附件一：「學研合作 5G 產業技術開發專案計畫」重點推動研發項目

〔註〕下表為法人各單位所提之實務研發議題。請直接與擬合作單位聯絡，並據以提出計畫申請書。

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
1	工業技術研究院資訊與通訊研究所-M 組	Channel estimation (CHEST) and measurement feedback for the advanced receiver	Channel estimation and measurement feedback are critical components in the receiver chain from link performance/system capacity and joint precoding for MU-MIMO or network MIMO point of view. In this task, the potential contributor is expected to design efficient channel estimation and measurement feedback algorithms for the next generation 5G system to support features such as network MIMO, massive MIMO, with competitive performance. The channel estimation and measurement feedback schemes shall be realizable/implementable by DSP or FPGA with efficiency from computation complexity point of view. Participants will work with ITRI counter-parts on CHEST and measurement feedback from design, link performance evaluation for both floating and fixed point to final implementation. *Note 1: CHEST for UE and cell sites can be different. We are looking for individuals who can contribute to both will be the best. *Note 2: Measurement	許仁源 03-5914850 jyhsu@itri.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			shall include CQI, PMI, RI and noise/interference power measurements.	
2	工業技術研究院資訊與通訊研究所-M 組	RF calibration procedure	RF impairments such as I/Q imbalance in both Tx/Rx paths, carrier frequency offset & transmit timing adjustment, transmit/receiver gain, magnitude & group delay equalization for analog filters, sampling timing error, phase noise correction, etc require RF calibration procedures to compensate them. Some RF compensations can be done at the factory (e.g. equalization for analog filters), others are to be performed at power up or on-the-fly. In this task, we expect to build a digital RF front-end simulation platform for both Rx and Tx paths including modeled RF impairments, and then implement the needed on-the-fly RF calibration procedures in this platform. The simulation platform can be either Matlab or C-based. The calibration procedures developed in this task will be deployed in the HW platform for verification and testing.	陳正中 03-5914844 m400ccchen@itri.org.tw
3	工業技術研究院資訊與通訊研究所-K 組	UDN system architecture & configuration	Next generation 5G system is envisioned to include services provided by ultra-dense networks (UDNs). Various system deployment scenarios for UDN are still under evaluation. Indoor vs. outdoor, macro-cell	劉家隆 03-5917188 CLLiu@itri.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			overlay with cluster of small cells, CRAN, distributed vs. centralized antenna system are areas being tackled to address capacity, spectrum efficiency, and feasibility of the UDN system. In this task, we will focus on developing a system architecture and deployment strategies for an enterprise UDN system where solutions for inter-cell interference mitigation, for dynamic clustering/reconfiguring distributed antennas for a logical cell, and for support of both coordinated distributed antenna system (network MIMO) and centralized massive antenna system (massive MIMO with >= 128 antennas, mmWave node). A system simulation model shall be developed to evaluate (1) the target UDN architecture, its corresponding capacity and spectrum efficiency; (2) the efficiency of the interference mitigation scheme; (3) algorithms for dynamic reconfiguration of a distributed antenna system based on the traffic loading & propagation environments.	
4	工業技術研究院資訊與通訊研究所-K 組	IMEC software architecture & its configuration	Next generation 5G network is expected to provide various vertical services with diverse QoS requirements. To support heterogeneous configuration of	廖彥彰 03-5914618 yjliao@itri.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			ultra-dense RAN with various vertical services, we device an Intelligent Mobile Edge Computing gateway (IMEC) which serves as an ingress point from RAN to the core network as well as performs SON (Self Organization Network) functionality for the RAN, local traffic breakout to offload traffic toward core network. Furthermore, IMEC shall be designed to minimize the end-to-end delay, perform QoS negotiation/management with RAN and SDN/NFV based core network and manage some level of the RAN functional virtualization. An UDN may require several IMEC to support it. And each IMEC is envisioned to manage a group of clusters as described in Task 3. The number of clusters (size) of the IMEC is then determined by the amount of functionalities resided in the IMEC, the corresponding computation power, memory requirement of each function, peripheral, and the underlined HW platform capabilities. In this task, we need to (1) list all functions performed by IMEC; (2) define software architecture to host these functions with efficiency; (3) estimate/profile CPU/memory needs for the dominant functions;	

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			(4) identify potential HW & virtualization platform that IMEC can be implemented.	
5	資訊工業策進會	MTC link simulation platform	3GPP is expected to complete the 1st version of the narrow-band cellular IoT (NB-IOT) specification this year to prepare for the arrival of the massive MTC in the 5G era. New air interface perhaps with new waveform, a more efficient access scheme for short package, co-existence with licensed and unlicensed operation are in the discussions. This task is to build a link level simulation platform (including PHY and lower MAC protocol) for the cellular IoT standard (including NB-IoT) to include functions that can be operated in unlicensed as well as the sub-GHz bands. Functions for MTC end-unit (MTC-EU) Rx/Tx and MTC access point (AP) Tx/Rx shall be included in this simulation platform. Appropriate channel simulator should also be provided in the end-to-end link level simulation. The software architecture of the simulation platform should be designed for smooth migration to DSP implementations. That is, the similar structure (for the digital baseband parts and perhaps some lower MAC parts) can be transferred to DSP	吳明儒 (02)6607-3763 mingzoo@iii.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			implementation with minimum changes. In this way, MTC-EU Tx/Rx chain can then be used as a reference for verification of the DSP/HW implementation. The design of MTC-EU shall be low-power, low complexity and shall be reflected in the link level MTC-EU Tx/Rx operation.	
6	資訊工業策進會	MTC/NB-IoT access protocols	In order to provide massive MTC (mMTC), the air interface protocol for upcoming NB-IoT in 3GPP R13 and beyond would need to be changed significantly from that of the current 4G LTE standard. For instance, NB-IoT devices are allowed to operate in multi-carrier. It will then need to monitor its anchor carrier for receiving control information, such as paging indication and system information blocks, to perform subsequent random access procedure for data transmission in one of the carriers. However, this system may run into a risk of the anchor carrier being accessed by burst NB-IoT devices if scheduling is not done properly at the access point for load-sharing across multiple-carriers. This task is to build a system simulation platform to model the MTC access protocol and its corresponding performance. An enhanced MTC access	許俊彥 (02)6607-2828 jameshsu@iii.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			protocol and scheduling algorithm shall be designed to address issues discovered from the simulation results. The system simulation platform shall emulate massive access behavior. The physical layer can be modeled using conventional way via link budget estimation. The enhanced MTC access protocol will be contributed to the 3GPP standard by III, and the scheduling algorithm will be implemented in the MTC HW platform for verification and validation.	
7	資訊工業策進會	vEPC: node vs functional virtualization	EPC virtualization is an essential technology to provide diverse service requirements under one unified core network in 5G era. For example for enterprise eMBB application, the S-GW and P-GW may need to be co-located to minimize GTP tunneling inefficiency; for metering or static mMTC application, mobility management, location update and handover performed in MME can be disabled; for uMTC (ultra-reliable MTC) application, control functions such as session management, authentication will need to be moved closer to the edge of the core network to reduce latency and to meet real time service requirement. The node	紀文瑋 (02)6607-3519 wwchi@iii.org.tw

項次	法人合作單位	主題	研究內容	聯絡人及聯絡方式
			virtualization (i.e. the entire node of MME, HSS, PCRF, and control functions of S-GW and P-GW) has been implemented by several tier-1 manufactures. This task is to (1) provide analysis of the node vs. functional virtualization of the EPC for the above-mentioned three 5G application scenarios; (2) recommend a functional split of the EPC nodes for functional virtualization and its corresponding placement in the network for enterprise application. The recommendation from (2) will be implemented in 5G test platform for verification.	