WP5 Converters
VESI QPM10 @ UoMcr

LJMU, Soton, Ncl & Mcr Universities

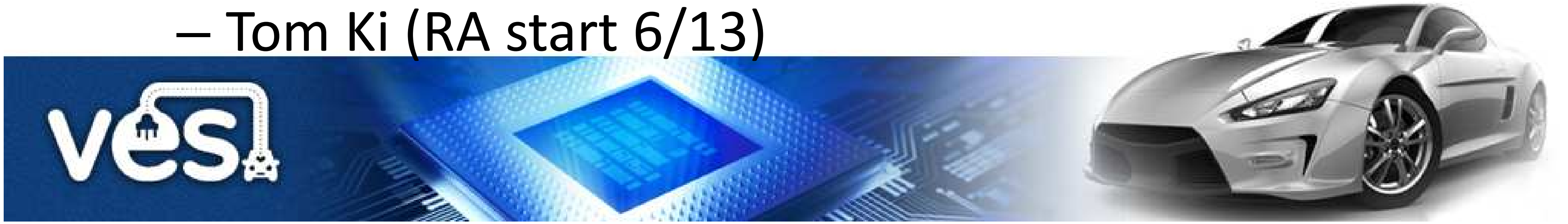
7-04-14

Scope

- Multi-phase traction drive with multi-use capability (LJMU)
- Integration of traction drive, charging & grid support functions (Soton)
- Techniques to minimise DC-DC converter filter inductance (Ncl)
- Power dense techniques for DC-DC conversion (Mcr)

Researchers

- LJMU (1PhD & 12m RA)
  - Ivan Subotic (PhD start 10/11), Nandor Bodo (RA start 10/13)
- Soton (1 PhD)
  - James Donoghue (PhD start 12/11)
- Newcastle (0.5 PhD)
  - Haimeng Wu (PhD start 1/12)
- Manchester (12m RA)
  - Tom Ki (RA start 6/13)



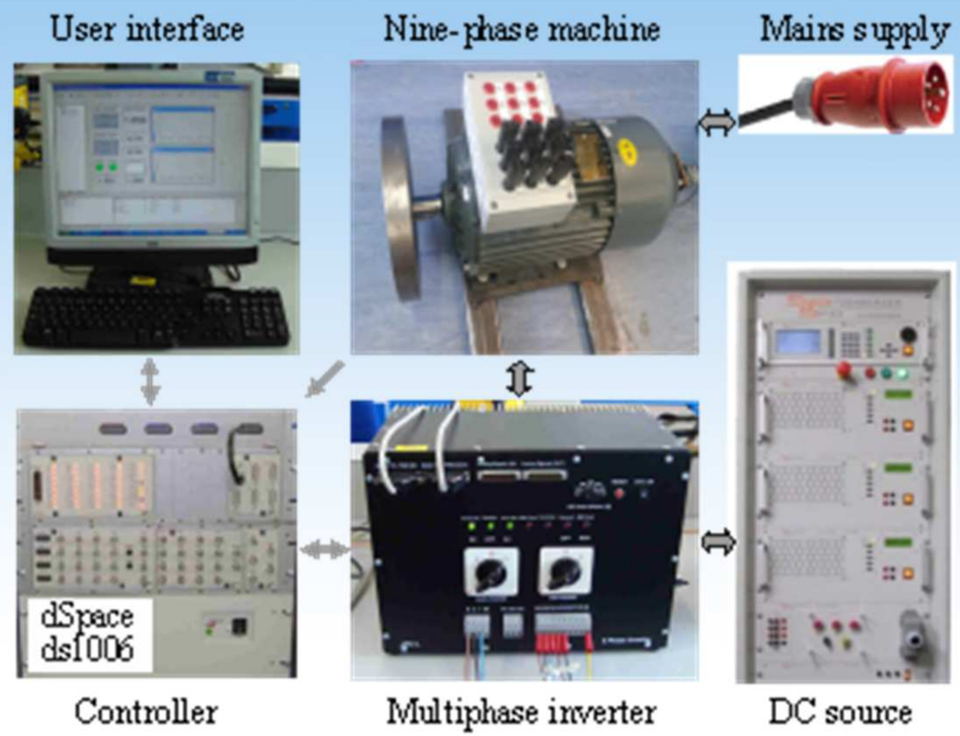
LJMU: Integrated on-board battery chargers

Work completed, 01/01 - 31/03/2014:

- Work on the completion of an accepted conference paper (IEEE ISIE, June 2014), including software development, simulations and writing-up; paper completed and submitted. Pre-print made available to go on the VESI web-site.
- Experimental work on the charging/V2G operation using a nine-phase induction machine with three-phase charging.
- Experimental work on the propulsion mode with the nine-phase machine and the nine-phase inverter.
- This has replaced planned activities for this quarter (due to the arrival of the nine-phase machines), which are therefore again appearing as planned activities for the next quarter.
- More detailed technical report will be given in Demonstrator 3 presentation.

Laboratory prototype

- Two multiphase inverters, paralleled to the same dc-link, are used for nine-phase configuration.
- A dc source is used to supply/sink dc power in charging/V2G (batteries have only just arrived).
- Asymmetrical nine-phase machine.



Theme 5
Lab Based V2G Demonstrator

Project Management Meeting
Manchester
Monday 7th April 2014

James Donoghue Prof. Andrew Cruden
University of Southampton
Electro-mechanical Research Group

Communications compression

- With progression towards the definition of a custom V2G protocol optimised for the cellular network in mind, tests and comparisons of different optimisation techniques have been carried out on standard V2G data using several compression techniques:

Gzip **Xmill** **XMLPPM** **Fast Infoset** **XEBU** **EXI** **EXI + Gzip Hybrid**

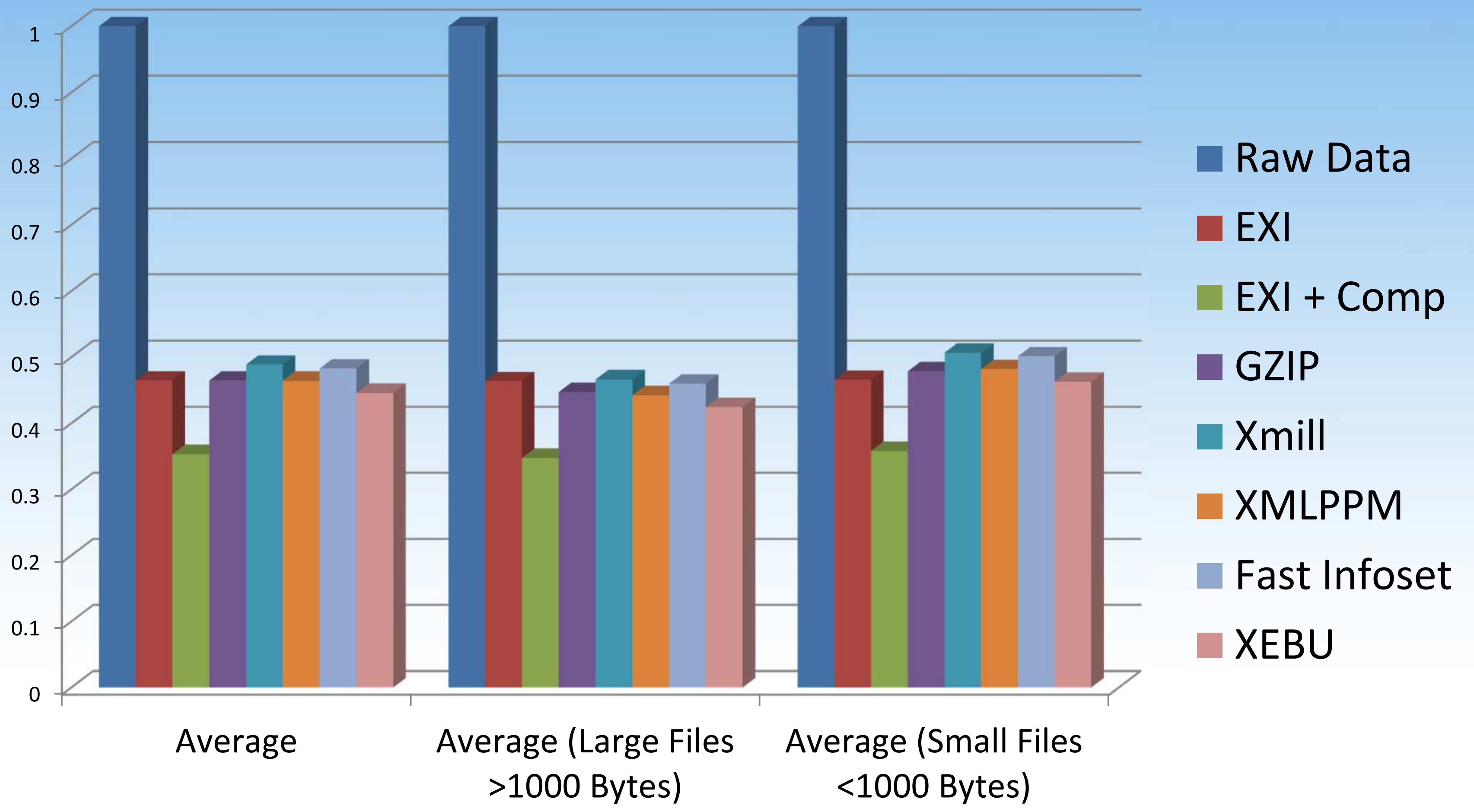
Communications compression

Southampton (University of)

Results showed that all techniques produced significant size reduction capabilities with the **EXI+Compression** Hybrid Performing best in this case

Message Type	Raw Data (Bytes)	Compressed Data (Bytes)						
		GZIP	Xmill	XMLPPM	Fast Infoset	XEBU	EXI	EXI + Comp
Boot Notification	1282	561	592	558	575	536	612	453
Diagnostic Status Notification	1282	573	592	558	576	534	612	453
Meter Values	1090	467	489	467	480	446	468	353
Status Notification	1005	479	496	473	484	454	473	361
Start Transaction	997	474	499	470	485	445	467	360
Stop Transaction	996	466	496	466	481	436	466	357
Firmware Status Notification	905	436	447	438	441	429	424	316
Authorise	852	411	440	417	423	408	389	307
Heartbeat	797	388	419	397	408	382	373	289
Normalised								
Average (Normalised)	1	0.4648778	0.4889111111	0.464489	0.483068444	0.445909	0.46491111	0.3535
Average (Large Files >1000 Byte	1	0.4474	0.466425	0.4424	0.460096	0.424704	0.4637	0.347475
Average (Small Files <1000 Byte	1	0.47886	0.5069	0.48216	0.5014464	0.462874	0.46588	0.35832

Communications compression



Communications compression

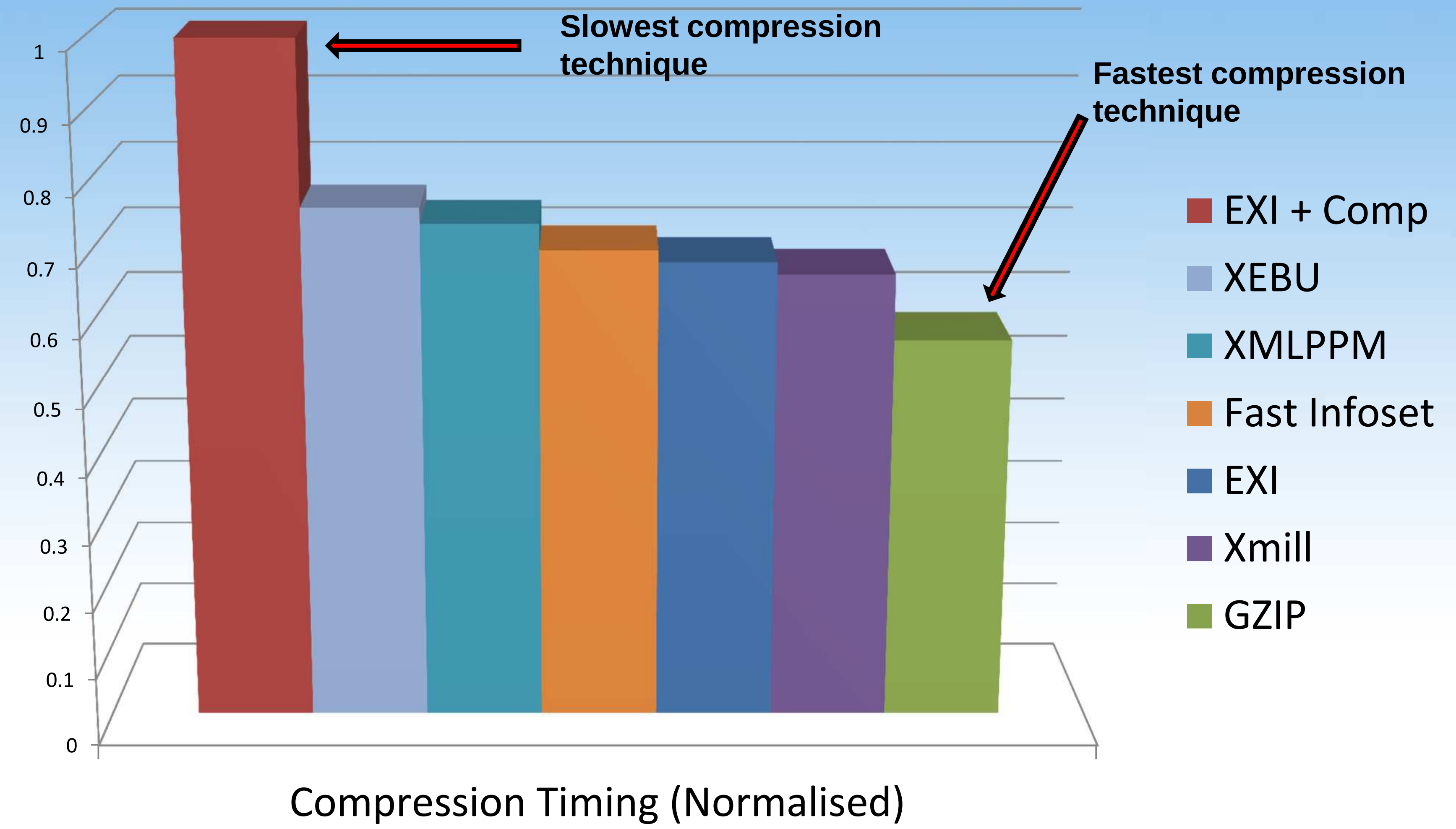
Southampton

- Comparison on the computational workload required to perform each calculation shows that the better compression techniques take considerably longer to achieve this compression
  - i.e. **EXI+Compression** achieves greatest data compression however takes the longest time to achieve this compression!
  - GZIP achieves reasonable data compression volume ***and*** is the quickest to implement this compression (hence is optimal technique)

Compression Timing (ms)

	EXI + Comp	Xebu	XMLPPM	Fast Infoset	EXI	Xmill	GZIP
Average	3578	2718	2636	2501	2438	2374	2032
Normalised	1	0.759642258	0.736724427	0.698993851	0.68138625	0.663499162	0.567915

Communications compression



Summary of Quarter's work

- The author's vision is that V2G communications will be enabled via the 3G (or future 4G) wireless network
- The data traffic volumes for both vehicle annunciation and control will be significant for large numbers of aggregated EVs
- Data compression performance, and optimisation of the processing time/power required to compress data, is critical
- This work has focussed on possible compression algorithms to help implement V2G comms on 3G/4G networks,

School of Electrical and Electronic Engineering

Nonlinear analysis for Interleaved Boost Converters

Haimeng Wu

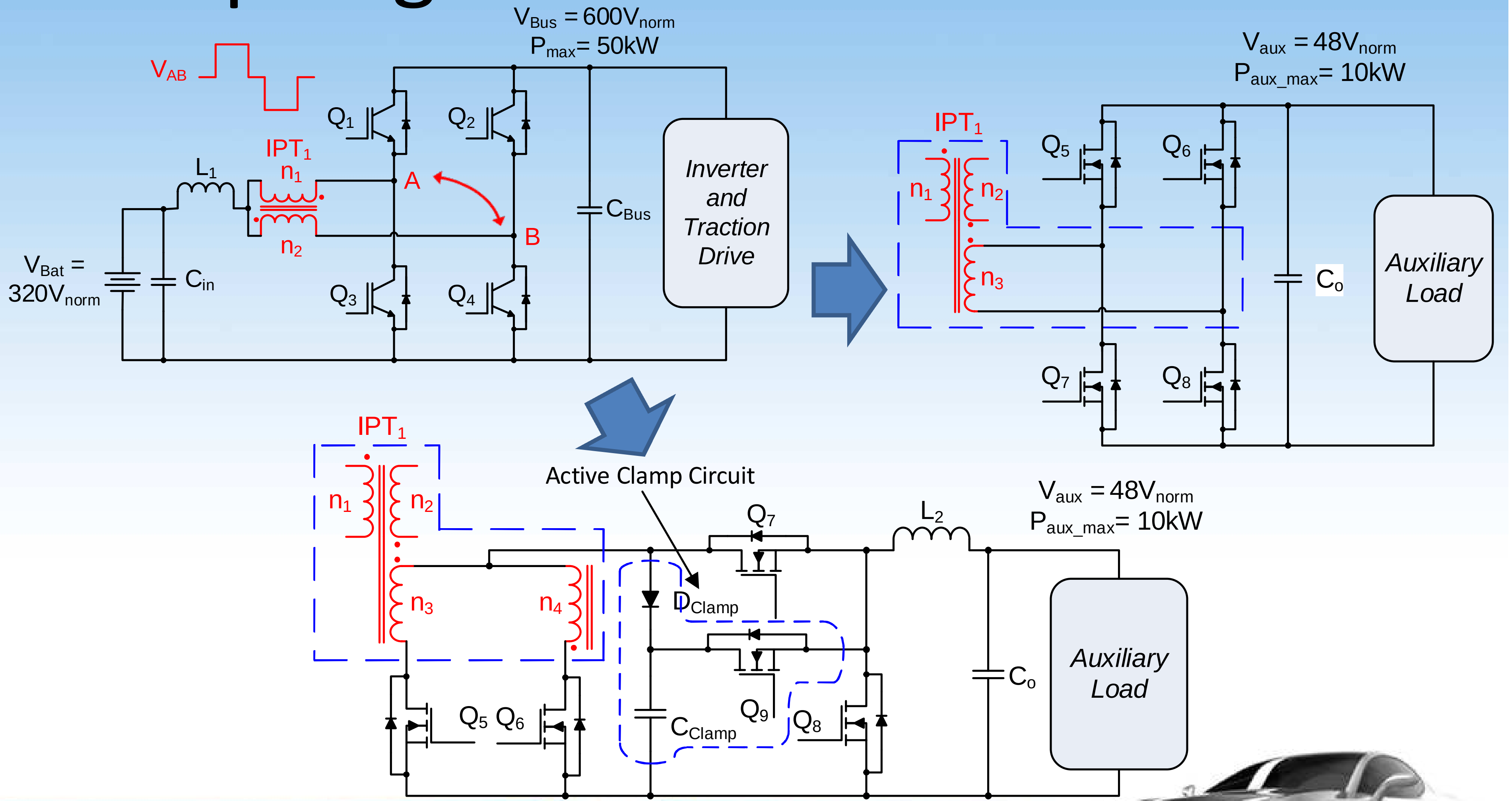
Prof. Volker.Pickert

October 7th

UoMcr: Topologies for Auxiliary Power Connections

- Investigate techniques for integrating low power sources / supplies into the main power train DC-DC converter
  - Objective to reduce system size / cost
  - 48 V DC supply for vehicle systems (10 kW)
  - Charger input from residential mains (3 kW)

Topologies for 48 V Connections



Performance Summary

	Center-Tap Topology	Synchronous Active Bridge Topology
Control method	PWM Control with Active clamp signaling	Phase-Shift Control
Number of semiconductors	7 pcs	8 pcs
Conduction loss in semiconductors	302.24 W	270.02 W
Switching loss in semiconductors	12.87 W	Null (ZVS)
IPT turn-ratio	24:6→4:1	24:2→12:1
Output filter	L-C filter	C filter
Output voltage ripple	≤ 1 Vp-p	2.77 Vp-p
Loss in output capacitor	≤ 1 W	9.93 W
Loss in output inductor	20 W (estimated)	Null
Loss in clamping capacitor	≤ 1 W	Null
Current losses	317.11 W (output capacitor not included) 337.11 W (output capacitor included)	279.94 W

UoMcr: Topologies for 48 V Connections

- Forward plan
  - Detailed control design for the sync active bridge topology
  - System design and testing