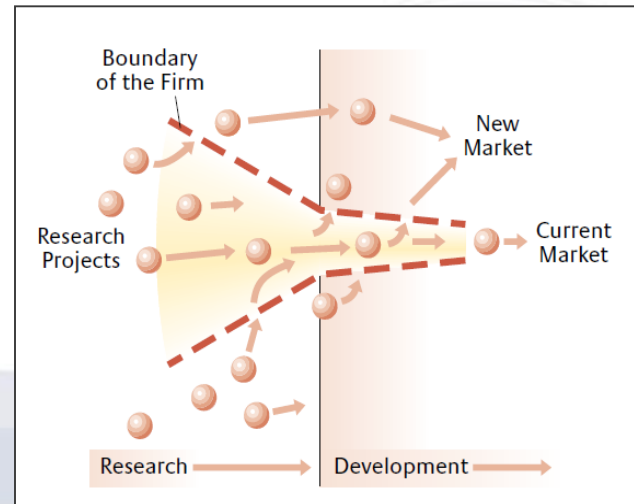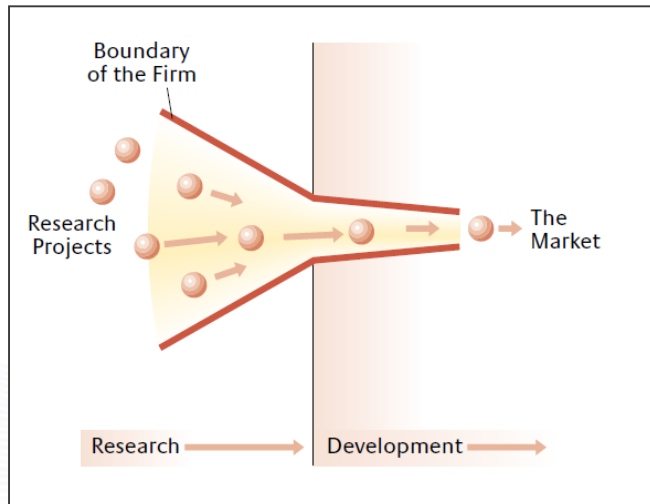
Research – The key questions

- This project looks to evaluate the techno-economic drivers, enabling technologies and innovation model required to deliver NfV.

- These may be phrased as the following research questions:

R1: What are the economic and technical drivers behind NfV?
  - **R1.1**: How applicable are existing technologies to enabling NfV?
  - **R1.2:** Does automation and Software Defined Network (SDN) have a role in the deployment and operation of NfV?
  - The literature presents a wide consensus that virtualization provides significant benefits.
  - Existing research on why and how network functions may be virtualized, is not readily available.

R2: Review of Open Innovation and the applicability to the development and deployment of NfV.
  - "The Future of Open Innovation" by Gassmann, Enkel & Chesbrough (2010)
    - Identifies technology sector innovation as a gap in the research
    - Suggests that, "A new perspective might be needed to integrate these disparate strands of evidence into a larger theory." (2010:219)

Research – Documenting the problem space

- Evidence gathering
  - "A Critical Survey of Network Functions Virtualization" to help define the problem space
    - Qualitative and exploratory study (Eisenhardt 1989, Yin 2009, Thomas 2011)
    - Inductive, hypothesis-generating approach
    - Guided by tenets of Grounded Theory (Glaser and Strauss 1967, Charmaz 2006, Corbin and Strauss 2008, Suddaby 2006)

- Analysis (Miles and Huberman 1994)
  - Detailed coding of interview transcripts (nVivo).
    - Development of concepts and their dimensions.
    - Intensive review around each concept.

- Interpretation
  - Combining memos & concepts into cohesive whole.
    - Establishing cross-user connections.

- Writing up
  - Develop substantive model and frameworks.
  - Construct authentic & plausible arguments (economic and technical) based on evidence generated.
  - Publishing findings and conclusions documents (including informational I-Ds).

Timeline – The critical survey

Jan (2013)	Feb	Mar	Apr	May	Jun	Jul
Study of NfV literature.						
	Creation of interview guide.					
		24 Interviews with key stake holders.				
			NfV Workshops.			
		Analysis starts immediately. Data is coded, constantly compared across cases, summarised in memos and displays.				
						Develop literature to enfold in the analysis.

"*Also, the researcher does not want to be so steeped in the literature that he or she is constrained and even stifled by it. It is not unusual for students to become so enamoured with a previous study or theory, either before or during their own investigations, that they become literally paralyzed.*" (Corbin and Strauss 2008, p.36)

Limitations and Challenges

- Theoretical Sampling & Saturation
  - Dual interviews per organisation.
  - Suitable diversity of network operators.
  - Dealing with standards bias.

- Validity (Construct, Internal and External)
  - Need to satisfy the four tests "commonly used to establish the quality of any empirical research." (Yin 2009, p40)

- Reliability
  - Qualitative, exploratory study.
  - Two researchers, with advisor.

Next Steps – Survey candidates

- Seeking network operators who are interested in participating with the survey.
  - Interview can be conducted in person or remotely.
  - All results will be anonymised.
  - Participants will have early and full access to the findings and conclusions.