The promise of personalisation and enabling policy and regulatory trends

Contacts:
Mario Romao

Healthcare at Intel
Where information and care meet

It is more important to know what sort of person has a disease than to know what sort of disease a person has.

Hippocrates, born 460 BC

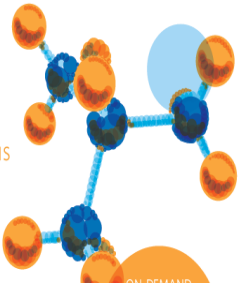
Healthcare at Intel
Where information and care meet

Can computers cure diseases?

3

Cost Effective Power of On-Demand Supercomputing – AWS, CycleComputing, Schrodinger

IN 60 MINUTES, SCHRÖDINGER CAN TEST 16 MILLION MOLECULES, SO PHARMACEUTICAL RESEARCHERS CAN MAKE BREAKTHROUGHS SOONER



ON-DEMAND SCALABILITY: 1 to 50,000 INTEL® XEON® PROCESSORS

"For years, pharmaceutical companies have been scaling up staffing resources via contract research organizations. Now, thanks to high-performance computing in the Amazon Web Services cloud, it's incredibly simple and cost-effective to scale their compute resources in a similar way."
—*Scott Becker, VP of Enterprise Products, Schrödinger*

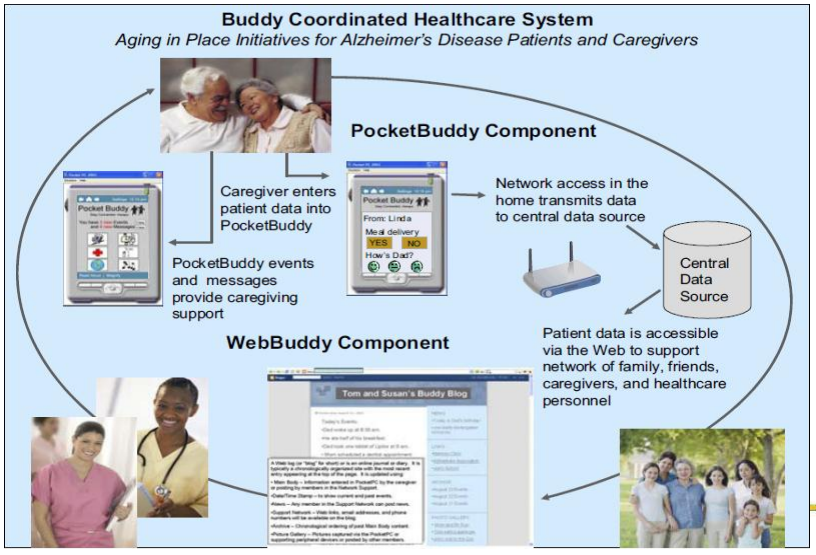
SCHRÖDINGER. amazon web services™ CYCLECOMPUTING

Challenge: Team of cancer researchers had to screen a drug concept with a list of tens of millions of molecules working with a tight deadline, a fixed budget, and strict security and compliance requirements. Schrödinger's existing in-house servers would be tied up for weeks
Solution: Schrödinger leveraged software from AWS partner (CycleComputing) to provision a fully secured cluster of 50,000 cores, powered by the Intel® Xeon® processor E5 family.

- This configuration enabled the team to run 16 million molecular simulations an hour.
- Developed 1000 molecule list in < 8hrs.

Healthcare at Intel
Where information and care meet

Not all data was born big …



Making sense of me

Drug Research

Social Media

Patient Records

Gene Sequencing

Test Results

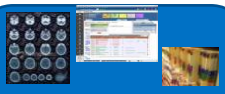
Claims

Home Monitoring

Mobile Apps

Vision of Compute for Personalised Medicine

1. Patient Information – History, PHRs, Allergies etc.



2. Clinical Information – Admission, Discharge, Radiology, Surgery, Images, Clinical notes, Diagnosis, Demographics etc.

3. Genetic Information – Proteomics, SNPs, Clinical Trials, Publications, Databanks etc.

Personalized Diagnostics

4. Drug/dose/cure Design
Molecular docking, Biosimulation, radiotherapy, etc...

Personalized Medicine

7

Healthcare at Intel
Where information and care meet

Example: Global Alliance to Enable Responsible Sharing of Genomic and Clinical Data

(http://www.broadinstitute.org/files/news/pdfs/GAWhitePaperJune3.pdf)

The opportunity: to dramatically accelerate medical progress by learning from the world's data on genome sequences and clinical phenotypes.

The challenge: how to gather extensive data on variation in genome sequencing and phenotypes

The solution:

- a global alliance bringing together researchers, healthcare providers, funders, disease advocacy groups, life science and technology companies, and informed citizens to enable, support and promote the responsible sharing of genomic and clinical data
- the creation and management of interoperable technology platforms with open standards.

8

Healthcare at Intel
Where information and care meet

Example: Global Alliance to Enable Responsible Sharing of Genomic and Clinical Data

Issues to be addressed globally (non-exhaustive):

- Public engagement
- Protection of privacy, including participant centered-initiatives
- Access to data and results by participants, researchers and others
- Governance of repositories including cross-jurisdiction data transfer
- Open technology standards supporting secure information sharing

Example: European Alliance for Personalised Medicine (http://euapm.eu/)

The opportunity: to tailor the right therapeutic strategy to the "molecular make-up" of an individual

The challenge: to adapt, among others, policies and regulations

The solution: bring together like minded organisations to promote alignment among diverse views and priorities, and to bridge the gap between the lay and professional perceptions of innovation

Example: European Alliance for Personalised Medicine

Issues to be addressed (non-exhaustive):

- **Data related:** resolve complex data protection rules that impede biomedical progress; break silos of single use data; no separate rules for genetic information; accept certified Cloud environments
- **Translational related:** wider and multidisciplinary research collaboration – PPPs; clinical registries for observational studies; more involvement of bio-informatics; adaptive clinical trials; facilitation of international trials
- **ICT related:** technologies for generation and handling of data from multiple sources; life-long monitoring; quality assurance

Focal areas

1. **"Liberate the Data"**: address the privacy and security protections while ensuring that patients worldwide are benefitting from research that depends on interoperable EHRs and repositories of patient genomes mapped to treatments and experience
2. **"Target incentives"**: more funding for multidisciplinary international clinical trials; reimbursement of genetic testing; funding of collaborative PPPs
3. **"Compute for AD"**: rally academia and companies to develop systems capable of analyzing how genomic abnormalities cause changes in the molecular architecture of cells and tissues in individual patients

Thank you

Legal Notices and Disclaimers

Intel product plans in this presentation do not constitute Intel plan of record product roadmaps. Please contact your Intel representative to obtain Intel's current plan of record product roadmaps. All products, computer systems, dates and figures specified are preliminary based on current expectations, and are subject to change without notice.

INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

INTEL'S PRODUCTS PURCHASED OR USED FOR ANY SUCH MISSION CRITICAL APPLICATION, (a "Mission Critical Application" is any application in which failure of the Intel Product could result, directly or indirectly, in personal injury or death). REQUIRE THE PURCHASER OR USER TO INDEMNIFY AND HOLD INTEL AND ITS SUBSIDIARIES, SUBCONTRACTORS AND AFFILIATES, AND THE DIRECTORS, OFFICERS, AND EMPLOYEES OF EACH, HARMLESS AGAINST ALL CLAIMS COSTS, DAMAGES, AND EXPENSES AND REASONABLE ATTORNEYS' FEES ARISING OUT OF, DIRECTLY OR INDIRECTLY, ANY CLAIM OF PRODUCT LIABILITY, PERSONAL INJURY, OR DEATH ARISING IN ANY WAY OUT OF SUCH MISSION CRITICAL APPLICATION, WHETHER OR NOT INTEL OR ITS SUBCONTRACTOR WAS NEGLIGENT IN THE DESIGN, MANUFACTURE, OR WARNING OF THE INTEL PRODUCT OR ANY OF ITS PARTS.

No computer system can provide absolute security under all conditions. Built-in security features available on select Intel® Core™ processors may require additional software, hardware, services and/or an Internet connection. Results may vary depending upon configuration.

Intel vPro, Ultrabook, vPro are trademarks of Intel Corporation in the U.S. and/or other countries. Other names and brands may be claimed as the property of others.

Legal Notices Continued

† Intel® vPro™ Technology is sophisticated and requires setup and activation. Availability of features and results will depend upon the setup and configuration of your hardware, software and IT environment. To learn more visit: http://www.intel.com/technology/vpro.

‡ Software and workloads used in performance tests may have been optimized for performance only on Intel® microprocessors. Performance tests, such as SYSmark* and MobileMark*, are measured using specific computer systems, components, software, operations, and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

± Intel® AES-NI requires a computer system with an AES-NI-enabled processors, as well as non-Intel software to execute the instructions in the correct sequence. AES-NI is available on select Intel® Core™ processors. For availability, consult your system manufacturer. For more information, see http:///software.intel.com/en-us/articles/intel-advanced-encryption-standard-instructions-aes-ni

¥ No system can provide absolute security under all conditions. Requires an Intel® Identity Protection Technology-enabled system, including a 2nd or 3rd gen Intel® Core™ processor, enabled chipset, firmware, and software, and participating website. Consult your system manufacturer. Intel assumes no liability for lost or stolen data and/or systems or any resulting damages. For more information, visit http://ipt.intel.com.

§ No computer system can provide absolute security under all conditions. Intel® Trusted Execution Technology (Intel® TXT) requires a computer with Intel® Virtualization Technology, an Intel TXT-enabled processor, chipset, BIOS, Authenticated Code Modules and an Intel TXT-compatible measured launched environment (MLE). Intel TXT also requires the system to contain a TPM v1.s. For more information, visit http://www.intel.com/technology/security

∫ Intel® Anti-Theft Technology requires an enabled chipset, BIOS, firmware and software, and a subscription with a capable Service Provider. Consult your system manufacturer and Service Provider for availability and functionality. Service may not be available in all countries. Intel assumes no liability for lost or stolen data and/or systems or any other damages resulting thereof. For more information, visit http://www.intel.com/go/anti-theft.

Legal Notices Continued

¤ Intel® Active Management Technology (Intel® AMT)

◊ KVM Remote Control (Keyboard, Video, Mouse) is only available with Intel® Core™ i5 vPro™ and Core™ i7 vPro™ processors with Intel® Active Management technology activated and configured and with processor graphics active. Discrete graphics are not supported.

Ω Intel® Virtualization Technologies requires a computer system with an enabled Intel® processor, BIOS, and virtual machine monitor (VMM). VT technologies include VT-x, EPT (Extended Page Tables), and VT-d (VT-directed i/o); VT-d is currently exclusive to vProFunctionality, performance, or other benefits will vary depending on hardware and software configurations. Software applications may not be compatible with all operating systems. Consult your PC manufacturer. For more information, visit http://www.intel.com/go/virtualization.

∂ (OS Guard) No system can provide absolute security. Requires an Intel® OS Guard enabled system with a 3rd gen Intel® Core™ vPro™ processor and an enabled operating system. Consult your system manufacturer for more information.

Ѧ (Secure Key) No system can provide absolute security. Requires an Intel® Secure Key enabled PC with a 3rd gen Intel® Core™ vPro™ processor and software optimized to support Intel Secure Key. Consult your system manufacturer for more information.

BACKUP

Alertness: Training for Focused Living

AIM: Develop a technology platform and training programme to support the improvement of attention alertness and focus in mature adults.

Research Background

- Declines in attention can lead to accidents, falls, and other negative consequences for elderly adults. Home based technology supports may provide an effective intervention.

Research Questions

- Can self reported states of attentiveness and alertness be improved through technology supported home based coaching?

Research Activity

- In home mindfulness/attention training and coaching program
- Prototype Mobile biofeedback system use for biometric data capture and attention feedback

Big Data Technology Stack in Healthcare