

出國報告（出國類別：開會）

2021 世界應急通訊大會出國報告

服務機關：內政部警政署警察通訊所

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派赴國家/地區：西班牙馬德里

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摘要

本所派員參加本年度世界應急通訊大會，是為認識應急通訊領域之專家、學者、顧問及代表講授發表之新知，並了解各國現行公共安全單位通訊使用狀況，掌握通訊科技發展趨勢，會中發表的內容包羅萬象，如雲端運算技術、大數據分析、影像辨識分析、人工智慧、5G 網路、網路安全及無人機等等，而將這些技術整合是本次大會的重點，將不同的技術介面整合在同一個平臺上，大幅增加技術使用之便利性及實用性，發表會中也介紹各國應急通訊應用之現況。

通訊網路中要達成領域內互連操作性是較容易的，惟為了符合世界趨勢潮流，跨領域的互連操作性更是重要且必須的，但這必須借助政府公部門和私人民間企業之間的合作，共同協力才能完成。

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第一章、 目的

一年一度的世界應急通訊大會是由來自世界各地最專業的應急通訊專家學者、公司、製造商、聯營商、政府代表和使用者共同出席而有面對面交流機會之平臺，是其所在行業規模最大，最重要的展會，它將整個行業生態系統聚集在一起，為未來的應急通訊設定議程，為各國應急通訊專案提供一個獨家論壇。會議目標係為公共安全與救難應變單位提供相關應急通訊解決方案，致力於發表前瞻的應急通訊設備和應用方式，讓使用者能發現、比較當前尖端技術，獲得最新的政策、觀察和情報，並從真實案例研究和最佳實踐建議中受益。

本所派員前往西班牙馬德里參加本年度會議，是為了認識應急通訊領域之專家、學者、顧問及代表講授發表之新知，並了解各國現行公共安全單位通訊使用狀況，掌握通訊科技發展趨勢。

第二章、 過程

隨著新冠病毒大流行比預期的更加嚴重，為了確保會議參與者安全和活動圓滿成功，2021 世界應急通訊大會舉辦地點由原荷蘭阿姆斯特丹重新安排至西班牙馬德里的 IFEMA 展覽中心 4 號展廳，並延期至 2021 年 11 月 3 日至 5 日舉行，議程如下：

大師級發表會（須付費）舉辦時間	2021 年 11 月 3 日，09：00—17：30
一般發表會（免付費）舉辦時間	2021 年 11 月 4 日，09：15—17：30
	2021 年 11 月 5 日，09：30—16：00
展覽開放時間	2021 年 11 月 3 日，13：00—18：00
	2021 年 11 月 4 日，10：00—18：00
	2021 年 11 月 5 日，10：00—16：30

世界應急通訊大會發表的內容包羅萬象，包含目前應急通訊所遭遇到的挑戰及各種解決方案，一般發表會的主講者有政府官員、企業領袖和專家學者等等，能從他們的經歷和研究中了解到最新尖端技術的發展應用如何影響到我們自己及我們所處快速變化的環境，擴展參與者的知識。

（一）雲端運算技術

雲端運算並非一個嶄新技術，而是一種概念，是基於電腦技術的運用，發展而成的一種網路交流型態，在現有的電腦科學中，我們常以「雲」來表示網際網路上為數眾多的計算機和基礎設施的抽象示意概念。而「端」則泛指任何可以使用瀏覽器通訊介面，如常見的電腦、到現在的智慧型行動手機等連接上網路的設備。

雲端運算技術的基本概念，是透過網際網路將數量龐大的運算處理程式自動分拆成無數個較小的子程式，再由多部伺服器所組成的龐大系統搜尋、運算分析之後將處理結果回傳給使用者。雲端運算技術的資源是動態易擴充、虛擬化的套件，透過網際網路提供，使用者無須了解位於雲上的計算機和基礎設施的相關細節，不必具有相對的專業知識，也不用直接進行控制，只要關注自己真正需要什麼樣的資源以及如何透過網際網路來得到相對應的服務。

（二）大數據分析

大數據分析是指數據資料量變得過於龐大，以至於需要更強大的計算能力來處理眾多來源的所有數據資料量，除了龐大的數據資料量之外，所收集來源數據資料的複雜性對於數據資料的架構、管理、集成和分析迎來了新的挑戰。此外，大數據的另一個組成部分是從傳感器、移動設備、網路點擊流和交易等激增來源

生成傳入數據，生成速度仍在加快，從而導致需要即時分析。最後，大數據是指數據資料的精確度和可信度。這並不是說所有數據資料都必須經過高度整理和過濾，因為對非結構化數據資料源的分析可以帶來新的見解。

重要的是，數據管理員和決策者都應了解用於決策制定的數據資料的質量、準確性和可信度。大數據的確切定義為種類更多樣化、數量不斷增加且產生速度越來越快的數據資料。簡而言之，大數據是指更龐大且更複雜的資料集，尤其是源自於新資料來源的資料集。這些資料集過於龐大，因此傳統的資料處理軟體已無力招架。但靠著這些巨量資料，先前無法解決的問題或許有機會迎刃而解。

(三) 影像辨識

由於傳統的安全監控系統大多屬於被動式錄影，無法即時反應並採取積極行動，而事發後也多以人工方式調閱影像，影像辨識就是設法以辨識軟體替代人的視覺判斷，因此發展出可自動偵測及追溯人或物體，達到跨攝影機智慧影像分析功能，能處理大範圍區域，將影像輸入至分析的儀器中來進行影像分析，廣泛應用在影像監控系統。

而透過影像分析設定，可以針對入侵者、移動物體、火焰、煙霧等進行特殊事件觸發設定，具有提早預警的效果。影像辨識的終極目標就是教導機器能夠像人一樣理解所見之物，像是辨識人臉，識別物體，推論物體的幾何形態，從中理解其中的關聯、情緒、動作及意圖。

(四) 人工智慧

5G Artificial Intelligence and Machine Learning

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- Artificial Intelligence (AI) and Machine Learning (ML) will become an integral part of future networks
- AI and ML will enable significant network efficiency gains

3GPP TR 37.817 (Release 17)
Study high-level principles for RAN intelligence enabled by AI, the functional framework (e.g. the AI functionality and the input/output of the component for AI-enabled optimization) and identify the benefits of AI-enabled NG-RAN through possible use cases (e.g. energy saving, load balancing, mobility management, coverage optimization, etc.).

- Study standardization impacts for the identified use cases including the data that may be needed by an AI function as input and data that may be produced by an AI function as output, which is interpretable for multi-vendor support.
- Study standardization impacts on the node or function in current 5G-RAN architecture to receive/provide the input/output data.
- Study standardization impacts on the network interface(s) to convey the input/output data among network nodes or AI functions.

One general objective for the work is that the studies should be focused on the current 5G-RAN architecture and interfaces to enable AI support for 5G deployments.

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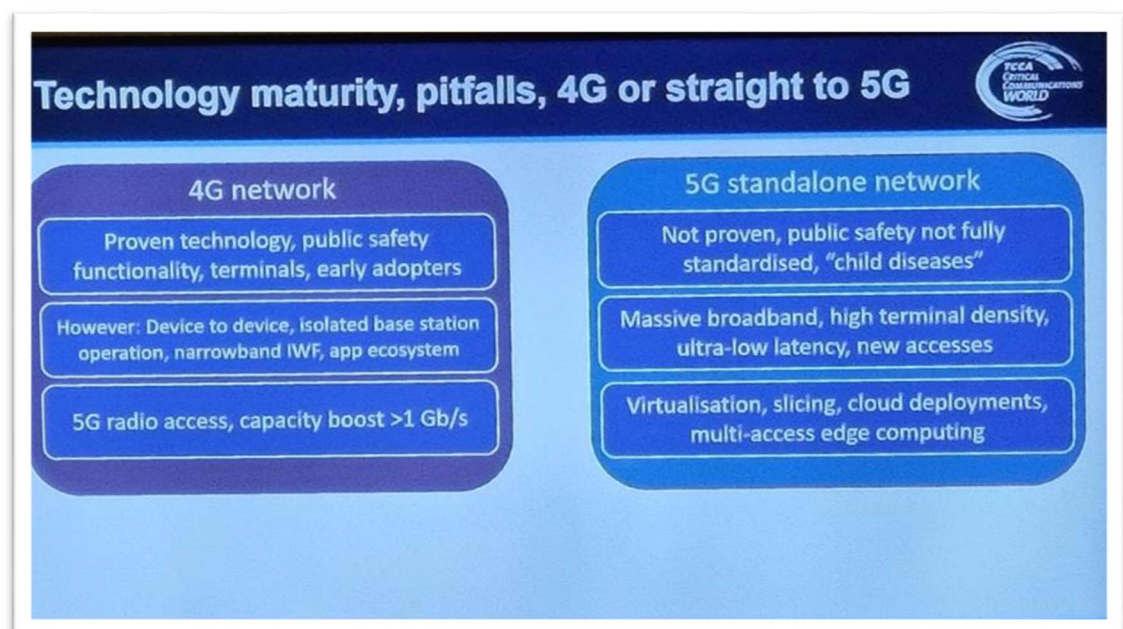
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照片 1 人工智慧與機器學習(發表會投影片)

人工智慧指的是能模仿人類的智能執行任務的系統或機器裝置，可以根據所收集的資訊不斷自我調整、進化，人工智慧的類型五花八門，而人工智慧的重點其實在於超級思維與數據分析的過程和能力。雖然人工智慧會讓人聯想到強大的機器人主宰全世界的畫面，但人工智慧的出現並不是為了取代人類，而是在大幅提高人類的能力，快速成為創新的基石，並為世界做出貢獻。

人工智慧最核心的原則是複製並超越人類感知世界及反應的方式。通過各種機器學習技術，可以識別出資訊模式並更全面深入了解大量可用數據，以往過於複雜或繁瑣的工作或過去需要人工進行的流程或任務，藉由人工智慧自動執行，人工智慧技術正在提高企業的績效和生產力，同時，也可以理解人類無法理解的大規模數據，人工智慧的強大力量將可以帶來巨大的利益。

(五) 5G 網路



照片 2 4G 或直接升級至 5G(發表會投影片)

新冠疫情突顯了網路的重要性，各方面強大的需求，將網路的韌性發揮到極致，成為塑造新常態的關鍵。5G 即為第五代行動通訊技術，成為次世代物聯網發展的催化劑，是最新一代行動通訊技術，為 4G 系統的延伸，其效能目標是高傳輸速率、低延遲、低耗能、低成本、高系統容量並和大規模裝置設備連結。透過安全的遠端技術，解決金融、製造、醫療等領域的痛點，聚焦工業物聯網、垂直整合運用、數位供應鏈與物聯網應用產業等。

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5G reduced capability

- Main motivation is to lower device cost and complexity as compared to high-end eMBB and URLLC devices, and compact device form factor. Reduced capabilities include:
 - Reduced number of UE Rx/Tx antennas, UE bandwidth reduction, Half-duplex FDD operation, Relaxed UE processing time, Relaxed maximum number of MIMO layers, Relaxed maximum modulation order

TR 38.875 (Release 17)

The study includes identification and study of potential UE complexity reduction techniques and UE power saving and battery lifetime enhancements for reduced capability UEs in applicable use cases, functionality that will enable the performance degradation of such complexity reduction to be mitigated or limited, principles for how to define and constrain such reduced capabilities, and functionality that will allow devices with reduced capabilities to be explicitly identifiable to networks and networks operators and allow operators to restrict their access if desired

The scope of the study includes support for all FR1/FR2 bands for FDD and TDD and coexistence with R15/R16 UEs

This study focuses on Stand Alone mode and single connectivity. The scope of the study does not include LPWA use cases.

Use cases include:
Industrial wireless sensors
Video Surveillance
Wearables

Technology	Category	BW	DL peak	UL peak
NB-IoT	Cat. NB1	200KHz	82.5kbps	25.3kbps
LTE-M	Cat. M1	1.4MHz	0.8Mbps	1Mbps
NR	NSA	>100MHz	4.1Gbps	2.1Gbps
Redcap	-	20MHz	2.150Mbps	2.50Mbps

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照片 3 5G 降低成本(發表會投影片)

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5G coverage enhancements

- 5G services are of no value if there is no coverage!
- Study underway into 5G radio improvements to provide better coverage

TR 38.830 (Release 17)

The objective of this study item is to study potential coverage enhancement solutions for specific scenarios for both FR1 and FR2. The detailed objectives are as follows:

- Urban (outdoor gNB serving indoor UEs) scenario, and rural scenario (including extreme long distance rural scenario) for FR1
- Indoor scenario (indoor gNB serving indoor UEs), and urban/suburban scenario (including outdoor gNB serving outdoor UEs and outdoor gNB serving indoor UEs) for FR2
- TDD and FDD for FR1
- VoIP and eMBB service for FR1
- eMBB service as first priority and VoIP as second priority for FR2
- LPWA services and scenarios are not included
- Identify baseline coverage performance for both DL and UL for the above scenarios and services based on link-level simulation
- UL channels (including PUSCH and PUCCH) are prioritized for FR1
- Both DL and UL channels for FR2
- Identify the performance target for coverage enhancement, and study the potential solutions for coverage enhancements for the above scenarios and services
- The target channels include at least PUSCH/PUCCH
- Study enhanced solutions, e.g., time domain/frequency domain/DW-IRS enhancement (including DM-RS-less transmissions)
- Study the additional enhanced solutions for FR2 if any
- Evaluate the performance of the potential solutions based on link level simulation.

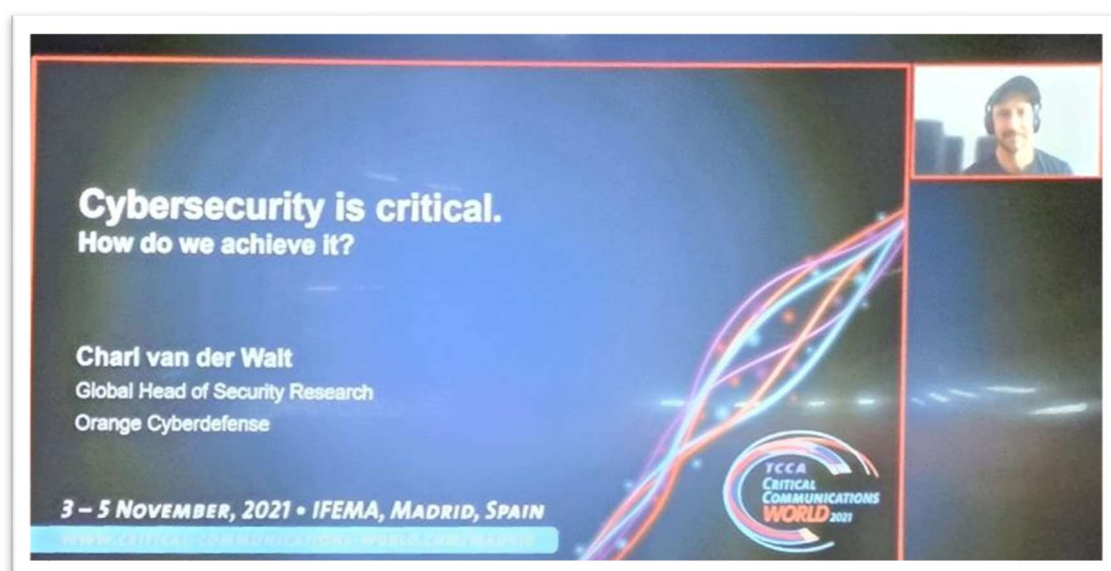
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照片 4 5G 提供更佳之訊號涵蓋(發表會投影片)

(六) 網路安全

隨著全球對資料安全保護的議題持續關注發展之下，傳統的安全監控系統也走向數位化及行動化，而網路安全是保護系統、網路和程式免於遭受數位攻擊的做法，這些網路攻擊的目標通常是存取、變更或摧毀敏感重要的資訊、向使用者勒索金錢，或是妨礙阻止一般業務工作流程。而時至今日，執行有效的網路安全措施特別具挑戰性，因為系統裝置的數量多於使用人員的數量，而且攻擊者越來越有創新能力，成功的網路安全方法具有多層防護，分佈在想要保護的電腦、網路、程式或是資料中。

在一個組織中，人員、流程和技術都必須相輔相成、相互補足，才能打造出對抗網路攻擊的有效防禦。在現代處處連接網路的世界中，所有人都能夠從先進網路防禦程式中獲益。以個人來說，網路安全攻擊可能會導致包括身分盜用、遭到勒索及損失重要資料、財產等各種問題。對社會而言，發電廠、醫院和金融服務公司等相關重要基礎建設是不可或缺的，保護這些基礎建設對於相關組織和維持社會運作是相當重要的。現今的網路攻擊正逐漸複雜化，不僅對企業造成莫大的損害，也損及公家機關等重要的單位設施，而且在這數年之間網路攻擊事件急遽成長，也迅速提高了網路安全的急迫性和必要性。



照片 5 網路安全主講者以視訊方式發表

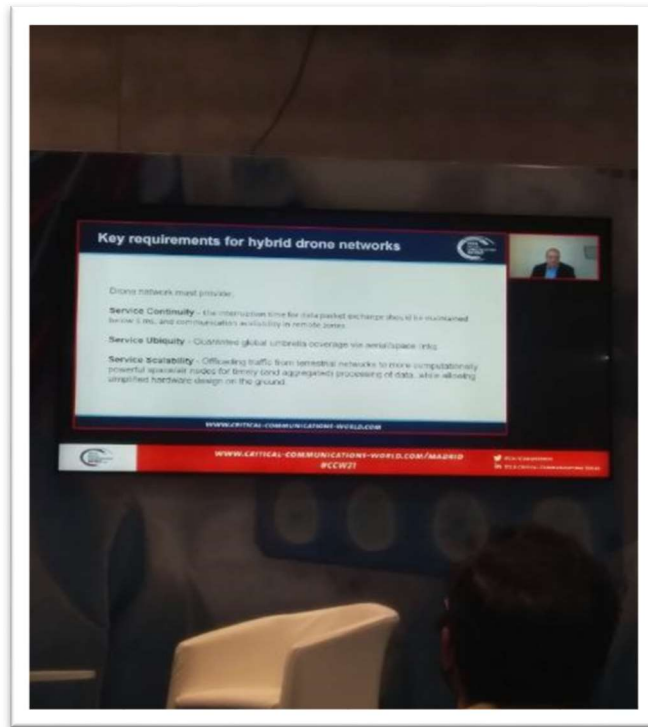
(七) 無人機

現代新興的無人機生態系統包括無人機、無人地面車輛、無人水下航行器和無人水面航行器，無人機正變得廣泛並迅速滲透到物流、災害管理、執法、第一反應和精準農業等不同領域，但無人機的使用仍受到限制，因為智慧城市環境仍然未有精確的定義和模型，無人機基於空中的衛星和地面 LTE/5G 網路拓樸相結合，將可以在不可預測的城市地區或森林條件下實現無縫操作和更有效率的頻譜利用。

無人機早期為戰略需求，開發應用於軍事用途，美國為全球最大市場，隨著通訊技術的進步與發展，無人機之應用範圍更加廣泛，如國土安全監控、地理資訊收集測繪、設施檢查、安全巡邏、農田農藥噴灑及災害防治等，並已多元用於攝影、空中觀測與娛樂等民生商業用途。



照片 6 現場展示之無人機



照片 7 無人機網路主講者以視訊方式發表

Typical hybrid drone networks

Types of drone networks

(a) UAV-Assisted Cellular Communication (b) Cellular-Assisted UAV Communication (c) UAV-UAV Communication

Cellular + non-terrestrial UAV network architectures can be:

- Network Function Virtualization (NFV) Oriented** – NFV transforms the traditional network services into software based solutions (Virtual Network Functions) that can be dynamically deployed on a general purpose hardware platforms.
- Multi-access Edge Computing (MEC) Oriented** – In general, UAVs possess physical constraints in terms of computational capability, storage and battery capacity. Provides real-time computing ability, is considered as an effective approach to improve performance of flying ad-hoc networks (VANET).
- IoT Oriented** – Integrating IoT devices in UAV networks. For example, UAV not only acts as a flying BS in emergency situation, but also behaves as a cellular connected UAV for information dissemination.
- Service Oriented (SOA)** – LAS Service Abstraction Layer (USAL) for UAV contains a set of predefined useful services that can be configured quickly according to the requirements of mission which implements different types of missions with minimal re-configuration time.

WWW.CRITICAL-COMMUNICATIONS-WORLD.COM

照片 8 無人機網路(發表會投影片)

(八) 各國應用現況

- 美國：
 - 聖地牙哥行政司法部門利用一個龐大可互連性的行動無線電網路來和其他部門通訊，參與互連性作業系統之間交換的資料能夠得到對方正確的處理和使用，藉由這個網路使各部門之間的合作工作更有效率，以實現共同商定和互惠互利的目標。
 - 某些學校使用基於安全目的設計之影像分析技術來追蹤和監控校園裡的狀況，以確保師生的安全。透過對攝影機進行分組、排序優先級，改進校園調度或安保人員與影像管理系統的交互方式。對大型校園影像系統進行分析是值得付出努力的，正確使用影像監控技術可以對我們校園的安全產生重大影響，從而增強學生的安全和體驗。
 - 波士頓警察部門在第一次新冠疫情封鎖 72 個小時之內，整合寬頻和一鍵通訊來擴展陸上無線電的通訊範圍，使得分散較偏遠的前線員警和員工能使用智慧型手機或家中的通訊設備來做語音和資料的通訊傳輸，能如此迅速的布局，皆仰賴使用新科技前，部門提供的溝通和訓練，讓使用者清楚知道如何使用及使用的益處。

- 英國：
 - 一家大型連鎖零售商光在 2020 年上半年就發生 1,350 件員工被攻擊威脅的事件，因此在 250 間分店員工身上配備超過 1,000 臺攝影機穿戴裝置，在安全操作中心，只要按一個鍵，就可以看到現場的直播畫面，藉以應對隨時可能發生的意外和威脅。
 - 倫敦交通管理單位使用影像安全技術，應用影像、網路系統和穿戴裝置攝影機來監測、管理和應對不守規矩的乘客之行為，來確保員工和旅客的安全，此外，系統會從 200 多個地鐵車站蒐集旅客裝置的連網數據，在經過去個人化後，只會知道裝置的連網位置，而不會紀錄裝置的瀏覽或歷史紀錄，加以分析，可以用來優化地鐵服務，例如提供即時的路線擁塞資訊，服務人員也能據此提供旅客搭車路徑建議，讓旅客有一個舒適的旅程。
 - 蘇格蘭警方利用智慧型行動裝置替代以前紙本的方式來填寫報告和筆錄等相關資料，並利用人工智慧軟體和這些可移動的智慧裝置來搜尋和保存相關證據，並連網上傳相關資訊，減輕相關人員的負擔，藉此為前線的警官節省了上千小時的時間。

- 馬來西亞：

捷運公司使用影像和軟體技術來偵測進入車站的旅客體溫，使用紅外線額溫、耳溫產品，雖不需碰觸人體，不過感測距離有限，且容易受量測者的穩定度影響，相較之下，利用影像和軟體技術使測量距離能拉至約兩公尺，擁有連網監控功能，並會主動追蹤人體、提供發燒警報，讓捷運公司能在發燒旅客上車前阻止乘客上車，避免嚴重的安全風險發生。

- 挪威：

緊急健康服務部門對國民和健康服務之間提供控制室管理和緊急通訊功能，新冠疫情大流行時，決定以雲端技術軟體來更新控制室的資料中心，支援虛擬控制室，整合資訊、簡化意外管理流程並加強更好的通訊和緊急事件的立即反應。藉由將控制室的操作整合在一個技術平臺上，使資訊能更容易在醫藥中心、健康管理單位和緊急通訊中心之間傳送和接收，促使各單位能更有效率的合作，互連操作性的技術整合了通訊系統，使得急救護理人員、醫師和醫院在危機發生時能保持高度的通訊聯繫，處理緊急狀況的發生。

- 澳洲：

使用自動車牌辨識技術來確認可疑車輛，車牌辨識系統是一種智慧影像分析的基本應用，利用攝影機擷取車牌的影像之後，將影像資訊進行分析與演算，達到車牌辨識的應用。車輛牌照資訊對公共安全的調查研究是很重要的工具，能預防犯罪的發生，也能在新冠病毒流行期間偵測並防範邊界封鎖的漏洞，對疫情控制有很大的幫助。

- 新加坡：

有著 108 個車站，250 輛列車，每日超過 200 萬人次旅客的地鐵，使用影像安全技術來確保其服務運作順暢，地鐵公司也應用影像系統來主動維護檢查地下隧道，例如檢查牆面的裂縫和偵測其他可能導致安全問題的因素，軌道檢查從前需耗費大量人力，而使用影像分析系統可以做得更快更精確並降低員工遭遇危險的機會。

- 西班牙：

政府將投資 15 億 5,000 萬歐元於數位連結技術，來推動網路安全及部署 5G 通訊系統。部分經費來自歐盟復甦基金，將補助西班牙電信(Telefonica)、Orange 電信、Vodafone 電信及 MasMovil 電信，期望能提供連網挑戰之解決方案，盼將固網連通速度提升至 100Mbps，部署 5G 通訊及重要跨境傳輸網路等。

5G 及超高速寬頻通訊及 5G 雲端網路安全研發創新，均將成為西班牙經濟成長的主要動能及必備服務。另在資本收入部分，2021 年由於拍賣 5G 牌照，西國政府取得逾 10 億歐元收入。此外，西班牙政府也規劃培訓西國企業參與跨國數位基礎建設，為跨境傳輸網路奠定基礎。



照片 9 發表會中之西班牙內政部人員



照片 10 西班牙網路涵蓋(發表會投影片)

第三章、心得及建議

(一) 心得

由於全世界還處於新冠疫情期間，本次行程有一半的時間都在搭機及機場等待轉機中度過，過程艱辛且內心恐慌，雖然展覽會議舉辦國西班牙疫情趨緩，但全程仍戰戰兢兢，酒精狂噴，深怕染疫發燒，因此而耽誤了會議行程，甚至無法返國，幸好一路平安，順利完成任務。也因為新冠病毒在全球持續大流行，許多寶貴生命消逝，使全世界產生了人類健康危機意識，這突顯了兩件事變得非常重要，第一，安全被視為公共安全單位和整個社會的共同責任，第二，科技，尤其是通訊技術，對於保護人類的安全扮演了更重要的角色。

本屆世界應急通訊大會所展示發表和傳達的技術，皆為成熟且非最新的科技，也並非在討論艱深的技術內容，主要重點在於「整合」，將不同的技術介面整合在同一個平臺上。對於公共安全部門一個共同的挑戰是目前使用的系統缺少互連操作性，換句話說，目前使用的技術無法和其他單位部門互相通聯，因為各單位部門系統是不相容的，而疫情帶來了災難，也帶來了轉機，在疫情之下，使公共安全部門和企業組織快速創新，尤其在雲端運算技術、影像辨識、人工智慧、網路安全及不同部門組織和系統間的互連操作性，許多國家公共安全部門和企業組織在新冠疫情前已經計畫藉由數位科技來整合它們的使用系統，使之更現代化，更加有彈性，隨著新冠病毒大流行的到來，加速它們的計畫更快實現，迅速整合應用這些科技，便是為了因應新的風險來面對這快速演變的環境。

除了科技的整合，還需要「人」的整合，緊急服務組織和政府部門需要從基本的需求思考如何去接受、適應和應用這些科技，衡量分享資訊予其他部門及利用相容通訊的益處和風險，人們也需要去思考，在科技的整合應用下，也會侵害部分個人的隱私權，如個人的肖像權，車牌號碼及私人基本資料等等。然而在疫情下，不管是國家或人民對公共健康和對安全的期望和責任造成巨大的改變，為了適應這個疫情大流行的時代，雖然政府的管理和立法變得更加困難，但人民傾向支持更廣泛安全科技的使用，惟必須在信任、公平、包容及透明的前提下，也因為新冠疫情的關係，加速改變我們個人對安全的期望和促進對新科技的接受度，使得公共安全部門和企業組織願意信任彼此並分享更多資訊來促進公共安全的服務，人民也願意信任政府，讓政府保有個人資訊，只要能適當的使用這些私人資訊。

不同於行動電話網路，應急通訊網路強化了基礎建設，增加其可靠度和安全性，當創新的科技迅速發展，緊急通訊服務可以預防風險並以先進科技支援。而確保成功科技的接受度之關鍵是人民和安全提供者之間的信任和透明度，如何利用科技讓我們的世界更安全，必須讓民眾了解科技使我們安全是建立在信任、公平、包容和透明度的基礎之上，新冠病毒大流行改變了我們對安全的想法和感受，在疫情動盪之中，對

於安全，不只政府部門和企業組織有責任，個人也有需要接受的義務，個人的行為會有長遠的衝擊影響，因為只有在每一個人都安全的情況下我們才能真正得到安全。

應急通訊網路中互連操作性是現代通訊網路世界中的重要必須事項，能使同一安全機構之間透過語音與數據通訊系統於收到請求時、必要時及獲得授權時，能即時分享資訊，因為有共同語言、術語及戰術目標的存在，是所謂領域內互連操作性，但當緊急事故發生，需要公共安全機構協調執行聯合行動時，機構之間彼此溝通的能力更是重要，這是世界趨勢潮流，即達成跨領域的互連操作性，例如警察、消防、高速公路維護及緊急醫療系統的跨領域互連操作性，讓多個單位部門可共享資訊，互相協調以利執行相關任務。

(二) 建議

複雜的系統整合費用，必定會大幅增加整體系統成本，在政策和法規上的整合也是無可避免的，畢竟關係到許多部門單位和其使用的系統，要達成跨領域的互連操作性，也必須了解各通訊單位系統能提供的功能與資源，因此建議：

(1) 由政府成立一個專責機構來負責整合公部門及私部門。

(2) 仿效他國提供補助給民間私人企業機構，讓民間企業一起參與建置。

如此才能達成政府與民間各單位和機構之間的整合聯繫，畢竟安全是整個國家社會共同的責任。

第四章、 附錄

(一) 大師級發表會議程(11月3日舉辦)

THE CRITICAL COMMUNICATIONS ASSOCIATION 

MASTERCLASSES

3RD NOVEMBER 2021

ROOM 1	ROOM 2	ROOM 3	ROOM 4
<p>09:00-12:30 A: CONTROL ROOMS: MANAGING THE TRANSITION TO BROADBAND CHAIR: IAIN IVORY, Founding Partner, Hermitage Comms HARALD LUDWIG, CHAIR, Technical Forum, TCCA</p> <p>As mission critical users look to adopt new mission critical broadband services, the control room is one of the key elements organisations must consider. It is critical to understand the standards and interfaces needed within the control room, and the implications for control room staff and users.</p> <p>This masterclass will review the 3GPP standards from the perspective of the control room. It will also cover the challenges of migration including interoperability during migration, and look at how this is being addressed in countries implementing broadband services.</p> <p>14:00-17:30 D: FUTURE TECHNOLOGIES CHAIRS: ROBIN DAVIS, Chair, Future Technologies Group, TCCA IAIN IVORY, CHAIR, Future Technologies Group, TCCA</p> <p>This masterclass will be presented by members of the TCCA Future Technologies Group and will cover the up and coming developments in adjacent technologies that the Group feels will likely have relevance or impact on the work of TCCA.</p> <p>This includes technologies that are connected to and relevant for mission critical users and that may utilise mission critical communications as a bearer. For example, new or novel uses of 5G, trends in the transportation market such as vehicle connectivity, PPDR device innovations, developments in the IOT and SCADA world that may have impact or relevance on connectivity or data provision to critical communications users.</p> <p>The Future Technologies Group aims to provide a platform for everyone interested in future technologies that are connected to and relevant with mission critical users and that may utilise mission critical communications as a bearer. The group produces a quarterly 'horizon scanning' newsletter that highlights the most interesting developments.</p> <p>So please take the opportunity to come and join this Masterclass and listen to our group of visionaries to learn about future developments.</p>	<p>09:00-12:30 B: APPLICATIONS OF BROADBAND IN FRONTLINE CRITICAL COMMUNICATIONS PART 1 CHAIR: TERO PESONEN, Chair, Critical Communications Broadband Group, TCCA</p> <p>The use of broadband for frontline critical communications is currently a key topic for the sector.</p> <p>With the likes of FirstNet and the Emergency Services Network beginning to come to fruition, this masterclass will look at core issues around the technology as well as its implications for life on the frontline.</p> <p>14:00-17:30 B: APPLICATIONS OF BROADBAND IN FRONTLINE CRITICAL COMMUNICATIONS PART 2 CHAIR: TERO PESONEN, Chair, Critical Communications Broadband Group, TCCA</p> <p>Part 2 will take a more in-depth look into the challenges of deployment of broadband technology in mission-critical and business-critical environments.</p>	<p>09:00-12:30 C: TETRA: THE OPTIMAL MISSION-CRITICAL VOICE SOLUTION. TRUSTED, ALWAYS EVERYWHERE CHAIR: FRANCESCO PASQUALI, Chair, TETRA Industry Group, TCCA</p> <p>TETRA networks are specialist networks delivering mission critical communications services, a specific feature set and a high grade of reliability and availability. These networks are designed to provide a high level of inherent resilience and redundancy in their architectures. Dimensioned to provide a specific grade of service at peak load to the user groups they serve, the services on a TETRA network are intended for command and control operation, focusing on group-oriented services to enable fast and efficient communication and dissemination of information.</p> <p>TETRA has matured over the past 25 years to become the technology of choice for millions of PPDR users who demand true mission-critical communications.</p> <p>In this session we will discuss how TETRA continues to deliver mission-critical coverage, security, availability and resiliency. Also, an update will be provided on ongoing enhancements.</p> <p>14:00-17:30 F: BROADBAND INDUSTRY MASTERCLASS CHAIR: JASON JIHUR, TCCA Broadband Industry Group Chairman, Board Member</p> <p>This masterclass will cover key topics relating to 3GPP mission-critical broadband technology, including aspects to aid the planning, design, implementation and enhancement of networks built on this cutting-edge technology.</p> <p>The target audience for these presentations includes government agencies, end user organisations, communication service providers and professional consultants.</p>	<p>09:00-12:30 E: SECURITY AND CYBERSECURITY CHAIR: TREVOR EVANS, Chair, Security and Fraud Prevention Group, TCCA</p> <p>This masterclass will consist of high-level discussion around the latest developments in security in both TETRA and 3GPP technologies.</p> <p>As communications technology evolves, so does the urgent need to protect the information being transmitted.</p> <p>14:00-17:30 G: INTERWORKING CHAIR: HARALD LUDWIG, Chair, Technical Forum, TCCA</p> <p>Today, most existing regional and nationwide (narrowband) mission critical mobile radio networks are not connected with their neighbouring systems. Only a few years ago the first TETRA networks in Norway, Sweden and Finland were connected via the IS1 (intersystem interface).</p> <p>With the start of the rollout of broadband systems the interconnection between these systems and the interworking with existing mobile radio technologies like TETRA, P25 or GSM-R is becoming an important topic.</p> <p>This masterclass will present the technical, organisational and operational challenges with connecting networks, with a focus on interworking with currently used networks.</p> <p>Attendees will learn about the current status of the various standardisation activities to connect 3GPP and non-3GPP systems and how these standards will be put into reality.</p>



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(二) 一般發表會議程(11月4,5日舉辦)



CRITICAL COMMUNICATIONS WORLD 2021

CONFERENCE TIMETABLE

4TH NOVEMBER 2021

STREAM 1 PROTECT AND ENHANCE	STREAM 2 ENVISION AND ADVANCE	STREAM 3 PROTECT AND ENHANCE	STREAM 4 ENVISION AND ADVANCE
<p>09:15-09:30 CONFERENCE OPENING & INTRO MLADEN VRATONJIĆ, Chair, TCCA</p> <p>09:30-10:00 KEYNOTE ADDRESS: OPPORTUNITIES AND CHALLENGES OF NEW TECHNOLOGIES RORY CELLAN-JONES, Journalist & BBC News Technology Correspondent</p> <p>10:00-10:30 KEYNOTE ADDRESS: ASSESSING TELECOMMUNICATIONS STRATEGIES FOR THE FUTURE PROFESSOR ARTURO ACCORRA, Telecommunications General Director, Ministry of Economic Affairs and Digital Transformation, Spain</p> <p>10:45-11:15 THE SPANISH PATH TOWARDS A MISSION CRITICAL BROADBAND NETWORK ENRIQUE BELDA, Deputy Director General of Communication and Information Systems for Security, Spanish Ministry of Interior</p> <p>11:30-12:00 SHARED SITUATIONAL AWARENESS: LESSONS FROM THE LANDSLIDE DISASTER IN NORWAY IN DECEMBER 2020 SIGURD HEIER, Head of Department, The Norwegian Directorate for Civil Protection (DSB) ANDERS LØBERG, Fire and Rescue Chief, Øvre Romerike Fire and Rescue LARS MAGNE HOVTUN, Emergency Management Advisor, The Norwegian Business and Industry Security Council</p> <p>12:15-13:00 PANEL DISCUSSION: INTERNATIONAL CO-OPERATION IN THE NORDICS TODAY AND IN THE FUTURE CHAIR, JARMO VIKVIST, COO, Virve, Erillisverket RONNY HARPE, Head of Raket and Command Operating Systems, Swedish Civil Contingencies Agency (MSB) SIGURD HEIER, Head of Department, The Norwegian Directorate for Civil Protection (DSB) LENE GISSELØ MAALØE, Head, Danish Centre of Emergency Communication (CFB)</p> <p>13:45-14:15 CHALLENGES IN THE TRANSFORMATION OF THE COMMAND AND CONTROL LANDSCAPE OF THE AUSTRIAN FEDERAL MINISTRY OF THE INTERIOR WOLFGANG MÜLLER, Ministry of the Interior, Republic of Austria IVAN GOJMERAC, Regional Sales Manager for Central Europe, Public Safety, Frequentis</p> <p>14:30-15:00 HYBRID NETWORK INFRASTRUCTURES UNDER TEST: BDBOS BROADBAND TASK FORCE'S FINDINGS GERALD BEDÜRTIG, Head of the Network Design Division, German Federal Agency for Public Safety Digital Radio (BDBOS)</p> <p>15:15-15:45 ACHIEVING MAXIMUM ADVANTAGE FROM EXISTING CRITICAL COMMUNICATIONS NETWORKS PETER HUDSON, Chief Technology Officer, Sepura</p> <p>16:00-16:30 LEONARDO SPONSORED SESSION FUTURE PROOF PROFESSIONAL COMMUNICATIONS ECOSYSTEM: LEONARDO VIEW AND SOLUTIONS ANGELO BENVENUTO, Head of Solution and Product Marketing, Cyber Security Division, Leonardo</p> <p>16:45-17:00 WHY A PROFESSIONAL APPS ECOSYSTEM IS ESSENTIAL NIKLAS LAGERBLIOM, Solution Business Manager, Airbus</p>	<p>10:30-11:00 KEYNOTE ADDRESS: PRESERVING AND ENHANCING WHAT WORKS WELL TODAY ADRIAN SCRASE, CTO, ETSI</p> <p>11:15-11:45 CRITICAL COMMUNICATIONS OF HYBRID DRONE NETWORKS DR ANDRE SAMBURG, Expert and Project Evaluator for the European Commission on Public Safety and Security, Uusimaa Regional Rescue Association</p> <p>12:00-12:30 FUTURE TECHNOLOGIES ROBIN DAVIS, Co-Chair, Future Technologies Group, TCCA IAIN IVORY, Co-Chair, Future Technologies Group, TCCA</p> <p>12:30-13:15 PANEL DISCUSSION HOW ARE WE MAKING THE MOST OF CUTTING EDGE TECHNOLOGIES? CHAIR: ROBIN DAVIS, Co-Chair, Future Technologies Group, TCCA ED PARKINSON, CEO, FirstNet Authority JOHN ANTHONY, President, British APCO IAIN IVORY, Co-Chair, Future Technologies Group, TCCA</p> <p>14:15-14:45 PRESERVING THE BENEFITS – AND GAINING NEW ONES SIGURD HEIER, Head of Department, The Norwegian Directorate for Civil Protection (DSB)</p> <p>15:00-15:30 USING AI, VIDEO ANALYTICS, MISSION-CRITICAL BROADBAND AND LAND MOBILE RADIO TOGETHER AS A RESOURCE MULTIPLIER TO TACKLE PUBLIC SAFETY CHALLENGES PAUL STEINBERG, Senior Vice President of Technology, Motorola Solutions</p> <p>15:45-17:00 PANEL DISCUSSION SG: SUPPLY-CHAIN RISK MANAGEMENT AND ENABLING USE CASES CHAIR: TERO PESONEN, Vice-Chair, TCCA, Finland RYAN POLTERMANN, Wireless Communications Research Engineer, Pacific Northwest National Laboratory AUDUN JØSANG, Professor and Head of the Research Group on Digital Security, University of Oslo</p>	<p>10:30-11:00 CRITICAL COMMUNICATIONS FOR RAILWAYS DAVID ROTHBAUM, Director, Business Development, Ericsson</p> <p>11:15-11:45 SAVE MINUTES, SAVE LIVES DAVE HANNAN, Chief Inspector, Lancashire Constabulary IAN DRUMMOND-SMITH, Chief Superintendent, Devon and Cornwall Constabulary IAN WILLIAMS, Software Consultant for Europe, Motorola Solutions</p> <p>12:00-12:45 PANEL DISCUSSION BEYOND STANDARDISATION: HOW DO WE GET THIS TO BE A REALITY FOR ADOPTION? CHAIR: TONY GRAY, Chief Executive, TCCA NINA MYREN, Director and Board Member, TCCA ADRIAN SCRASE, CTO, ETSI PAUL STEINBERG, Senior Vice President of Technology, Motorola Solutions GIANCARLO SANTINI, Operations and IT Director, Airbus Mexico and LATAM</p> <p>13:00-13:30 MOTOROLA SOLUTIONS SPONSORED SESSION THE LIFECYCLE OF AN INCIDENT FROM A USER'S PERSPECTIVE IAN WILLIAMS, Software Consultant for Europe, Motorola Solutions DAVE HANNAN, Chief Inspector, Lancashire Constabulary</p> <p>13:45-14:30 PANEL DISCUSSION WHY DIVERSITY IS IMPORTANT AND HOW TO ACHIEVE IT ANNELI KARLSTEDT, Head of Inclusion and Diversity, Nokia TINISHA AGRAMONTE, Chief Diversity Officer, Motorola Solutions CLARA BODIN, Global Lead, Diversity and Inclusion, Tella</p> <p>15:00-16:30 GAGV: CRITICAL COMMUNICATION PROJECTS FROM AROUND THE WORLD SPEAKERS TO BE CONFIRMED</p> <p>17:00-17:30 TETRA: AN ADVANCED UNIFIED MISSION-CRITICAL BEARER FOR LIGHT RAILS PRAVIN MAGAR, Technical Architect, Consort Digital, Mauritius</p>	<p>10:45-11:15 EMOTIONAL AI: A NEW TOOL IN TRACKING CRIMINAL INTENTION: RISKS AND REWARDS DIANA MIRANDA, Lecturer in Criminology, University of Stirling</p> <p>11:30-12:00 INTEGRATED COMMUNICATIONS AND SECURITY FOR CORTINA 2021 ALPINE SKI WORLD CHAMPIONSHIPS NICOLA MORET, TLC Director, Cortina 2021 Alpine Ski World Championships</p> <p>12:15-12:45 KRIVAT CONCEPT: THE COLLABORATION PLATFORM FOR COMPANIES AND AUTHORITIES JOUNI HONKANEN, Product Manager, Erillisverket</p> <p>13:00-14:30 PANEL DISCUSSION THE SKY IS THE LIMIT – HIGH-SPEED INTERNET FROM SPACE IS GOING INTO OPERATION. WHAT IS IN IT FOR CRITICAL COMMUNICATIONS? CHAIR: BARBARA HELD, Journalist, Behördern Spiegel JONATHAN HOFFELER, Vice-President of Starlink Commercial Sales, SpaceX NICK SHAVE, Vice-President, Strategic Programmes, Inmarsat DYLAN BROWNE, President, OneWeb CHRISTOPHE ALLEMAND, European Space Agency (ESA) ANTI KAUPINEN, Head of Department, Erillisverket</p> <p>14:45-15:30 PANEL DISCUSSION STANDARDS, TESTING AND CERTIFICATION HARALD LUDWIG, Chair, Technical Forum, TCCA CHRIS HOGG, Programme Manager and Mission Critical Services Co-Convenor, Global Certification Forum SAURAV ARORA, Technical Project Manager, ETSI MAGNUS TRANKE, Product Manager, Mission Critical Applications, Ericsson</p> <p>15:30-16:00 HYTERA SPONSORED SESSION WHAT IS THE FUTURE OF NARROWBAND COMMUNICATION? MARTIN EDWARDS, Head of Engineering, Hytera Communications Europe</p> <p>16:15-16:45 BUILDING NEXT GENERATION SITUATIONAL AWARENESS: HARNESSING THE LATEST TECHNOLOGIES AND THE WORLD OF DATA SAMI HONKANENIEMI, Co-Founder & Managing Director, Mentura, Finland</p>

CONFERENCE TIMETABLE

5TH NOVEMBER 2021

STREAM 1 PROTECT AND ENHANCE

09:30-10:00

KEYNOTE ADDRESS: MAKING THE RIGHT DECISIONS FOR A NATIONWIDE MISSION CRITICAL BROADBAND SERVICE: LESSONS LEARNED FROM THE SPANISH CASE
FRANCISCO JAVIER TORIBIO TORREJON, Technical Director, Telefonica

10:00-10:30

KEYNOTE ADDRESS: COMMUNICATION SECURITY CHALLENGES IN THE POST-QUANTUM WORLD
MARK PECEN, Principal Advisor, Quantum Valley Ideas Lab

10:45-11:15

GOVERNMENT CRITICAL COMMUNICATIONS MOVING AHEAD IN ANZ
KEVIN GRAHAM, Director, Australasian Critical Communications Forum

11:30-12:00

AN AGE OF TRANSITION: ENSURING ONGOING OPERATION IN CHALLENGING SITUATIONS
RICARDO GONZALEZ, Vice President for Strategy in International Markets, Motorola Solutions

12:15-12:45

DIGITAL WITH PURPOSE: HOW TECHNOLOGY CAN ACCELERATE SUSTAINABILITY
KAROU INOUE, Director, Global Enabling Sustainability Initiative (GeSI)

13:00-13:00

MCS CONFORMANCE TESTING BECOMING A REALITY
FIDEL LIBERAL, Coordinator, MCS TaaSting

13:45-14:15

FINDING THE OPTIMAL TIMING FOR MOVING TO MISSION-CRITICAL BROADBAND
HANS PETER NAPER, Chief Engineer, The Norwegian Directorate for Civil Protection (DSB)
KNUT BALTERZEN, Specialist Director, The Norwegian Directorate for Civil Protection (DSB)

14:30-15:00

2020 CYBERSECURITY THREATS TO PUBLIC SAFETY COMMUNICATIONS
TYLER BRODBECK, Senior Threat Intelligence Team Lead, Motorola Solutions

15:15-15:45

WHAT CAN TACTICAL LTE BRING TO WORKERS IN THE FIELD?
MARC SOULACROUP, Sales Director, ETELM

STREAM 2 ENVISION AND ADVANCE

10:00-10:30

A PROCESS TO CHANGE LAWS TO ENABLE CRITICAL BROADBAND
JARMO VINKVIST, COO, Virve, Erillisverkot

11:15-11:45

AUGMENTED REALITY IN THE CONTROL ROOM
RYAN POLTERMANN, Wireless Communications Research Engineer, Pacific Northwest National Laboratory
DAVID VAN BALLEGOOIJEN, General Manager, Western Fire Chiefs Association
KISHAN SHETTY, Principal Software Engineer, JANUS Research Group

12:15-12:45

PANEL DISCUSSION INTERNATIONAL PERSPECTIVES ON THE MINING, OIL, UTILITIES AND TRANSPORTATION INDUSTRY APPROACH - FROM SCADA TO IOT
CHAIR: NICK SMYE, Principal Consultant, Mason Advisory
JULIAN STAFFORD, Technical Director, European Utilities Telecom Council
ROBIN DAVIS, Co-Chair, Future Technologies Group, TCCA
FIONA WILLIAMS, Research Director, Ericsson

13:15-13:45

KEYNOTE ADDRESS: CYBERSECURITY IS CRITICAL: HOW DO WE ACHIEVE IT?
CHARL VAN DER WALT, Head of Cybersecurity Research, Orange Cyberdefense

14:00-14:30

CONNECTING AIRCRAFT TO FIELD OPERATIONS: AIR-TO-GROUND BROADBAND COMMUNICATIONS
LEE NIGHTINGALE, Senior Manager ESN, EE
IMRAN DURRANI, Senior Account Manager, Nokia

15:15-15:45

ERICSSON SPONSORED SESSION PROPER PLANNING IS KEY: FROM LMR TO MISSION CRITICAL 4G AND 5G
ANTONIO FERNANDEZ MERINO, Global Business Development Director, Ericsson
MANUEL RUIZ, Global Head of Mission Critical Networks, Ericsson

15:30-16:00

NEXT GENERATION EMERGENCY SERVICES: ACHIEVING THE VISION
FABRICIO VELEZ, Pre-Sales Solutions Consultant, Nokia

STREAM 3 PROTECT AND ENHANCE

10:00-10:30

HYTERA SPONSORED SESSION NEXT-GEN MISSION CRITICAL COMMUNICATIONS TRENDS
SIMON YIN, Vice President, Hytera Latin America & the Caribbean

11:15-12:45

GAGV: CRITICAL COMMUNICATION PROJECTS FROM AROUND THE WORLD
SPEAKERS TO BE CONFIRMED

13:00-14:30

CCF SPONSORED SESSIONS DETAILS TO BE CONFIRMED

14:45-15:00

PANEL DISCUSSION SPECTRUM, THE POWER OF THE FUTURE?
CHAIR: LUZ FERNANDEZ DEL ROSAL, International Cooperation, Federal Agency for Public Safety Digital Radio (BDBOS)
RENAUD MELLIES, Standardisation and Innovation Leader, International Cooperation, French Ministry of Interior
ANESTIS GIGAPOLOUS, Spectrum Policy Unit at DG CNECT, European Commission

STREAM 4 PROTECT AND ENHANCE

11:00-11:30

THE CHALLENGE OF IMPLEMENTING A MULTI-OPERATOR CORE NETWORK IN BELGIUM
CHRISTOPH GREGOIRE, Technical Director, ASTRID

12:30-13:15

PANEL DISCUSSION: HOT OR NOT? TRENDS IN COMMERCIAL NETWORK SUPPORT FOR CRITICAL COMMUNICATIONS
KEN REHBEHN, Principal Analyst, CritComms Insights
VILLE SYRJÄNEN, Go to Market Manager, Enterprise Mobile Solutions, ELISA

13:30-14:00

KIMA: A 4G BASED MISSION CRITICAL SYSTEM
HEINI ØSTERØ, Fire Chief, Torshavn Fire Department
PAETUR MAGNUSSON, KIMA Project Manager, Faroese Telecom
NICKLAS SPANGBERG, Development Director, Ericsson

14:15-14:45

TRYING TO CONNECT TETRA TO THE FUTURE: WHAT WE HAVE LEARNED (SO FAR) FROM PILOTING A PTT APP
MATILDE BROWN MEGÅRD, Senior Advisor, The Norwegian Directorate for Civil Protection (DSB)

15:00-15:45

PANEL DISCUSSION PLANNING AI FUTURES: HOW TO MAKE THE RIGHT DECISION - PROGRESSING TO 5G/6G
CHAIR: ROBIN DAVIS, Co-Chair, Future Technologies Group, TCCA
NICK COPPENDALE, Principal Consultant, Actica Consulting
ANTTI KAUPPINEN, Head of Department, Erillisverkot
ASLE SVANØE, Head of Wholesale Division, Telenor Norway



(三) 參展廠商位置

EXHIBITORS AND PARTNERS

Organisation Name	Stand No	Organisation Name	Stand No
3GPP	C46	Mentura Group Ltd	F180
Airbus Defence and Space Oy	E240	Ministry of Justice and Security, Netherlands	B175
Amphenol Procom	F156	Motorola Solutions	F240
Antennentechnik Bad Blankenburg	D64	NEC Software Solutions	B182
ASTRID, Belgium	B175	NetTechnologies	B200
Athlonet	F94	Nokia	B204
ATOS	D155	Nokia	B200
Beaconsim	B200	Painramas Antennas	E176
BHE Bonn Hungary Electronics Ltd.	E66	PBE Axell	B153
Bitium	D240	PCTEL	C45
CELLNEX	A251	pei tel Communications	B192
China	B200	Peli Products, S.L.U.	A241
Cobham SATCOM	E200	POLONARCONI.IT	F186
Creamord	B200	PRESCOM	F102
Critical Communications Finland	B200	Rogee-GPS	B200
CROSSCALL	D242	SAF Tehnika JPC	G119
DAMM Cellular Systems A/S	D195	SCAN ANTENNA	H355
Decodio AG	H203	Secapp	B200
Department of Security, Biskope Country	B184	SEE CRITICAL COMMS	F158
Emergency Services Network (UK Home Office)	B175	See Telecom	D156
Ericsson	E155	Sapura	E195
Eriisverkot, Finland	B198	Sigmet	B200
Federal Agency for Public Safety Digital Radio (BDRDS), Germany	B198	SONIC COMMUNICATIONS LTD	B133
Figlex	D66	Spanish Ministry of Interior	B175
French Ministry of Interior	B175	SPINNER	C50
Frequents AG	F177	Stanzel GmbH	G180
Goodmill Systems	B200	STRABAG Infrastructure & Safety Solutions GmbH	B194
Government Authorities Global Village	B175, B184, B198	Streamwide	H175
HAM International 4GLSG Indoor GSM	H176	Sunet	B200
Handfree Group	A240	Svensk Civil Contingencies Agency (H58)	B184
HUBER+SUHNER	D60	Serisphone	F157
Hytera	H235	Tait Communications	F178
Jolla	B200	TASSTA GmbH	H202
Leird Antennas	B176	Tepron	E180
Lambda Antennas	H154	THALES SIX GTS France	B132
Leonardo	F120	The Norwegian Directorate for Civil Protection (D58)	B175
Lyfo	E67	Tigra Ltd	G159
MCS-TadSting	H150	TPL Systemes	E178
		Wave Solutions	F100
		ZEBRA TECHNOLOGIES SPAIN	E202



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FLOOR PLAN



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HEAR FROM THE EXPERTS:

RORY CELLAN-JONES
Journalist and BBC News technology correspondent
Opportunities and challenges of new technologies
November 4th, 9:30-10:00

CLARA BODIN
Global Lead for Diversity & Inclusion, Tene Company
Why diversity is important and how to achieve it
November 4th, 13:45-14:30


ADRIAN SCRASE
CTO, ETSI
Preserving and enhancing what works well today
November 4th, 10:30-11:00

MARK PECEN
Principal Advisor, Quantum Valley Jobs Lab
KEYNOTE ADDRESS: Communication Security Challenges in the Post-Quantum World
November 5th, 10:00-10:30

EDWARD PARKINSON
CEO, Finisar Australia
How are we making the most of cutting-edge technologies?
November 4th, 12:30-12:15

KAORU INOUE
Director, Global Enabling Sustainability Initiative
Digital with purpose: how technology can accelerate sustainability
November 5th, 12:15-12:45

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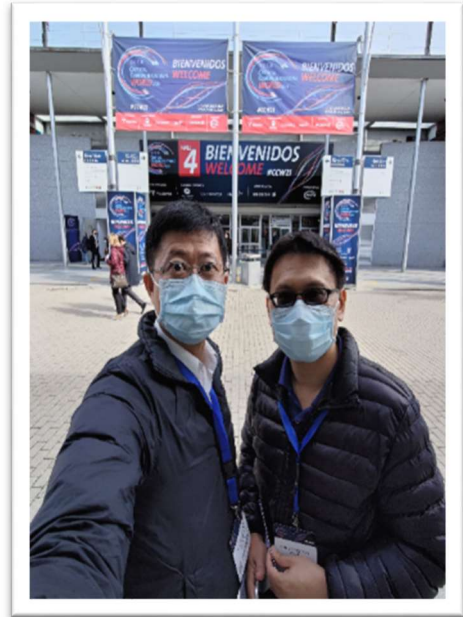
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(五) 會場照片



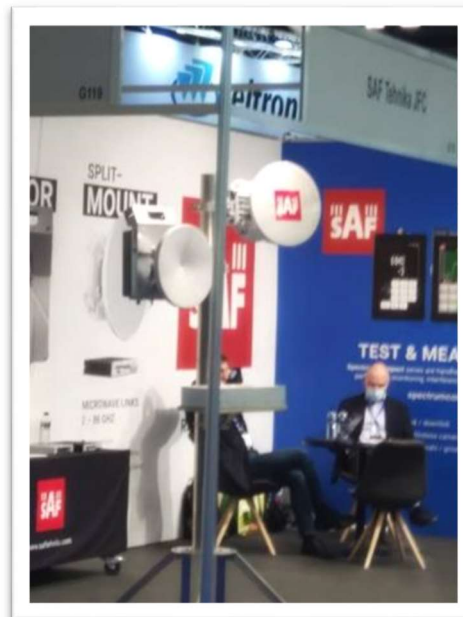
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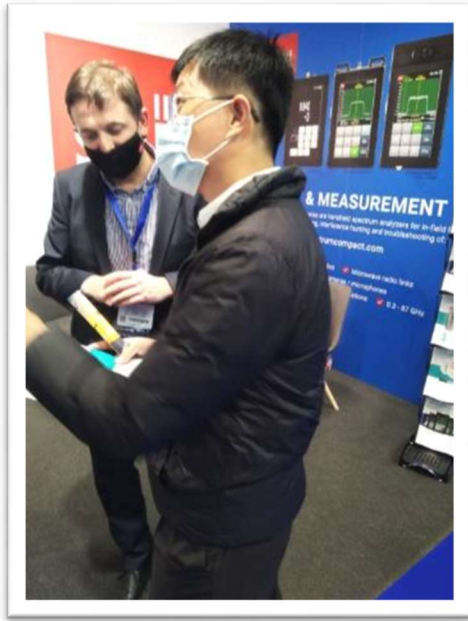
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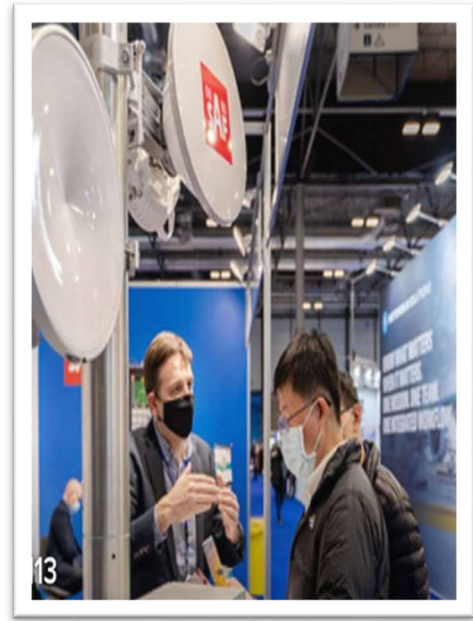
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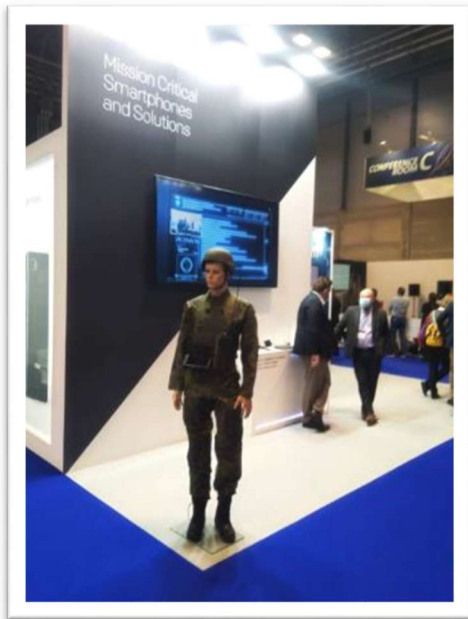
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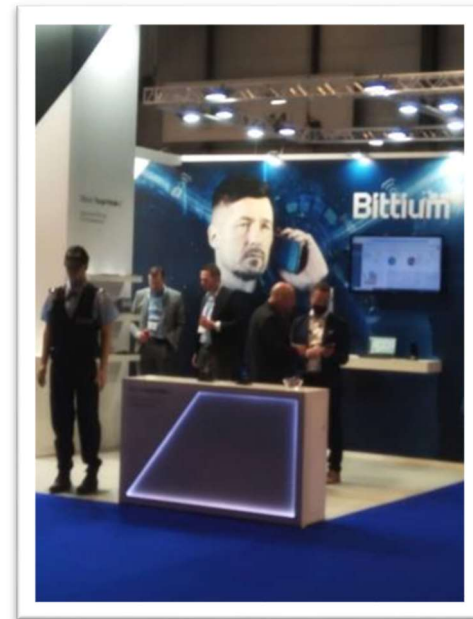
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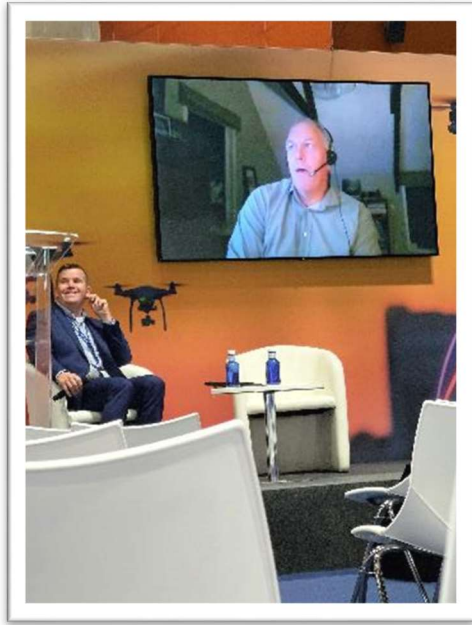
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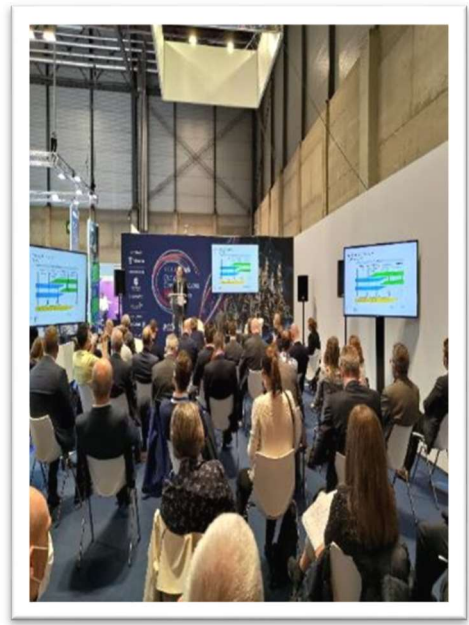
會場展示之穿戴裝置A



會場展示之穿戴裝置B



一般發表會主講者以視訊發表



一般發表會主講者現場發表



展覽會現場A



展覽會現場B