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Confederaziun svizra

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Civil Protection and Sport DDPS
armasuisse
Science and Technology

CH-2050



THE FUTURE SOLDIER





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Dear Reader,

Our world is changing fast these days. Never before in human history has technology brought about such significant social and economic transformations in such a short time. The democratisation of access to certain technologies that used to be more or less exclusively reserved for government agencies has made forms of conflict possible that were previously unknown or even inconceivable. The institutions responsible for national security therefore have a strategic interest in tracking technological trends and disruptions with a view to anticipating opportunities and threats for civilians and the military alike. armasuisse Science and Technology (S+T) coordinates the necessary research to develop the scientific and technological expertise we need to face up to future threats.

In this spirit of foresight, this publication seeks to illustrate some concepts relating to the Swiss soldier of the future in a way that is striking, perhaps even disturbing at times, but definitely novel. Our aim is to make it easier to understand possible future scenarios in which technology will certainly play an important role but will not be the only factor. Raising awareness of technological progress among our armed forces and planning bodies is the first step towards opening up a constructive dialogue on the complex issues we will be confronted with sooner or later.

I hope you enjoy reading what follows.



Dr. Thomas Rothacher

Director
armasuisse Science and Technology

Research is an investment in the future. In the defence industry, it is an investment in our country's future security. The continued development of our armed forces requires a solid grounding in the technologies set to emerge over the next 20 years. The fast pace of technological advancement, the ever-widening gap between civilian and military technologies and the interdisciplinary approach that has become essential to cutting-edge innovation represent significant challenges to researchers in defence-related fields.

At armasuisse, our research operations are responding to these challenges in order to develop technological expertise that supports overall military planning and also informs the procurement process. This reduces the risks associated with both the systems acquired for the armed forces and the continued development of those forces. We pay special attention to disruptive technologies.

These are new technologies that have caused a fundamental break from the past in economic and social terms as well as for the armed forces, transforming usage, processes and our day-to-day lives generally.

While the digital revolution is already in full swing on the civilian side, it is still in its infancy as far as the armed forces are concerned. The complexity of these changes can only be understood through an interdisciplinary and transdisciplinary approach in which experts at various levels and in various fields address a subject and seek to shed light on it from different angles. What you have here is a graphical representation of just such an approach on the theme "The Future Soldier: Digital and Enhanced ?"

We hope you find it an informative and enjoyable read and would be delighted to receive any feedback you may have.



Dr. Hansruedi Bircher

**Research Management Director
armasuisse Science and Technology**



Dear Reader,

In a defence context, it is vital to anticipate not only an enemy's intentions, but also the means by which the enemy will seek to achieve its ends. Recent technological developments, their interaction with each other and the speed with which they are evolving have prompted armasuisse Science and Technology to set up a research programme entitled "Technology Foresight". The programme aims to identify disruptive technologies and assess their impact on the military sphere in general and the Swiss Armed Forces in particular. To this end, it organises three DEFTECH Workshops a year. The theme of the workshop held on 8 May 2019 was "The Future Soldier: Digital and Enhanced?". During the afternoon session, those attending were split up into six groups, each tasked with working on the future of a specific topic in line with a defined process that concluded with a brief presentation lasting a few minutes. The structure and content of this publication are based on those six presentations. We have attempted to reproduce the ideas put forward at the workshop as faithfully as possible through pictures accompanied by explanatory texts.

We wanted to convey the findings in the most entertaining and informative way possible, and it was clear that this could not be done in the form of a standard report. Instead, we opted for a graphic novel format that we hope is easy to read and brings the subject matter to life.

In depicting some possible real-world scenarios, our intention was to provide food for thought on the big questions that will shape our future. Whether you love or hate what you read, the important thing is to understand the reasons behind your reaction. Visualising and, hopefully, understanding these concepts allows us to act on them; and what could be more important for us than acting to strengthen our country's defences and security and ultimately our freedom?



Dr. Quentin Ladetto

Director of the research programme
"Technology Foresight"
armasuisse Science and Technology



“Speed is the essence of war. Take advantage of the enemy’s unpreparedness and attack him unawares”, wrote Sun Tzu around 2,500 years ago. While this is certainly true for an attack, defence requires forward planning. Predicting events is about more than just knowing the lie of the land or when an attack will come: it is above all about having the right strategy and hardware to counter those used by the enemy. Greece’s city-states demonstrated this during the Greco-Persian Wars. The Greeks had more advanced weaponry than their Persian adversaries, and this was instrumental in the victory that ensured their continued independence.

After attending the workshop under the heading “The Future Soldier: Digital and Enhanced?”, I can confirm that armasuisse Science and Technology is meeting this need very effectively. With a forward-looking attitude, the workshop centred on digital strategies and future weapons and equipment. However, while technology was at the heart of the subject matter, it was far from the only topic under consideration. The discussions and presentations were also continually influenced by political, psychological, social and environmental factors. These had the

welcome effect of broadening the scope of debate and bridging the narrowing gap between the military and civilian worlds, between human and machine, the virtual and the real. All in all, the workshop brought us closer to a vision of the future.

Given the task of creating a graphic novel depicting the various ideas that had been raised, I adopted a fast-moving and direct visual style that immediately draws the reader into the story. I also opted to blend the classic hand-drawn aesthetic with a contemporary infographic approach, which I feel reflects the growing interaction between humans and machines. First and foremost, however, I sought to stay true to the spirit of the workshop and those who attended, focusing on technology without losing sight of the all-important human factor.

I sincerely hope that you enjoy reading these episodes and that, together with the accompanying texts, they give you a clear insight into the various issues discussed, which should be of interest to anyone curious about what the future holds.



Dr. Matthieu Pellet

**Lecturer and researcher
University of Lausanne**

BLACK

OUT



12

13

A CYBER-SOLDIER



I'm a part-time reserve soldier with an IT technician and system administrator role. My civilian job is technology consulting for large corporations. Most of my colleagues are part-time reservists as well. Our main tasks are keeping military and civilian networks secure and defending our critical infrastructure against attacks. We make our systems more resilient by controlling access to them. A special team supports our comrades out in the field with information warfare strategies.

The world's becoming more and more interconnected, and the growing influence of digital technology on our physical reality is now a central concern. Most technological innovations give rise to both opportunities and risks. Civilians and military alike are heavily dependent on (information) technology and critical infrastructure ranging from satellites up in space to energy suppliers. Whether coordinated or in parallel, automated or not, cyberattacks could be a prelude to conventional warfare. These days, they even constitute a business model. Information warfare has taken on a vital role in combating continual efforts to manipulate information across a broad front, particularly through fake news that can have a decisive impact on public opinion.





23 September 2050
Basel 22:38

22:39

›ENERGY DEPENDENCY

22:40



Switzerland
Central Command

ATTENTION
ALL UNITS !

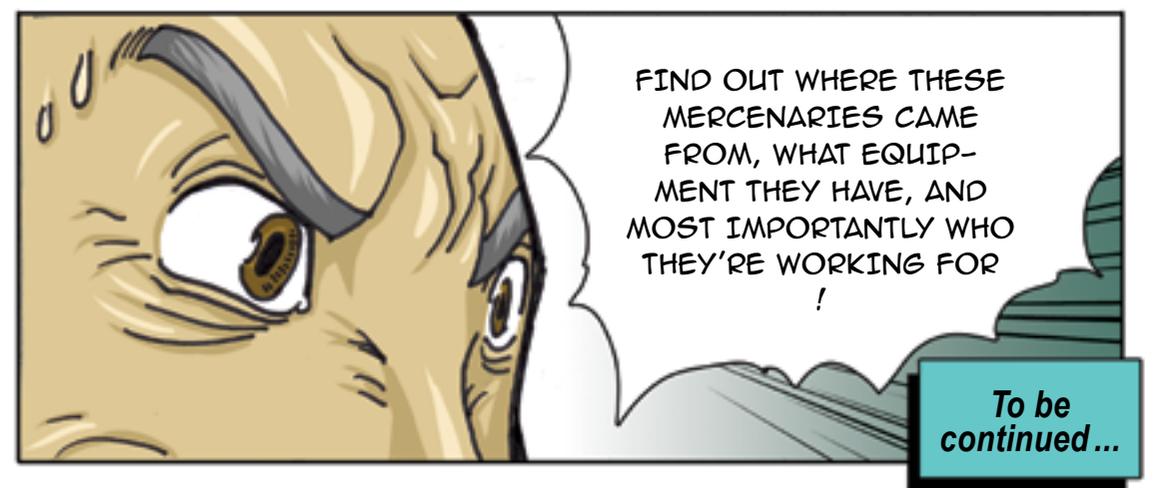
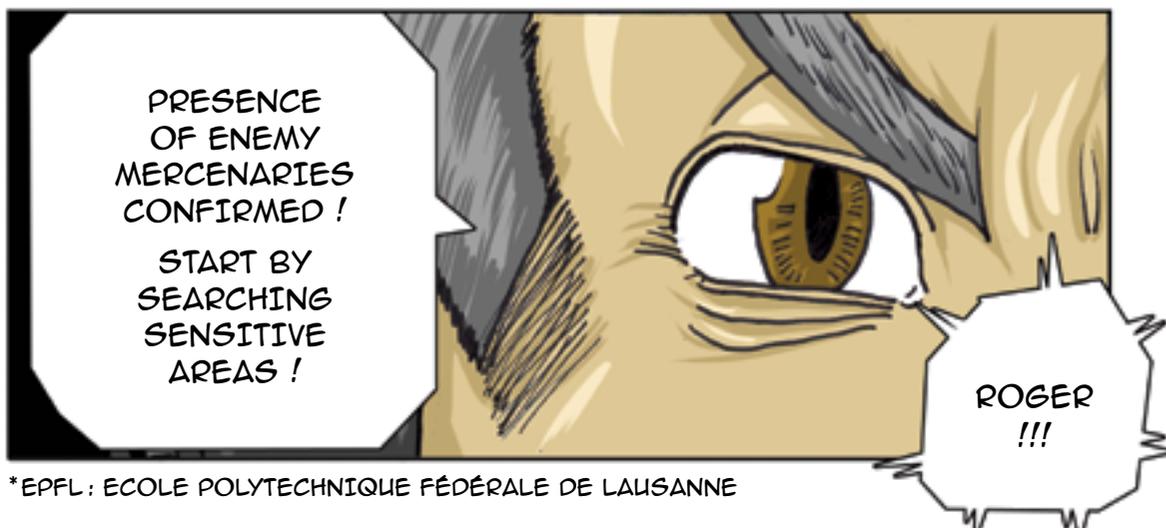
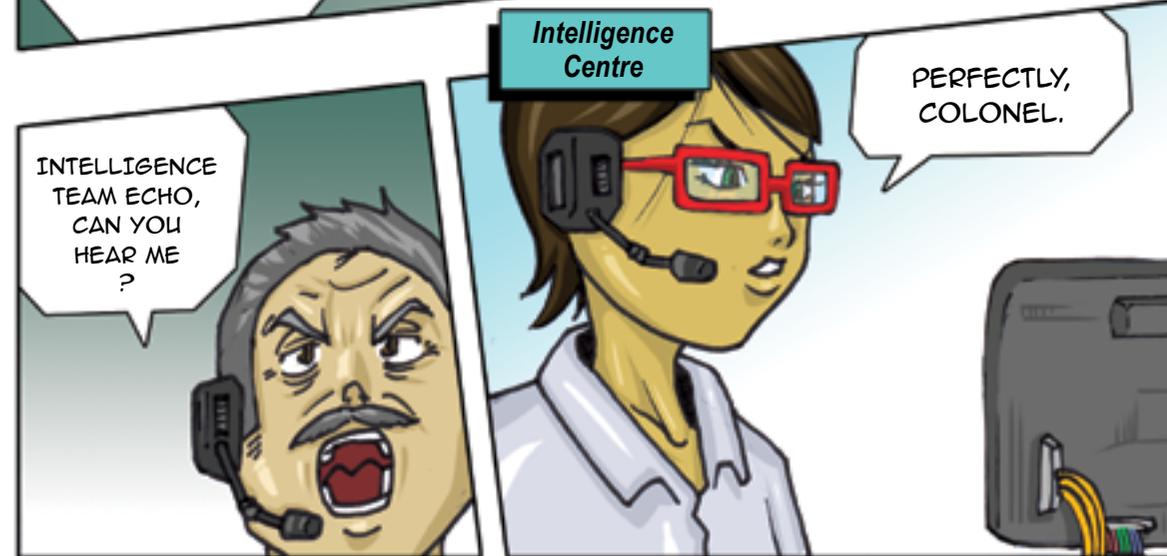
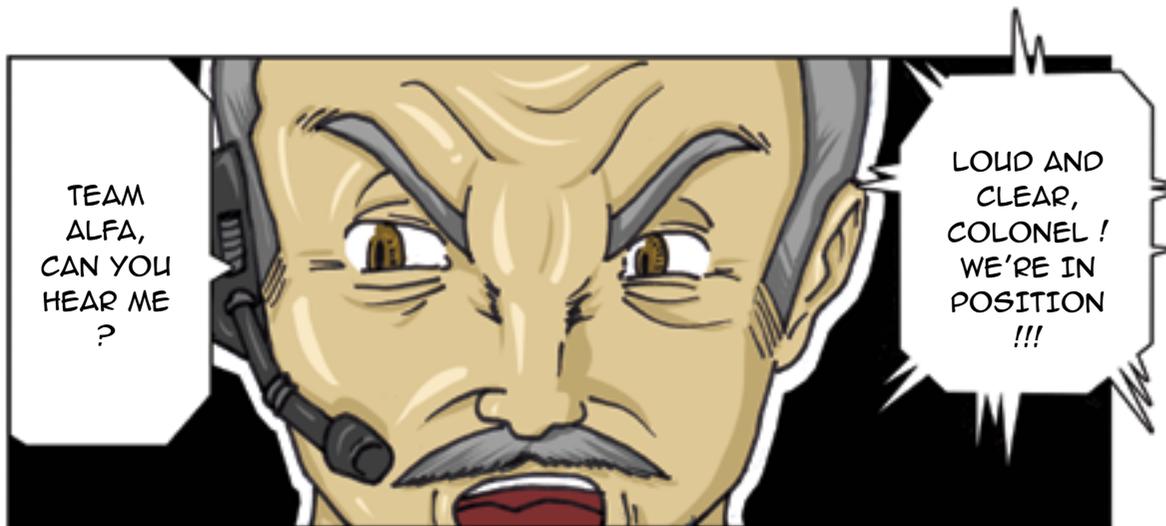
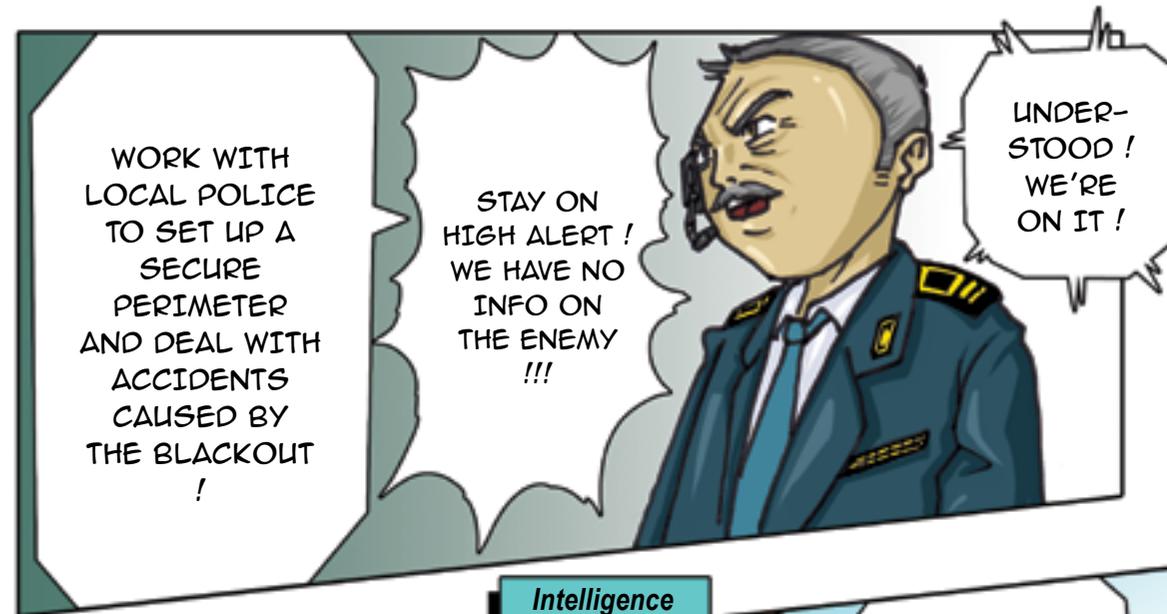
REPORTS CONFIRMED !
BLACKOUT IN BASEL !

12 minutes earlier,
Swiss Armed Forces
Intelligence Centre

YES, FORWARD
INFO TO HQ !
WE'VE GOT
12 MINUTES TO
PREPARE
COUNTERMEASURES !

›INTERNATIONAL CIVILIAN/MILITARY COOPERATION

THE BOMB THREAT
WAS A HOAX !
A JAPANESE STUDENT
DECRYPTED A
COMMS CHANNEL !
AWAITING CONFIRMATION,
BLACKOUT EXPECTED
IN BASEL !
ENEMY PRESENCE
STRONGLY SUSPECTED !



*EPFL : ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

A RECON SOLDIER 4.0

83%
COMPLETED



I work in reconnaissance, and I'm regularly deployed in different theatres of operation, increasingly in urban environments. Our battlefield is interconnected and complex because the number and variety of threats have grown. The main reason for this is easier access to technologies and systems that used to be restricted to state-controlled armed forces. We have a lot of physical and digital sensors supplying us with vast quantities of data all the time. They're monitored remotely by my civilian colleagues, all IT experts, who also handle the transfer of raw and pre-analysed data. Manipulating information is getting easier and easier, and the repercussions this has on public opinion can't be ignored. This is why it is of vital strategic importance for us to validate and authenticate each piece of information.

The main challenge military personnel face on missions today is filtering and processing all the information and data collected to form a detailed, objective picture of the situation. Every decision and its consequences depend on this. With this in mind, we make extensive use of automated processes supported by new technologies that allow us to refine our analysis and thus also our decision-making. Our colleagues away from the battlefield support us massively by making the most of every possible source of information – put simply, we see them as our guardian angels!

SITUATION ANALYSIS AND RECONNAISSANCE

20

21

Basel,
University Hospital
22:45

TEAM ALFA
REPORTING !
HANDLING
CASUALTIES WITH
THE MEDICAL CORPS !

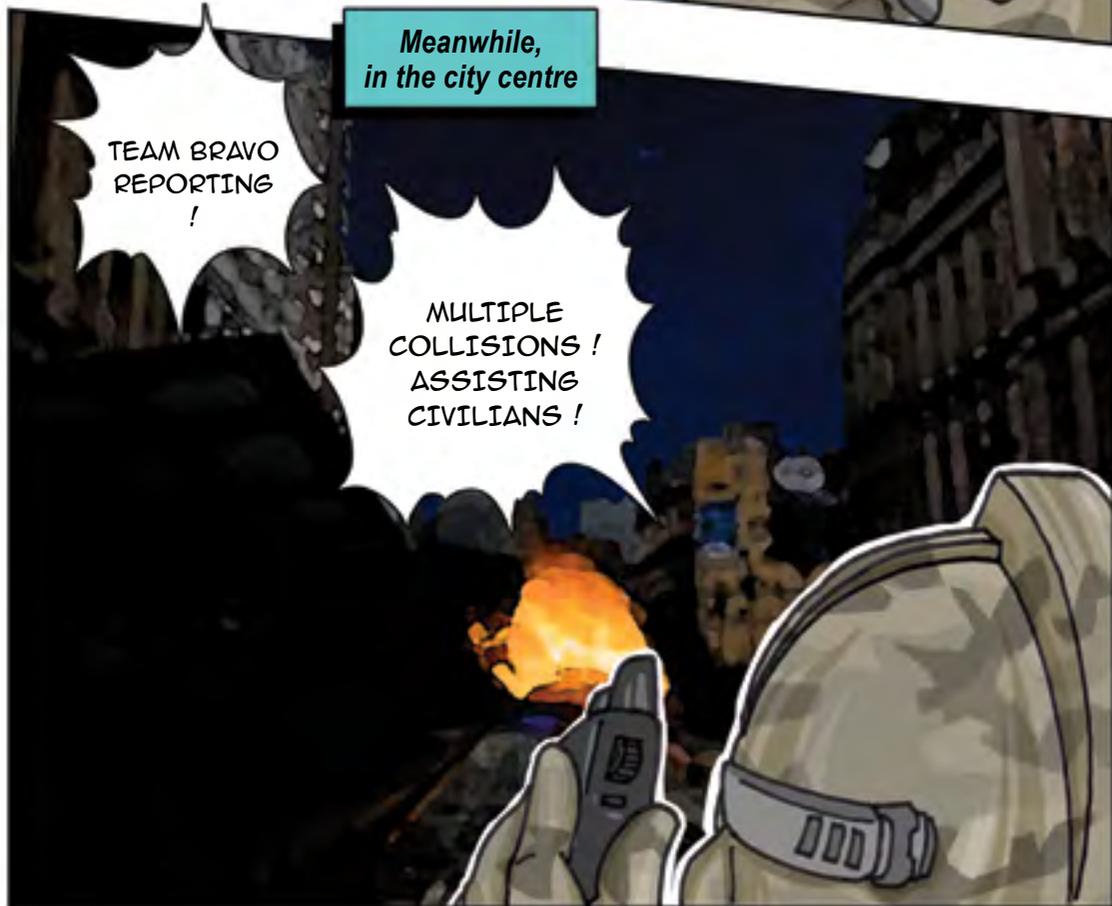
TEAM BRAVO !
WHAT'S HAPPENING
IN THE CITY CENTRE
?



Meanwhile,
in the city centre

TEAM BRAVO
REPORTING
!

MULTIPLE
COLLISIONS !
ASSISTING
CIVILIANS !



Fabrikstrasse
22:46

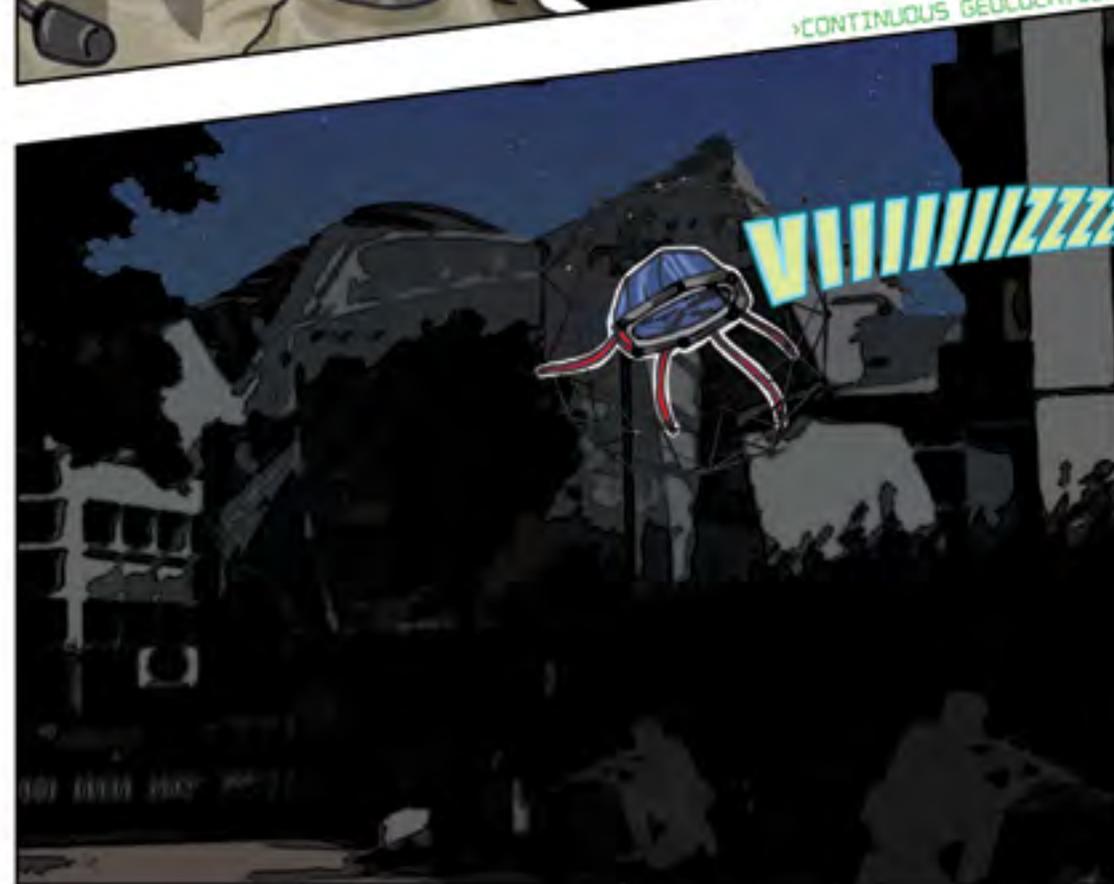
TEAM DELTA,
SITUATION
REPORT !

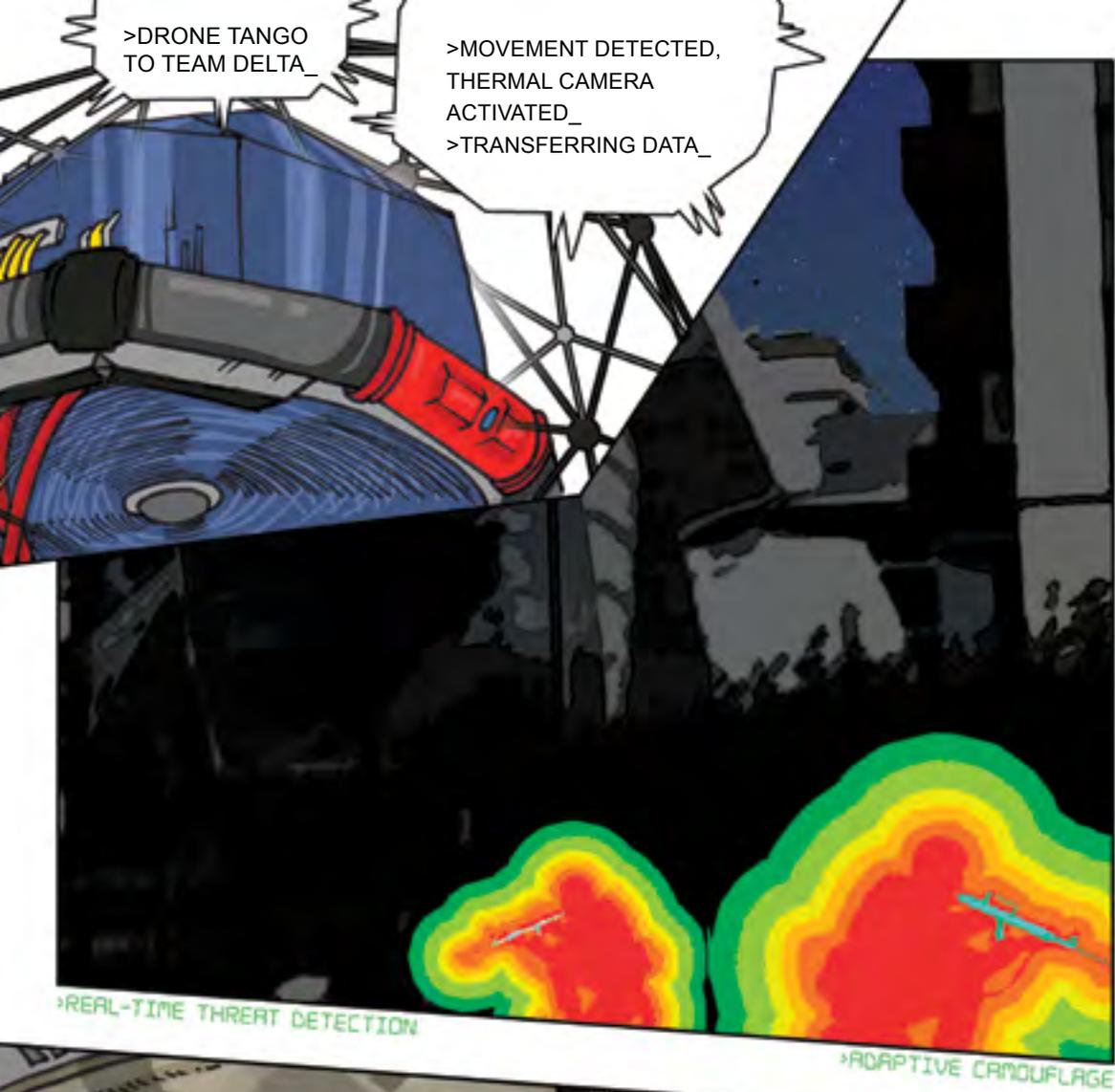
WE'RE IN
FABRIKSTRASSE,
SUSPICIOUS
ACTIVITY
DETECTED...
DEPLOYING
RECONNAISSANCE
DRONES.

>MULTI-PURPOSE DRONES



>CONTINUOUS GEOLOCATION



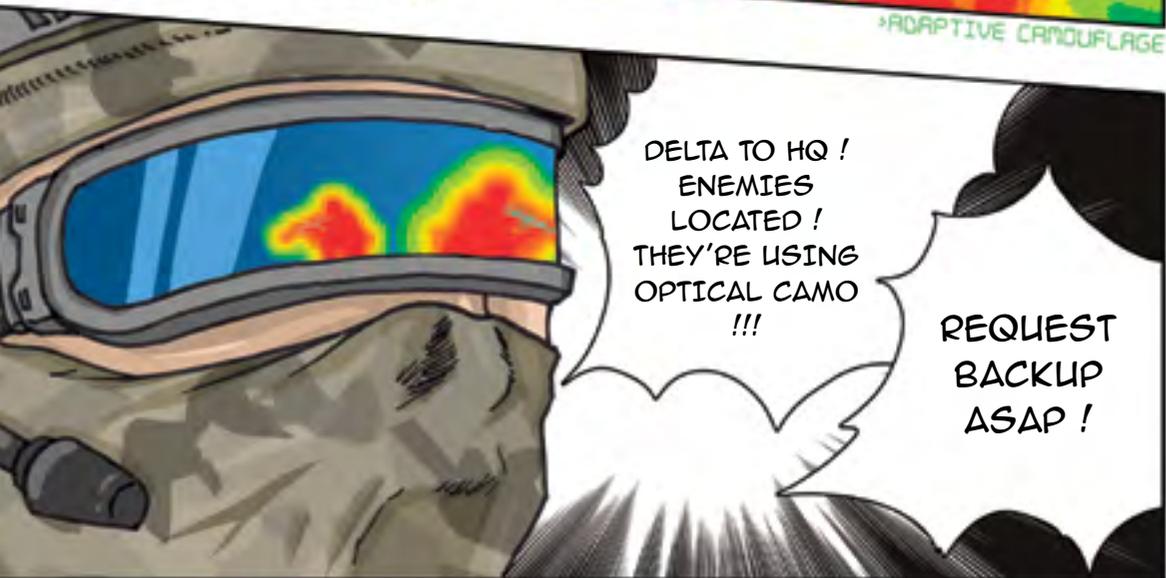


>DRONE TANGO TO TEAM DELTA_

>MOVEMENT DETECTED,
THERMAL CAMERA
ACTIVATED_
>TRANSFERRING DATA_

>REAL-TIME THREAT DETECTION

>ADAPTIVE CAMOUFLAGE



DELTA TO HQ !
ENEMIES
LOCATED !
THEY'RE USING
OPTICAL CAMO
!!!

REQUEST
BACKUP
ASAP !

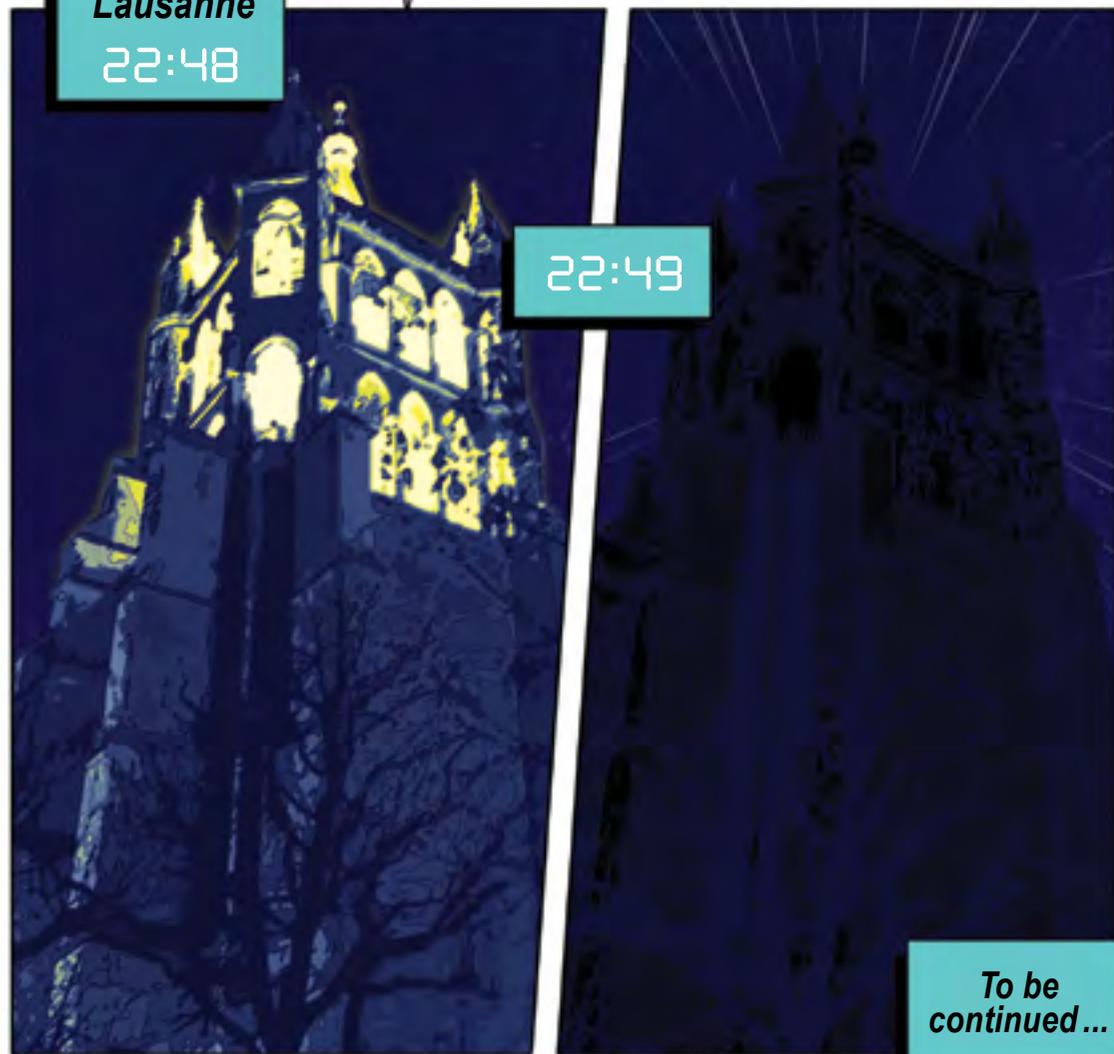
>AUGMENTED REALITY

Basel,
University Hospital
22:47

TEAM ALFA
REPORTING !
HOSPITAL
ZONE SECURED !

WILL JOIN
TEAM DELTA
AS BACKUP !

Lausanne
22:48



22:49

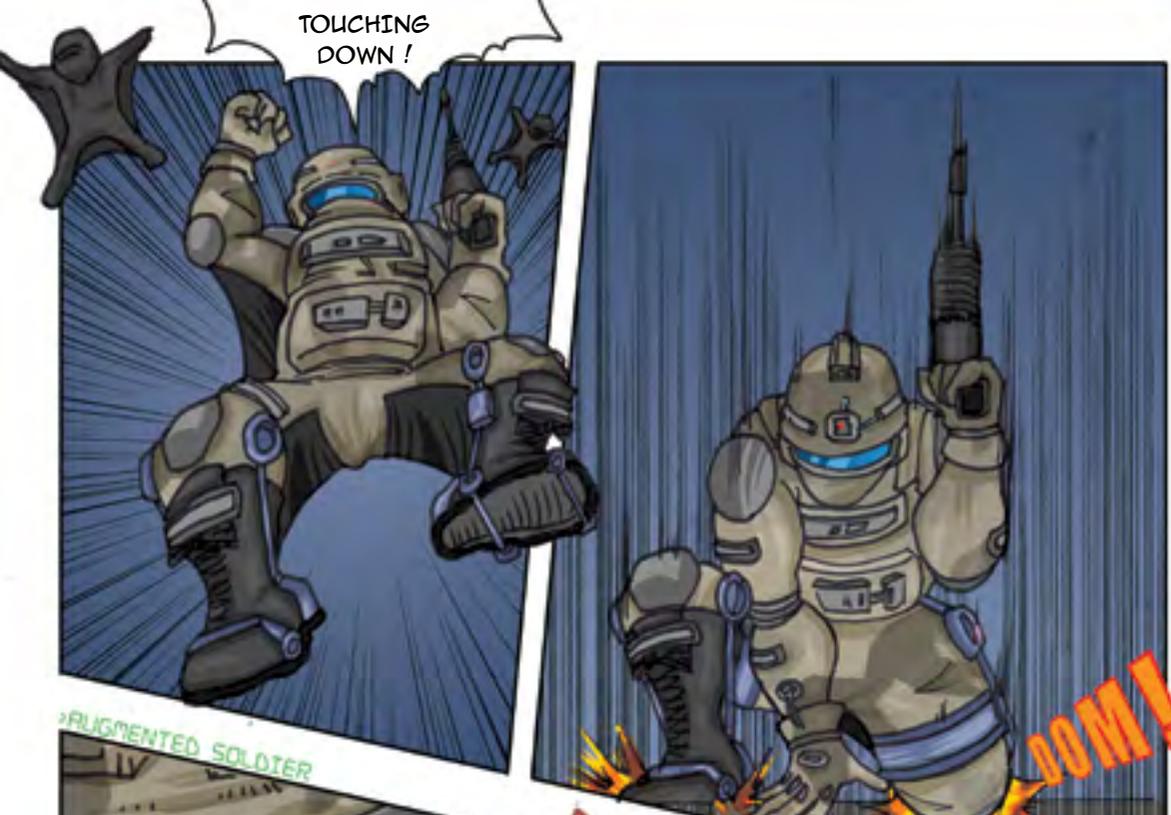
To be
continued...

A MOBILE SOLDIER

I'm deployed in a range of different environments, but mainly in urban areas. We rarely use static infrastructure, so we can adapt to agile, asymmetric opponents as well as complex and changing battle conditions. We're more independent and self-organising than would have been the case in the past.

I'm more or less permanently connected, not only to the rest of my team, but also to many experts working together in locations across the globe. This connectivity hinges on digital sensors built into our uniforms, so we count on the supply and storage of renewable energy to power them. We've got new vehicles and smart weapons designed mainly for urban combat. To minimise our dependency on logistics, we use rapid prototyping to repair and upgrade some of our kit, and robots follow us around carrying the heavy stuff.

Mobility's so central to what we do these days that most of my colleagues have the flexibility to work anywhere in the world. They remotely control weapons systems that give me protection and gather data from the field to help me understand my immediate surroundings. These data are processed and analysed continuously. In every phase of operations, each decision's backed up by artificial intelligence to arrive at an objective, optimised solution as quickly as possible. Our physical and digital sensors, just like our weapons systems, are interconnected and can be accessed remotely by authenticated users.



TOUCHING DOWN!

BOOM!

AUGMENTED SOLDIER

ENHANCED ACCURACY EXOSKELETON



Target

CRASH!

LIGHT!

BAM!



ALFA TO CENTRAL COMMAND. TARGETS NEUTRALISED ON FABRIKSTRASSE. CONFIRM MERCENARIES, OCTO GROUP.

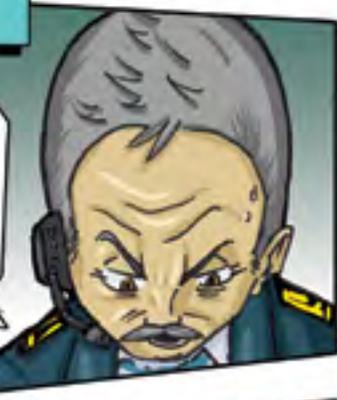
Intelligence Centre
22:50

INTELLIGENCE TEAM ECHO TO HQ! OCTO GROUP IS KNOWN TO WORK FOR TERRORISTS.



Central Command

TERRORISTS... THE BLACKOUT IN LAUSANNE MUST BE LINKED TO THE ONE IN BASEL.



OH, NO! COLONEL ...

BOMB DETONATED IN LAUSANNE !!!

To be continued...

AN ENHANCED SOLDIER



As a soldier, I'm regularly deployed in operations of varying length and intensity. Nowadays, thanks to a range of technological advances and remote tracking of my vital signs, I'm able to fight more effectively, and my life expectancy has increased significantly. Sensors permanently capture all my personal physiological and medical data, which are analysed to offer me the best possible support. I use an exoskeleton in my day-to-day work. It improves my stamina and concentration by reducing the fatigue caused by carrying heavy loads.

My whole team has been given basic medical training, so we can provide first aid immediately during operations out in the field. 3D printers and a direct video link to our doctors help us to ensure adequate treatment.



It's become essential for our colleagues working remotely and in difficult situations to receive psychological as well as physiological support throughout their mission.



Lausanne, Station
22:51

SENDING DATA VIA MEDICAL NETWORK !

TEAM CHARLIE TO COMMAND ! I'VE GOT A CASUALTY FROM THE BLAST ! BIOSENSORS IN PLACE !

ARGH ...

CHUV*
22:52

DR DUCHAMP TO CHARLIE ! I'M UPLOADING TREATMENT INSTRUCTIONS FOR YOU !

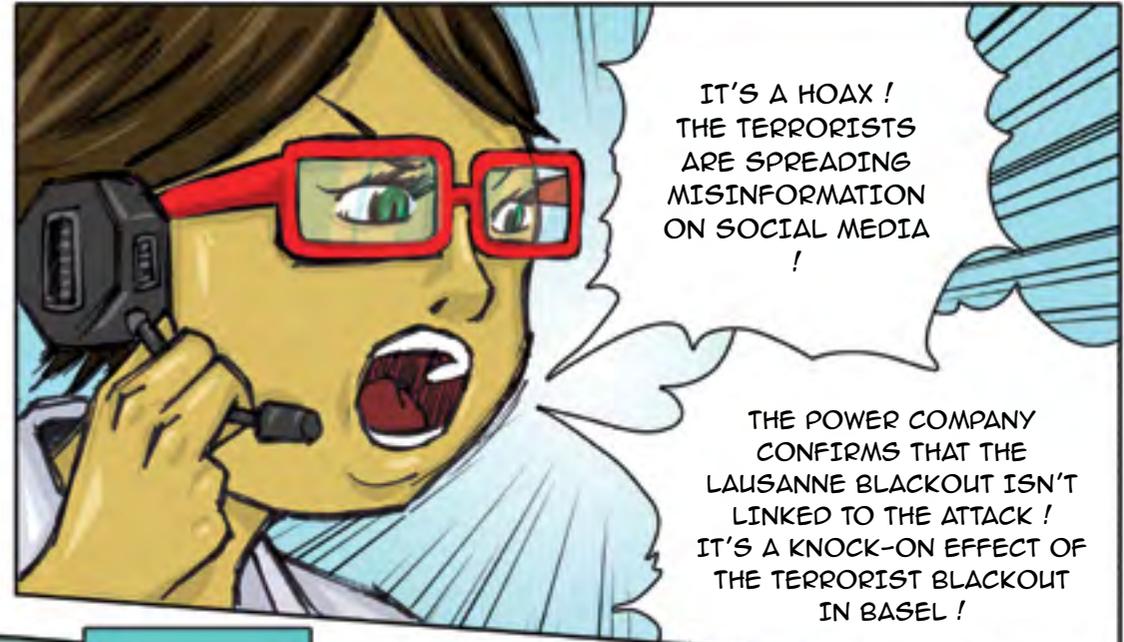
UNDERSTOOD. THANKS.

Central Command

CENTRAL COMMAND TO CHARLIE, DRONE DELIVERING MEDICAL SUPPLIES IN 1 MINUTE 17.

OK !

* CHUV : UNIVERSITY HOSPITAL VAUD, LAUSANNE



IT'S A HOAX ! THE TERRORISTS ARE SPREADING MISINFORMATION ON SOCIAL MEDIA !

THE POWER COMPANY CONFIRMS THAT THE LAUSANNE BLACKOUT ISN'T LINKED TO THE ATTACK ! IT'S A KNOCK-ON EFFECT OF THE TERRORIST BLACKOUT IN BASEL !

Central Command

TEAM CHARLIE, WHERE ARE YOU ?

Lausanne, near the station

SECOND BOMB FOUND !

CHARLIE BOMB DISPOSAL TO COMMAND !

DEFUSING...

ATTENTION CHARLIE ! SOCIAL NETWORK CHATTER ALSO SUGGESTS ENEMY PRESENCE IN LAUSANNE...

Intelligence Centre

BUT ... NO, HANG ON !



bip bip bip bip bip bip

>ADVANCED MATERIALS WITH HIGH STRENGTH AND LIGHT WEIGHT

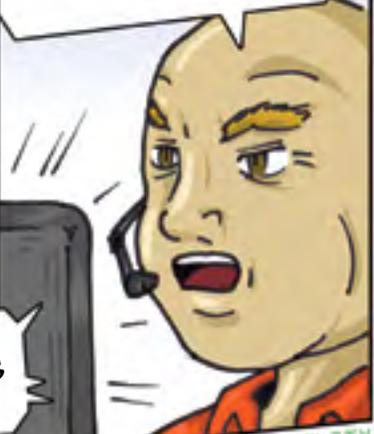


DAMN IT, I'VE NEVER SEEN WIRING LIKE THIS BEFORE ! REQUEST TECHNICAL SUPPORT !

THANKS !

Meanwhile, at ETHZ *

CHARLIE BOMB DISPOSAL, THIS IS PROFESSOR BÄCKER AT ETH ZÜRICH. I HAVE EYES ON YOUR BOMB, SENDING YOU THE SEQUENCE TO DEFUSE IT.



>INTEROPERABILITY

* ETHZ : EIDGENÖSSISCHE TECHNISCHE HOCHSCHULE ZÜRICH

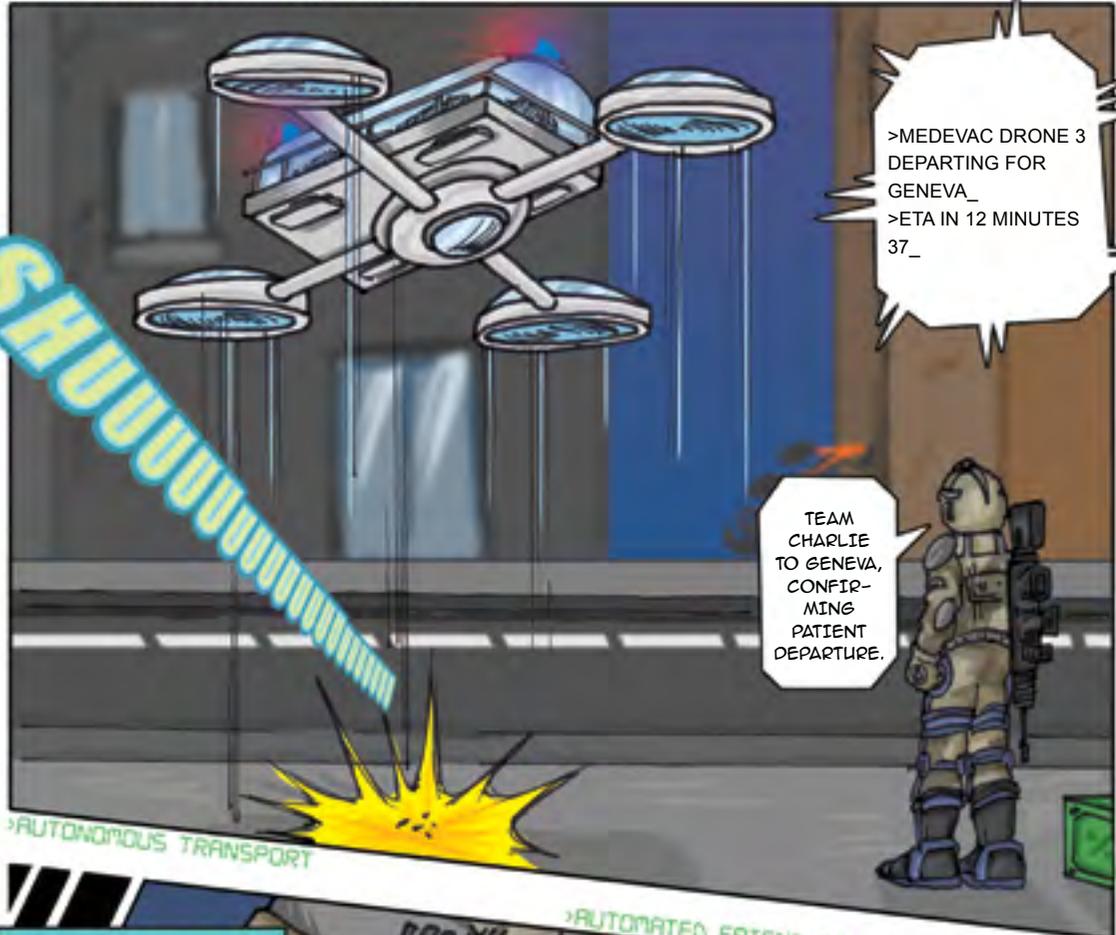
Lausanne station 22:54



CHARLIE TO HQ, FIRST AID ADMINISTERED ! AVS* TAKING CASUALTIES TO THE HUG*. SECOND BOMB DEFUSED, SECURING PERIMETER.

* AVS : AUTONOMOUS VEHICLES * HUG : GENEVA UNIVERSITY HOSPITALS

>CONTINUOUS HEALTH MONITORING



>MEDEVAC DRONE 3 DEPARTING FOR GENEVA_ >ETA IN 12 MINUTES 37_

TEAM CHARLIE TO GENEVA, CONFIRMING PATIENT DEPARTURE.

>AUTONOMOUS TRANSPORT

>AUTOMATED FRIEND-OR-FOE IDENTIFICATION

Basel, city centre 22:55

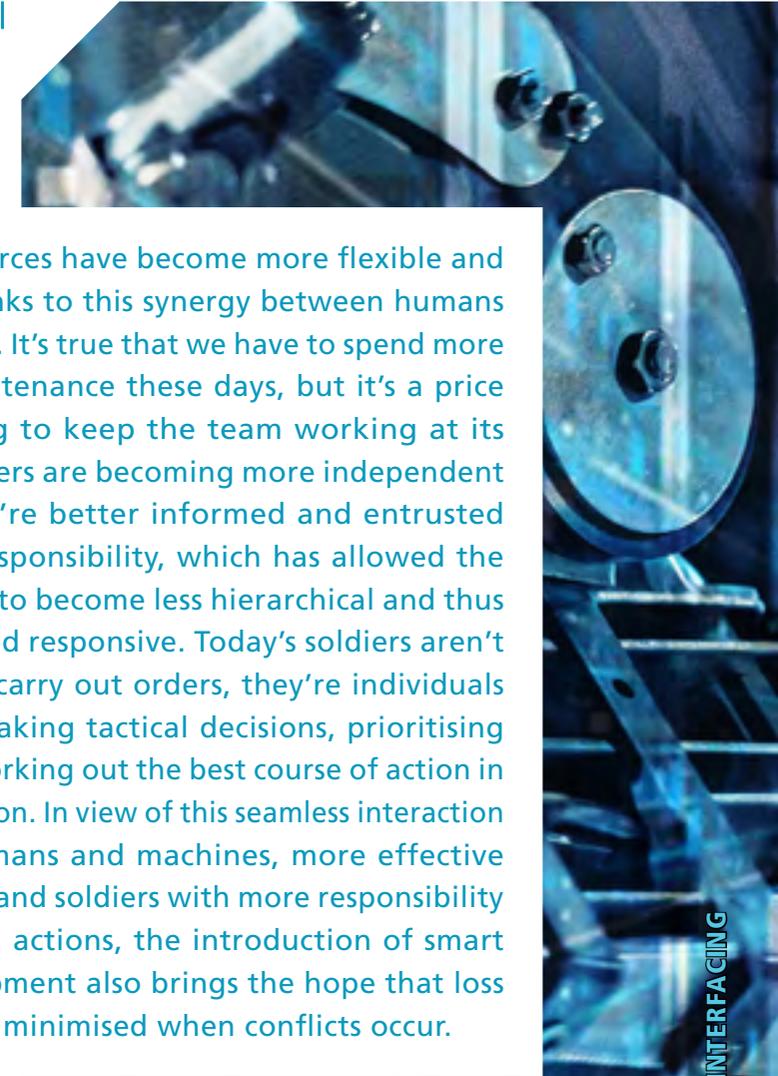


TEAM BRAVO ! TARGETS LOCATED, REQUEST BACKUP ASAP !

To be continued...



A SOLDIER-MACHINE TEAM



I'm a connected soldier, constantly interacting with a wide range of systems at varying distances. My capabilities have been enhanced significantly since the advent of intuitive, personalised human-machine interfacing. All repetitive tasks and those requiring a lot of manual labour are performed by machines. My work now centres on overseeing these machines and handling tasks that still need human input, such as decision-making, strategic situation analysis and liaising with civilians. I operate in synergy with the machines – we've become inseparable. They allow me to conduct fast and detailed assessments of the risks arising from my decisions with the aid of real-time scenarios. My digital assistant helps me to evaluate, sort and analyse the constant stream of information I receive.

Our armed forces have become more flexible and effective thanks to this synergy between humans and machines. It's true that we have to spend more time on maintenance these days, but it's a price worth paying to keep the team working at its best. All soldiers are becoming more independent because they're better informed and entrusted with more responsibility, which has allowed the armed forces to become less hierarchical and thus more agile and responsive. Today's soldiers aren't just there to carry out orders, they're individuals capable of making tactical decisions, prioritising orders and working out the best course of action in a given situation. In view of this seamless interaction between humans and machines, more effective armed forces and soldiers with more responsibility for their own actions, the introduction of smart combat equipment also brings the hope that loss of life can be minimised when conflicts occur.

HUMAN-MACHINE INTERFACING



Close to Nusshof

22:56



UNDERSTOOD, TEAM BRAVO...

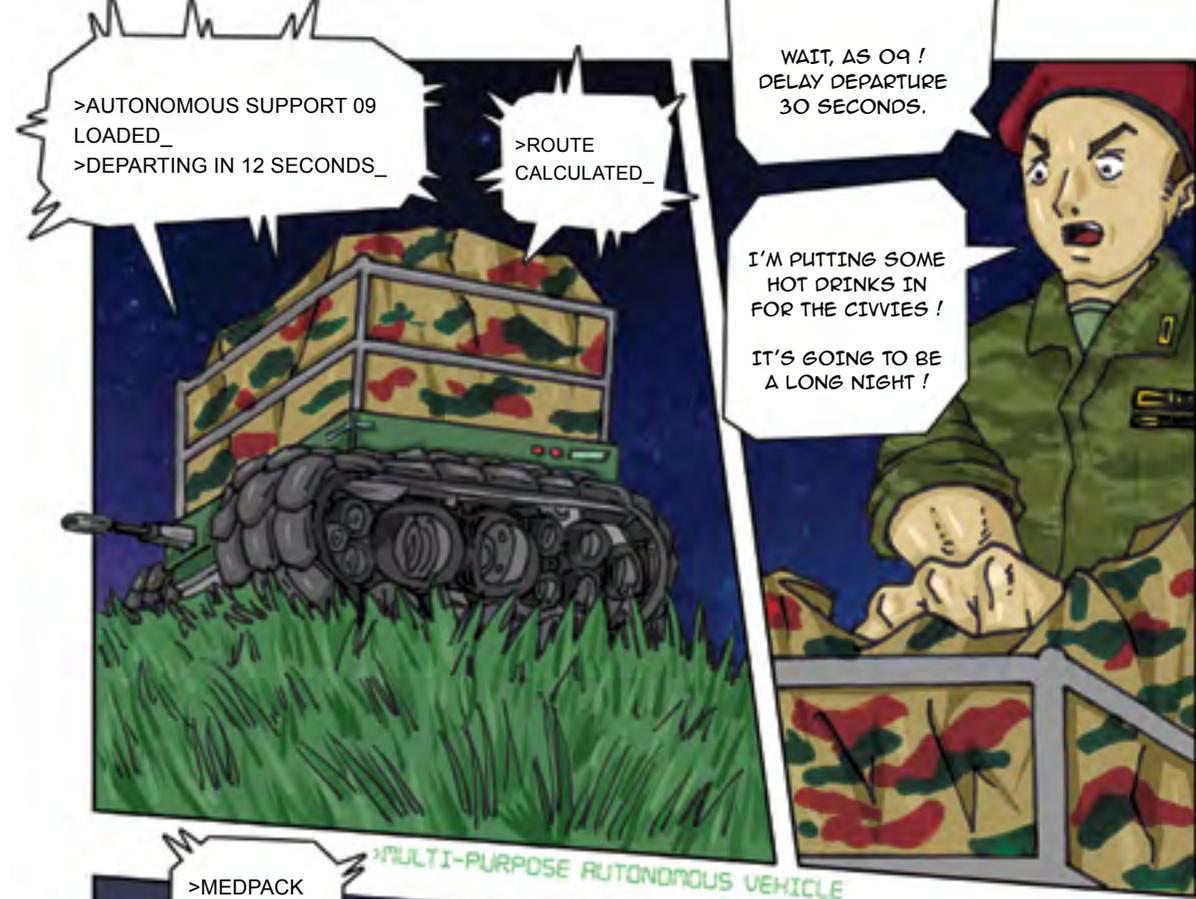


DID YOU ALL HEAR THAT ?

SEND AN AI* SUPPORT TO TEAM BRAVO WITH SUPPLIES GEARED TO URBAN COMBAT !

I'M TALKING RIGHT IN THE MIDDLE OF BASEL !

* >ARTIFICIAL INTELLIGENCE



>AUTONOMOUS SUPPORT 09 LOADED_>DEPARTING IN 12 SECONDS_

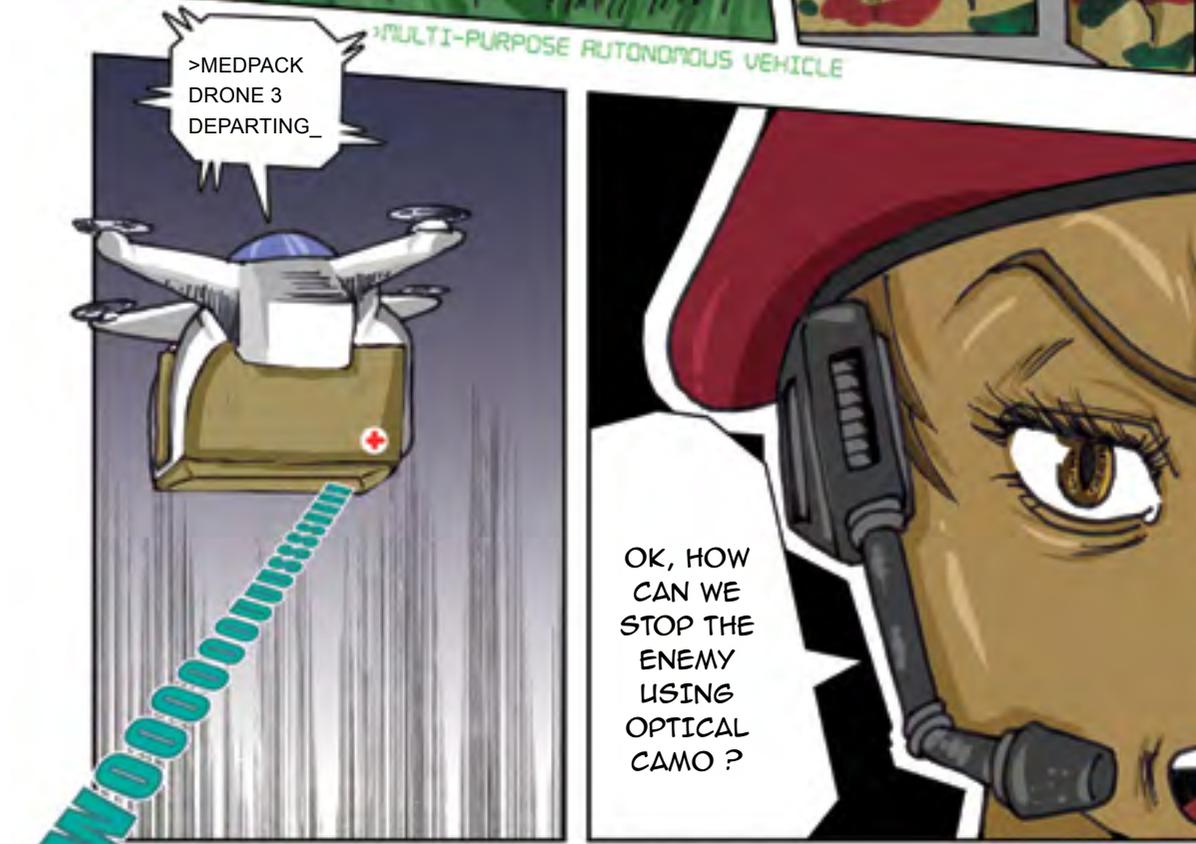
>ROUTE CALCULATED_

WAIT, AS 09 ! DELAY DEPARTURE 30 SECONDS.

I'M PUTTING SOME HOT DRINKS IN FOR THE CIVVIES !

IT'S GOING TO BE A LONG NIGHT !

>SOLDIER COMPANION



>MEDPACK DRONE 3 DEPARTING_

>MULTI-PURPOSE AUTONOMOUS VEHICLE

OK, HOW CAN WE STOP THE ENEMY USING OPTICAL CAMO ?

>GROUND AND AIR ROBOTS

>AI 23X TO LOGISTICS TEAM
SIERRA_

>USE JAMMING FOR 100%
EFFECTIVENESS_

>LAUNCHING HYDRONE_

Rhine 22:57

*Not far from the
Tinguely Museum*

>HYDRONE 9
IN POSITION_



>JAMMING/SPOOFING OF VARIOUS SIGNALS

>JAMMING ACTIVATED_
>RANGE 4 KM_



>GROUND-AIR-WATER INTEROPERABILITY

**Basel, city centre
22:58**

!?



OPTICAL CAMO
DISABLED,
TAKE THEM
DOWN
!

**Intelligence
Centre**

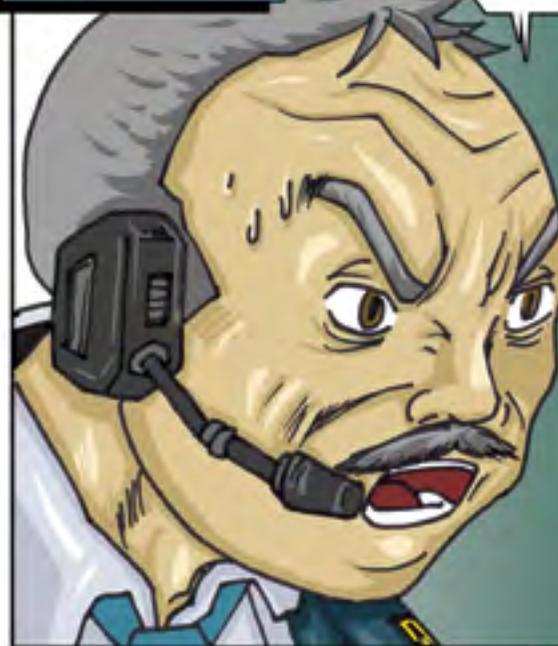
>AI 23X TO
COMMAND_
>PROBABILITY
CALCULATION
COMPLETE_
>ORIGIN OF
ATTACK: MÜSTAIR,
GRAUBÜNDEN,
46.627045 NORTH,
10.454172 WEST_

BAM! BAM! BAM!

**Central
Command**

TEAM
BRAVO
TO HQ,
TARGETS
DOWN !

GOOD
WORK,
BRAVO
!



**To be
continued...**

>HUMAN-MACHINE INTERACTION

AN AGILE SOLDIER

My colleagues and I are stationed in a civilian setting rather than on a military base. Cyber warfare is now commonplace, and our independence and mobility allow us to be more responsive and mount an effective defence. We engage in combat remotely through our computers, which are all interconnected to ensure a fast and robust response. As soldiers, we're being monitored and analysed all the time, and our operational decisions are based on our direct interaction with each other. Artificial intelligence supports and automates decision-making processes.

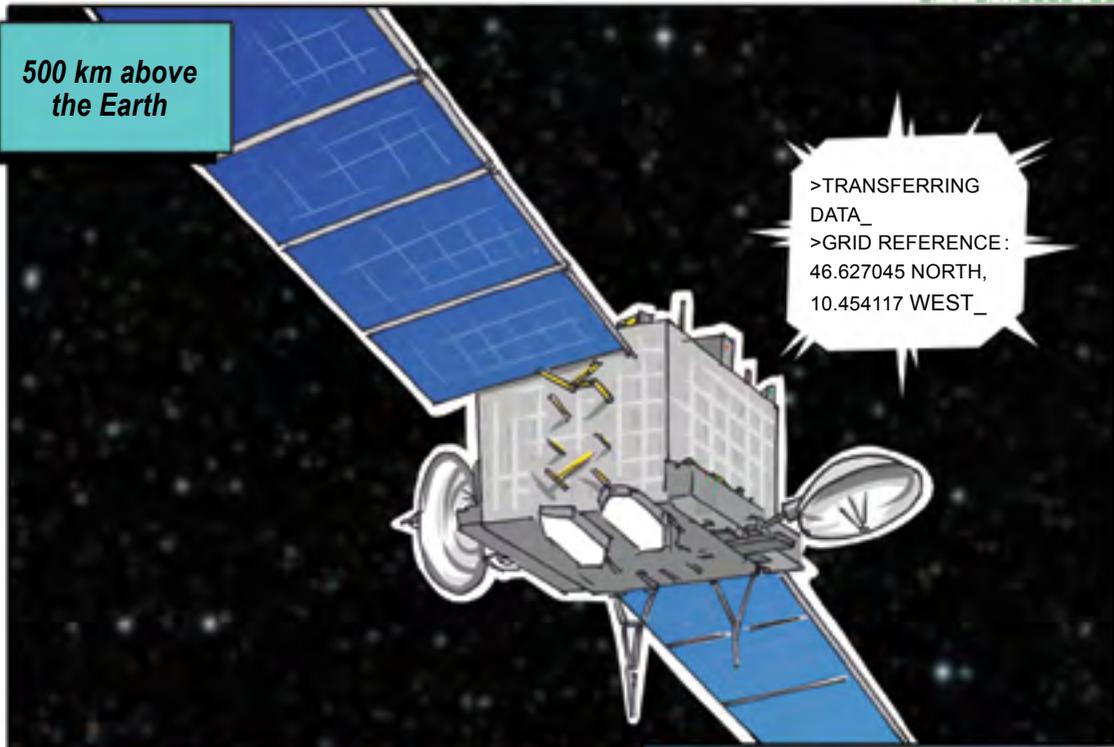
We're constantly in touch with our allies in combat situations. We use shared data formats and simultaneous translators so everyone can speak in their native language. In general, everything's standardised in the interests of total interoperability. We observe exactly the same rules of engagement as our allies. Regular inter-army training exercises are held to strengthen our cohesion and our confidence in each other.

That being said, we still need to be on our guard. The stakes can change fast at the global level, and today's partners could suddenly become tomorrow's enemies. That would turn the interoperability that's been so crucial to our success into a major vulnerability as our new enemies could infiltrate our systems. As welcome as interoperability is, therefore, we need to be able to revoke it at any moment.

INTEROPERABILITY

>SPY SATELLITES

500 km above the Earth



>TRANSFERRING DATA_
>GRID REFERENCE:
46.627045 NORTH,
10.454117 WEST_

>IMAGE ANALYSIS/REAL-TIME VIDEO



>ENEMY CAMP CONFIRMED_
>MOVEMENT DETECTED_

>DECISION-MAKING AIDS

Central Command

22:59

THIS IS COLONEL FEIST SPEAKING. MUSTAIR POLICE, ARE YOU RECEIVING ME ?

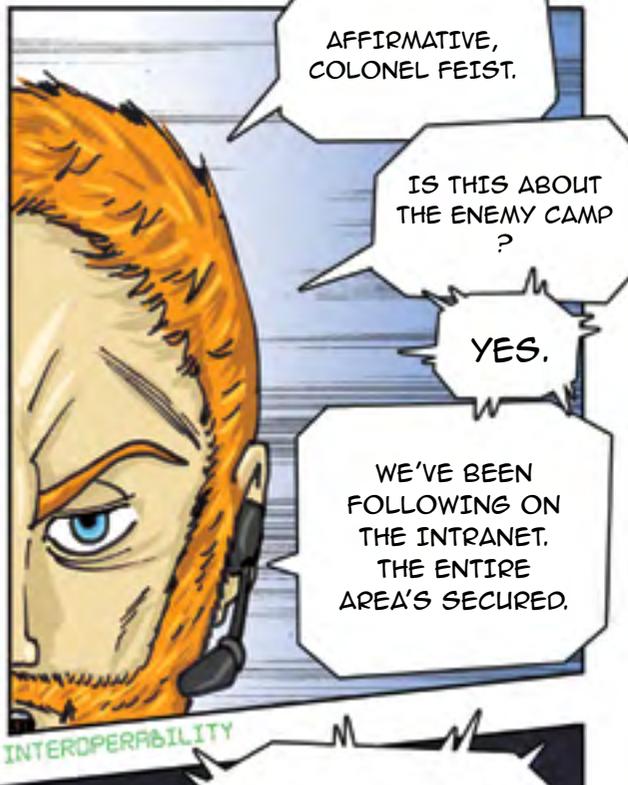


AFFIRMATIVE, COLONEL FEIST.

IS THIS ABOUT THE ENEMY CAMP ?

YES.

WE'VE BEEN FOLLOWING ON THE INTRANET. THE ENTIRE AREA'S SECURED.



>CIVILIAN/MILITARY INTEROPERABILITY

2 minutes by air from Payerne

AIRSTRIKE X68K TO HQ, MUSTAIR TARGET DEFINED ! ETA IN 6 MINUTES.



ENGAGE !

Bern

23:01

>HUMAN INPUT IN DECISION-MAKING



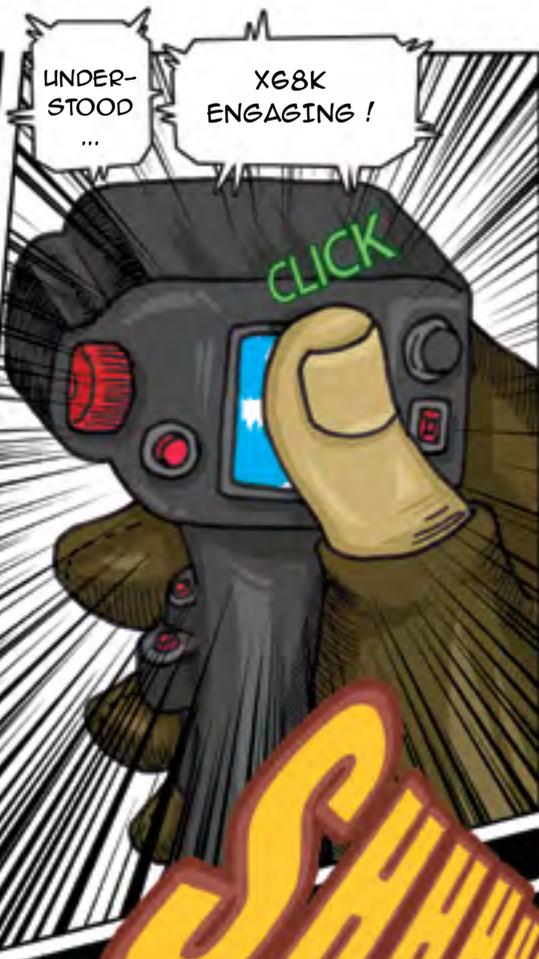
>DOWNLOADING FACIAL RECOGNITION DATA_

>IMAGE RECOGNITION

>BRAIN-MACHINE INTERFACE



ANTI-PERSONNEL MICROMISSILES ARMED !



UNDER-
STOOD ...

X68K
ENGAGING !

CLICK



Müstair Police Station
23:04

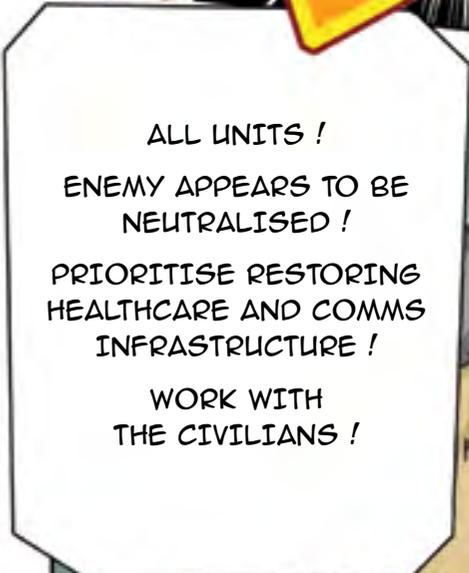
TARGET AREA CLEAR,
AIRSTRIKE X68K !

>REAL-TIME DATA TRANSFER



AIRSTRIKE X68K TO HQ !
TARGETS DOWN.

MÜSTAIR POLICE TO
COLONEL
FEIST, VISUAL
CONFIRMATION:
ENEMIES DOWN
!



ALL UNITS !
ENEMY APPEARS TO BE
NEUTRALISED !
PRIORITISE RESTORING
HEALTHCARE AND COMMS
INFRASTRUCTURE !
WORK WITH
THE CIVILIANS !

Central
Command
23:05



IT'S GOING TO BE A
LONG NIGHT !
GOOD LUCK !

PHEW
...

END



<https://deftech.ch>



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