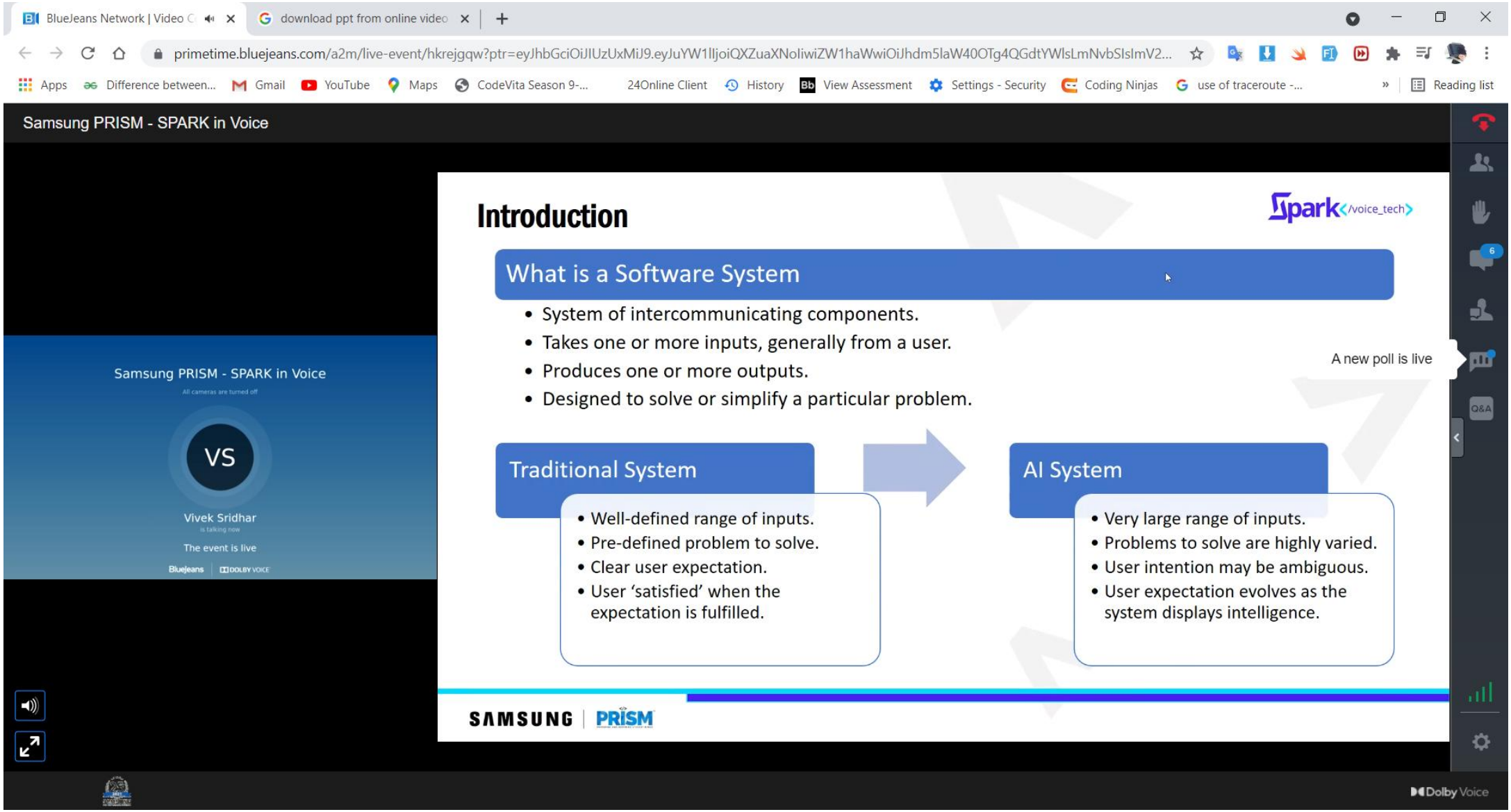
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Vivek Sridhar
is talking now
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Bluejeans
DOLBY VOICE
Introduction
Spark</voice_tech>
What is a Software System
• System of intercommunicating components.
• Takes one or more inputs, generally from a user.
• Produces one or more outputs.
• Designed to solve or simplify a particular problem.
A new poll is live
Traditional System
• Well-defined range of inputs.
• Pre-defined problem to solve.
• Clear user expectation.
• User 'satisfied' when the expectation is fulfilled.
AI System
• Very large range of inputs.
• Problems to solve are highly varied.
• User intention may be ambiguous.
• User expectation evolves as the system displays intelligence.
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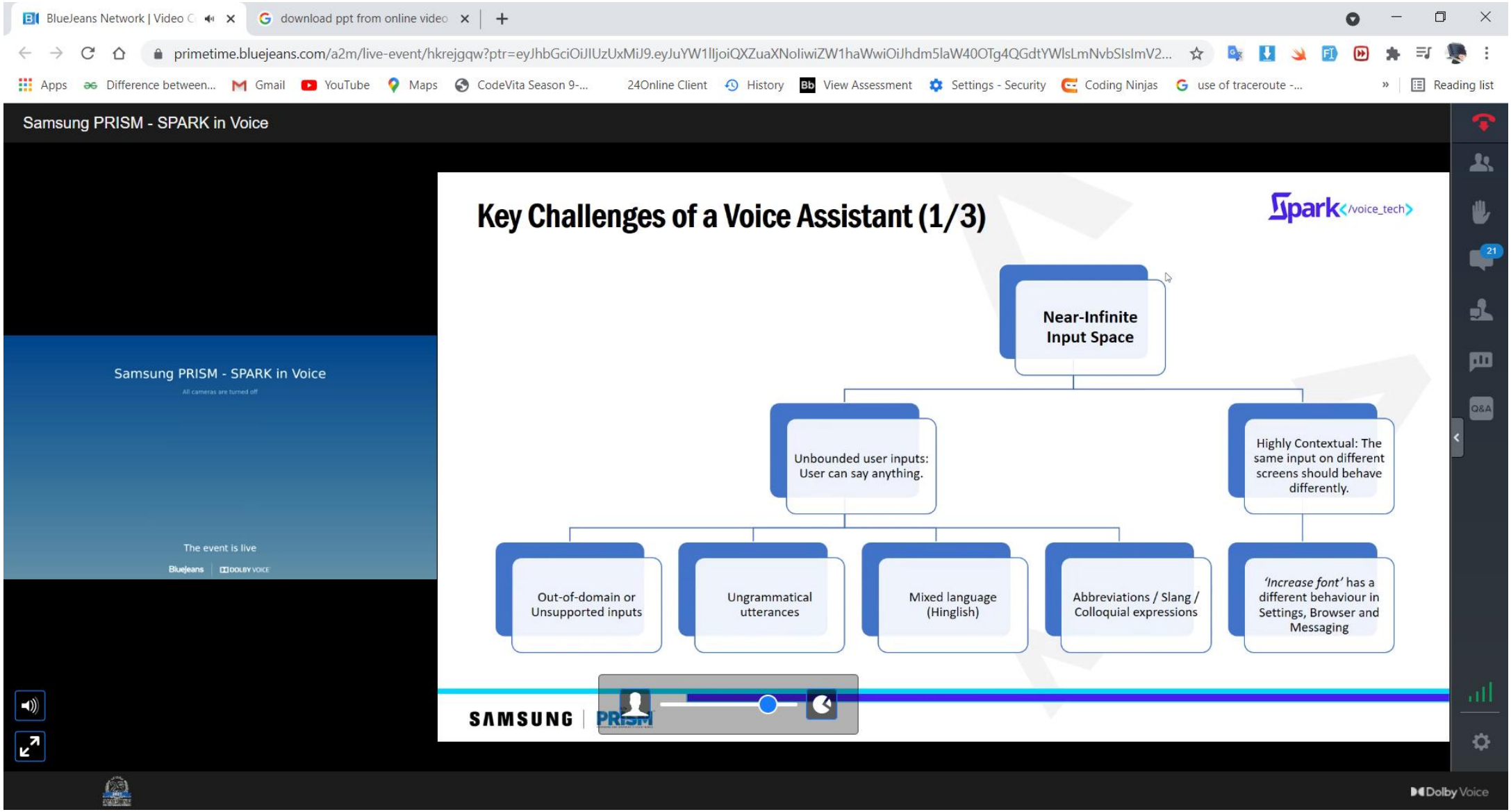
Dolby Voice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Key Challenges of a Voice Assistant (1/3)
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Near-Infinite Input Space
Unbounded user inputs: User can say anything.
Highly Contextual: The same input on different screens should behave differently.
Out-of-domain or Unsupported inputs
Ungrammatical utterances
Mixed language (Hinglish)
Abbreviations / Slang / Colloquial expressions
'Increase font' has a different behaviour in Settings, Browser and Messaging
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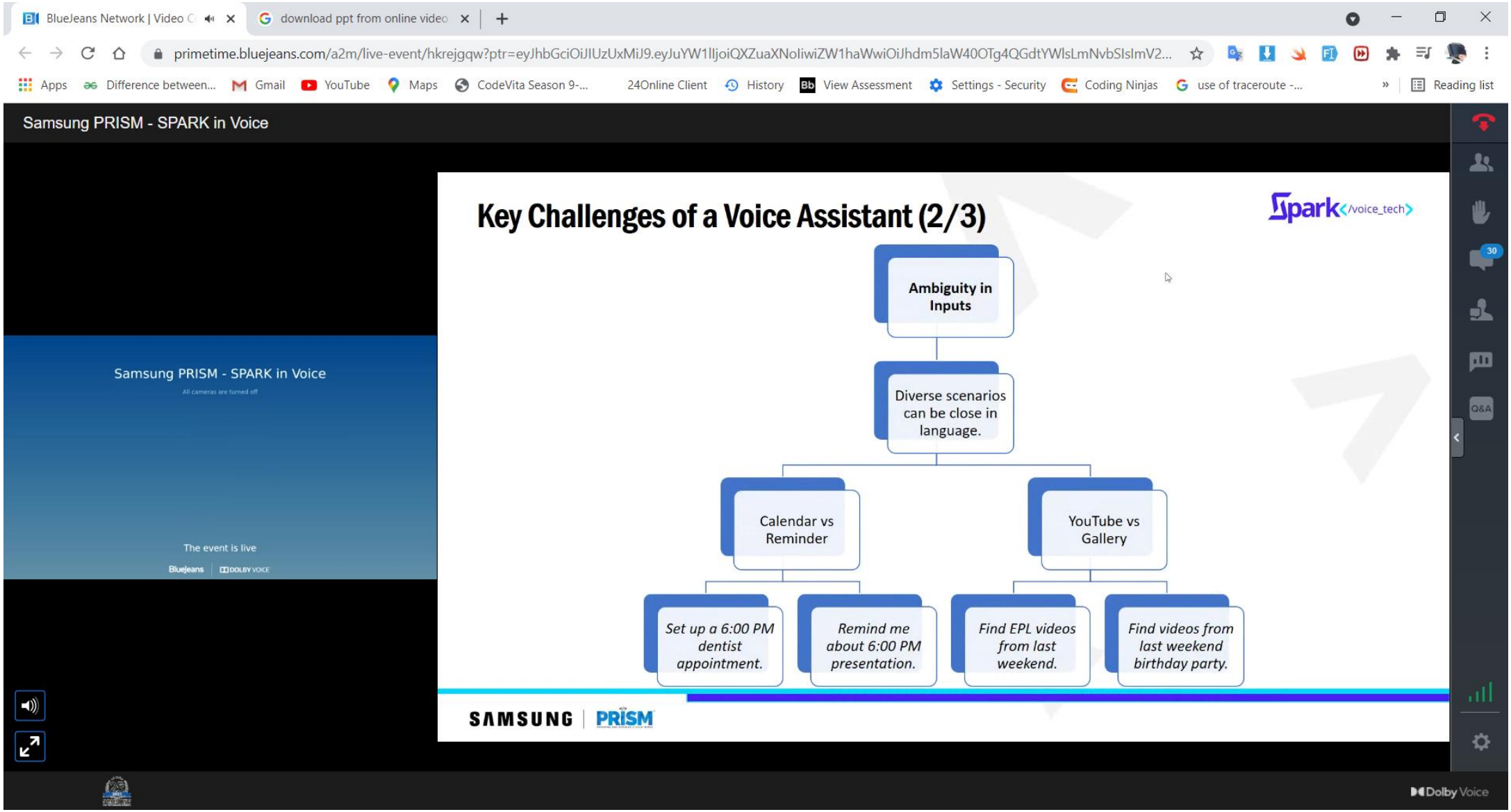
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Key Challenges of a Voice Assistant (2/3)
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Ambiguity in Inputs
Diverse scenarios can be close in language.
Calendar vs Reminder
YouTube vs Gallery
Set up a 6:00 PM dentist appointment.
Remind me about 6:00 PM presentation.
Find EPL videos from last weekend.
Find videos from last weekend birthday party.
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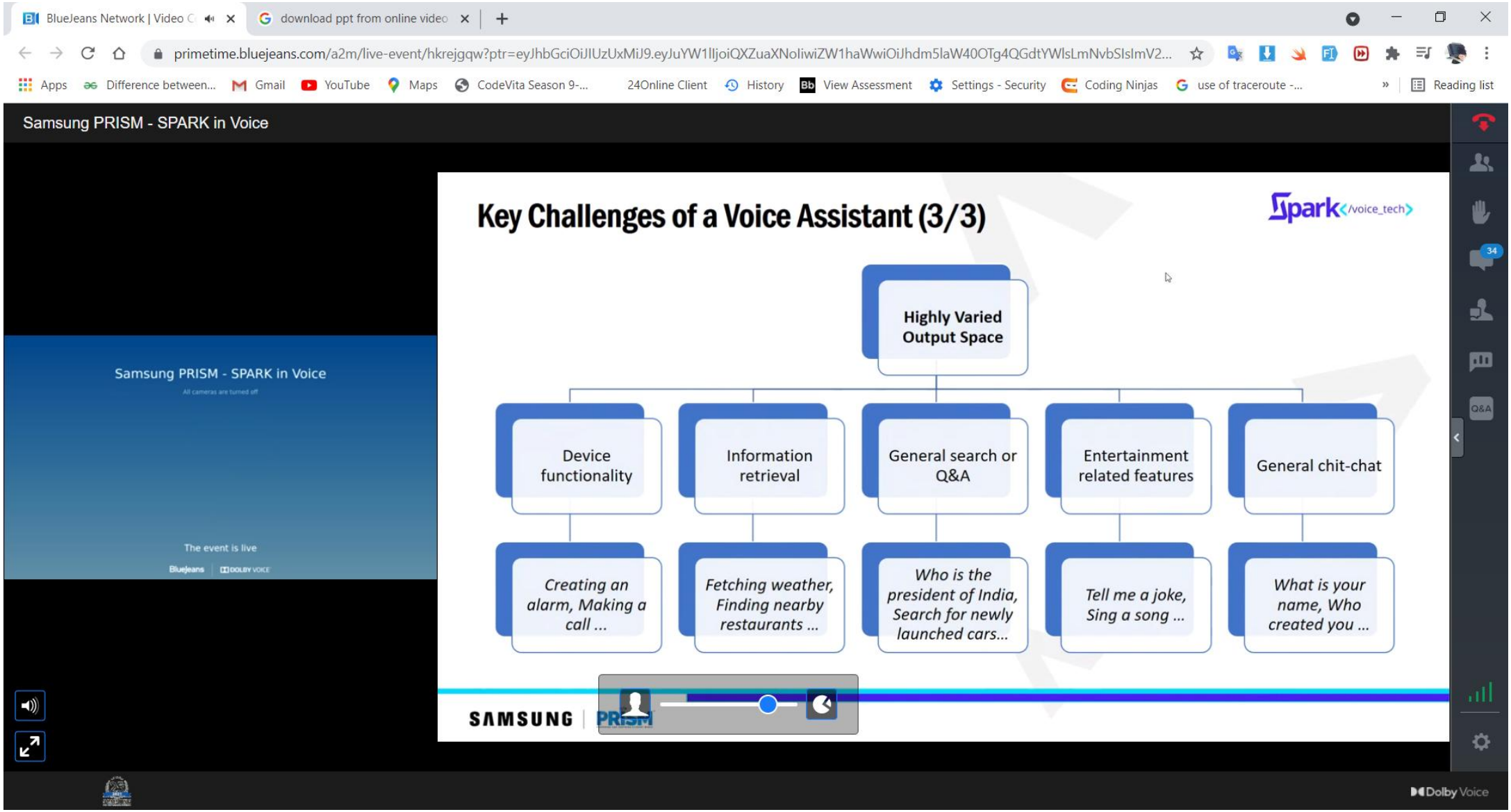
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Key Challenges of a Voice Assistant (3/3)
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Highly Varied Output Space
Device functionality
Information retrieval
General search or Q&A
Entertainment related features
General chit-chat
Creating an alarm, Making a call ...
Fetching weather, Finding nearby restaurants ...
Who is the president of India, Search for newly launched cars...
Tell me a joke, Sing a song ...
What is your name, Who created you ...
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Kunal

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Key Challenges of a Voice Assistant (3/3)

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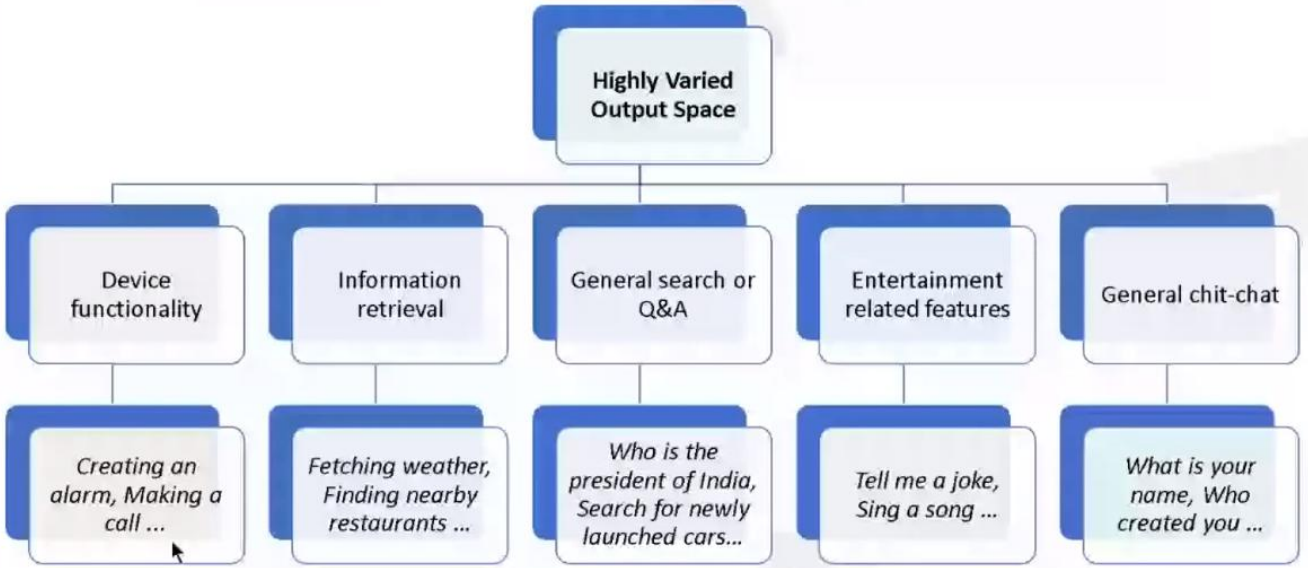

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Typical NLU in a Voice Assistant Pipeline

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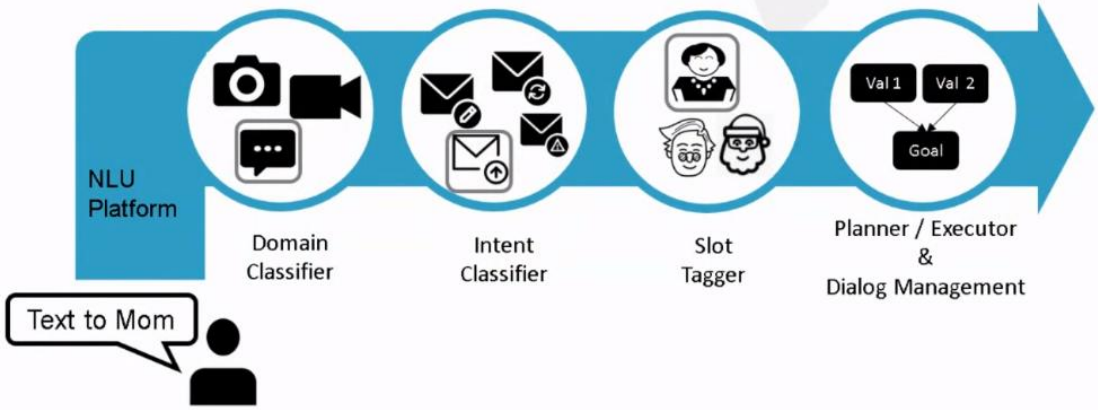

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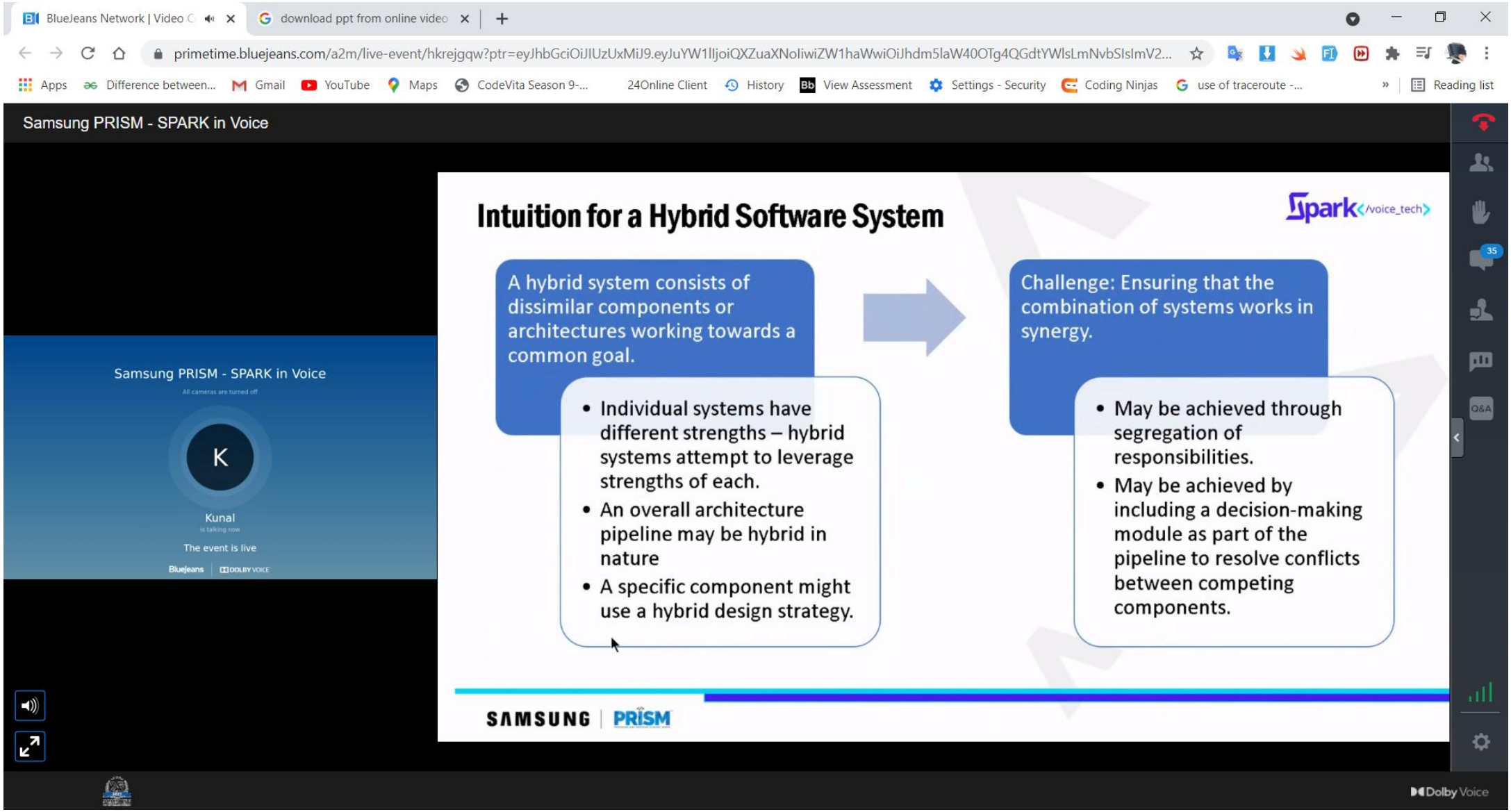
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Intuition for a Hybrid Software System
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A hybrid system consists of dissimilar components or architectures working towards a common goal.
Individual systems have different strengths – hybrid systems attempt to leverage strengths of each.
An overall architecture pipeline may be hybrid in nature
A specific component might use a hybrid design strategy.
Challenge: Ensuring that the combination of systems works in synergy.
May be achieved through segregation of responsibilities.
May be achieved by including a decision-making module as part of the pipeline to resolve conflicts between competing components.
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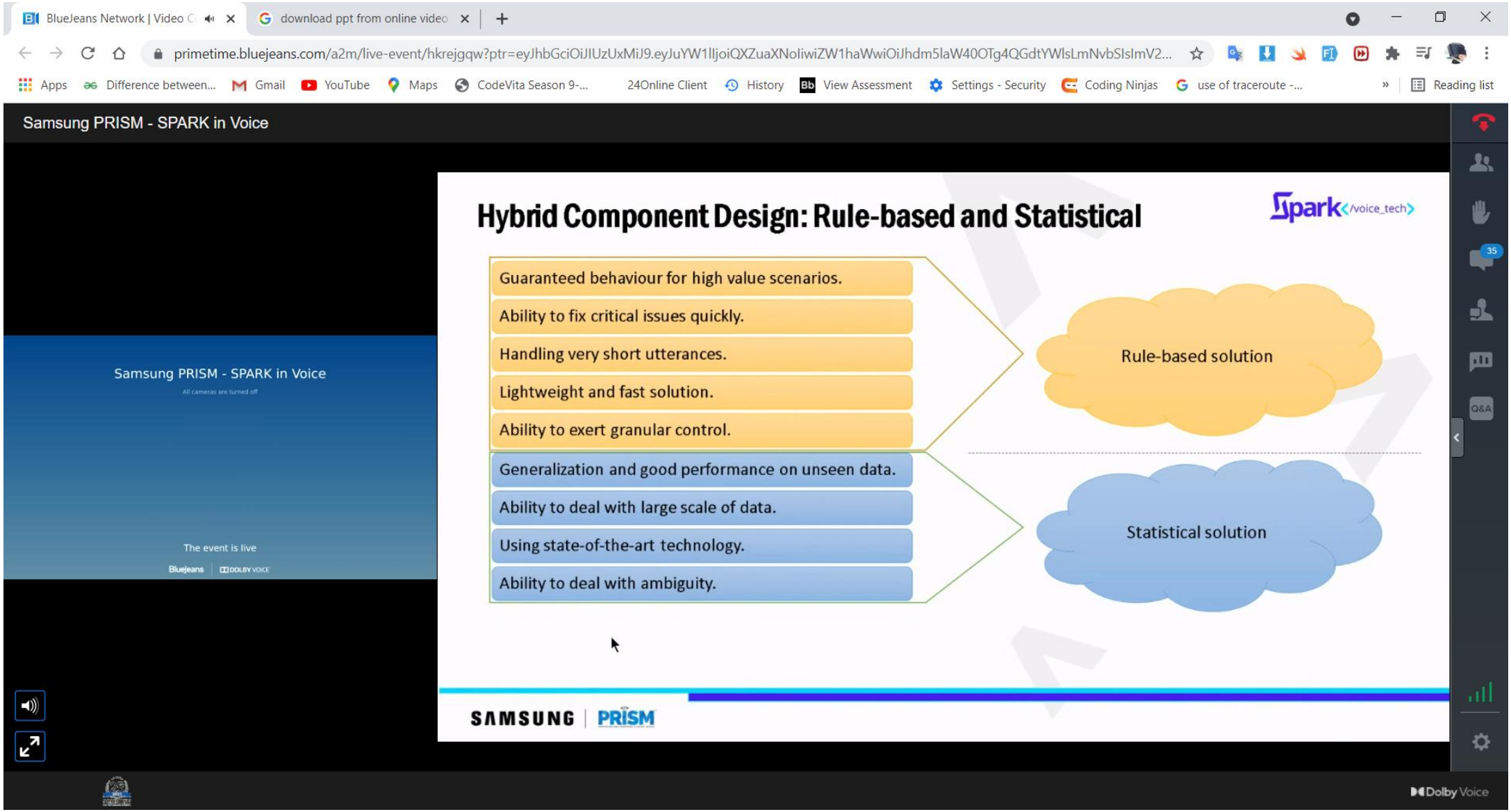
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Hybrid Component Design: Rule-based and Statistical
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Guaranteed behaviour for high value scenarios.
Ability to fix critical issues quickly.
Handling very short utterances.
Lightweight and fast solution.
Ability to exert granular control.
Rule-based solution
Generalization and good performance on unseen data.
Ability to deal with large scale of data.
Using state-of-the-art technology.
Ability to deal with ambiguity.
Statistical solution
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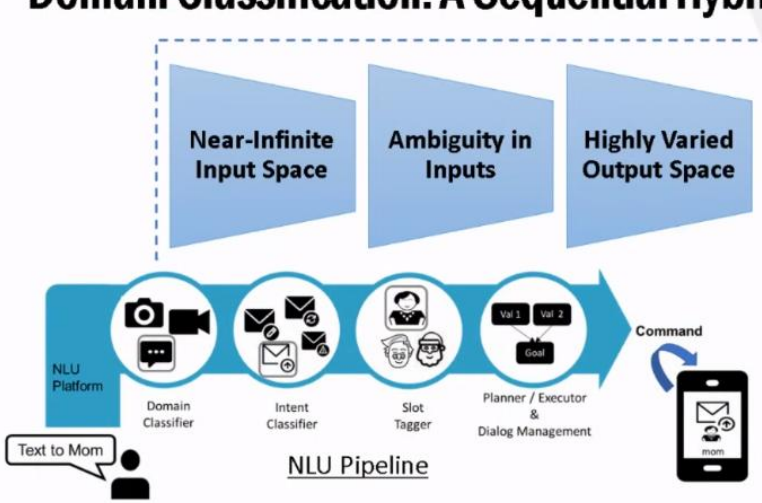
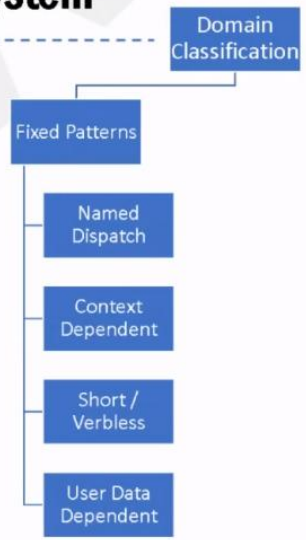
Domain Classification: A Sequential Hybrid System





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Domain Classification: A Sequential Hybrid System

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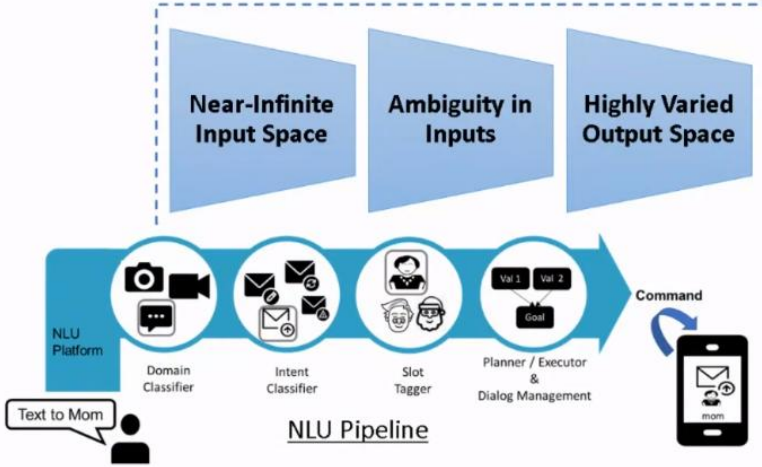

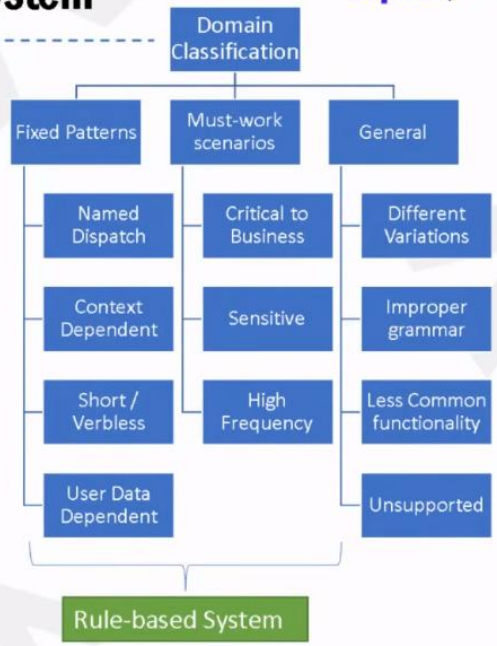

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Hybrid System Design: Cloud and On-Device

Bixby on cloud handles commands that requires the Internet connection.

Bixby in mobile handles commands that doesn't require the Internet connection.

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Q&A 1

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Hybrid System Design: Cloud and On-Device

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- Flexibility in programming languages / frameworks.
- Easy to maintain.
- Scalable
- Memory and Storage.
- Computation Power.

Cloud-based solution

- Access to user data without privacy concerns
- No dependency on internet connection.
- Speed of response to user.
- Personalization.

On-Device Solution

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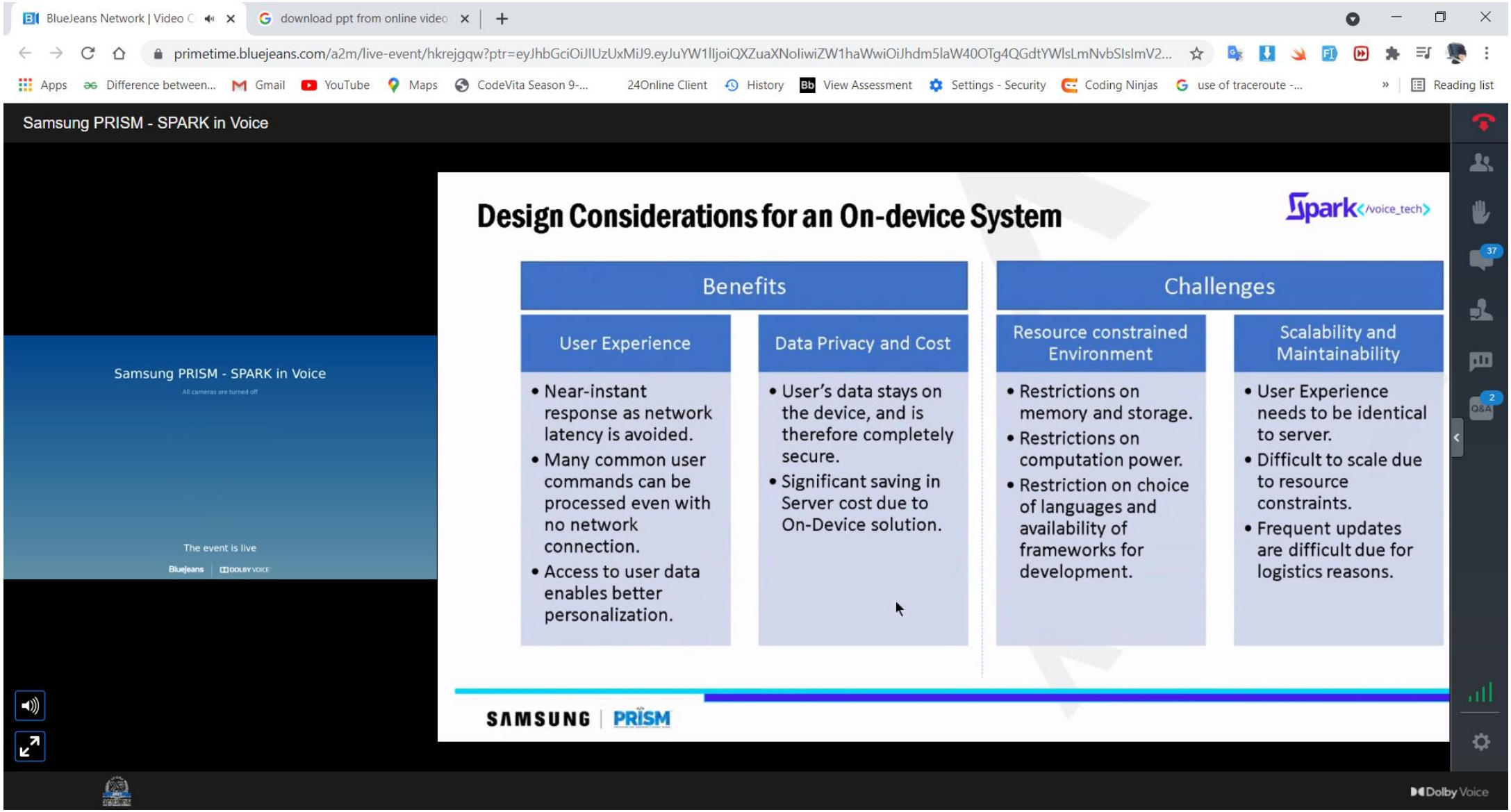
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Design Considerations for an On-device System
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Benefits
User Experience
• Near-instant response as network latency is avoided.
• Many common user commands can be processed even with no network connection.
• Access to user data enables better personalization.
Data Privacy and Cost
• User's data stays on the device, and is therefore completely secure.
• Significant saving in Server cost due to On-Device solution.
Challenges
Resource constrained Environment
• Restrictions on memory and storage.
• Restrictions on computation power.
• Restriction on choice of languages and availability of frameworks for development.
Scalability and Maintainability
• User Experience needs to be identical to server.
• Difficult to scale due to resource constraints.
• Frequent updates are difficult due for logistics reasons.
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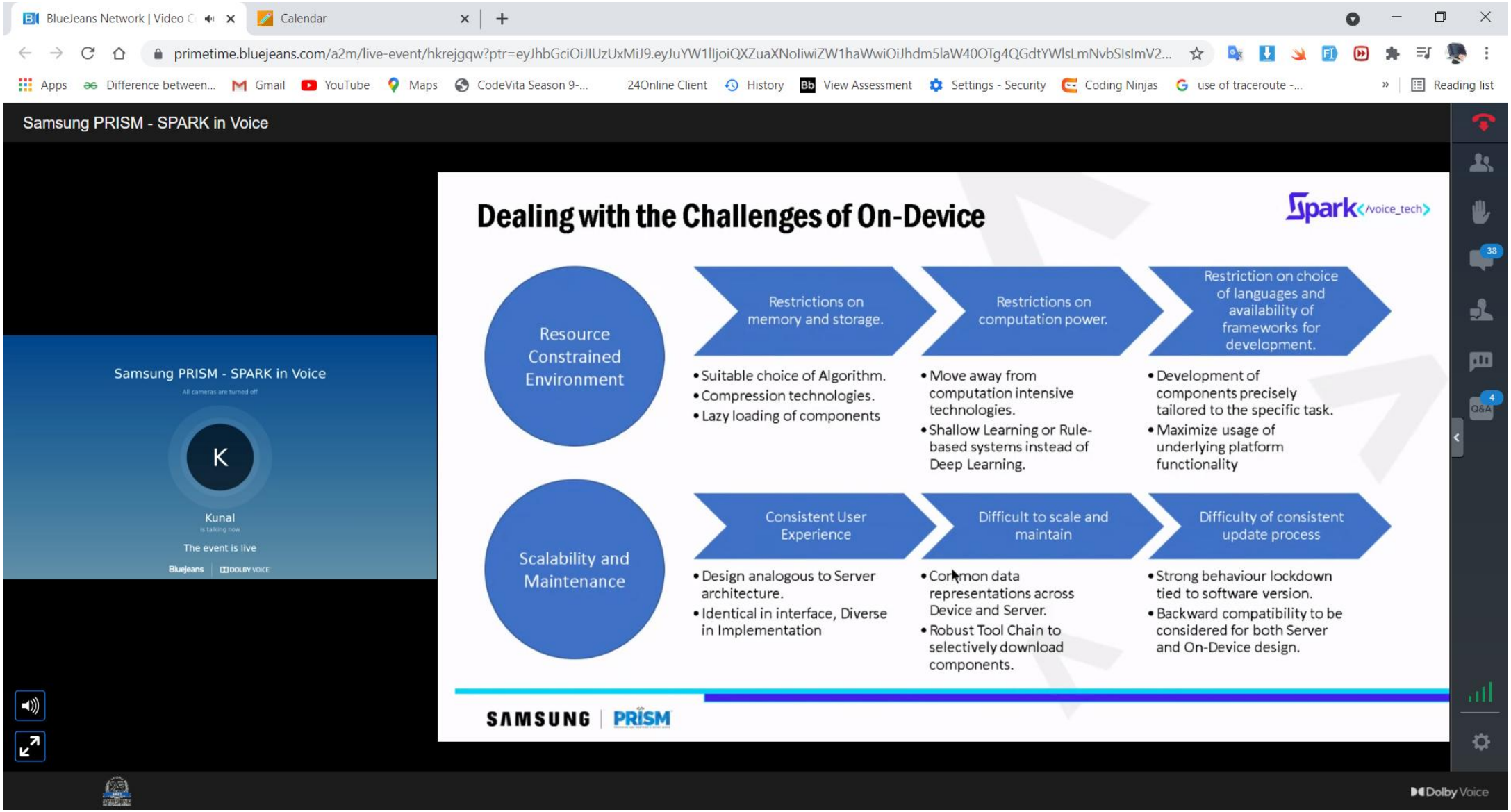
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Dealing with the Challenges of On-Device
Spark</voice_tech>
Resource Constrained Environment
Restrictions on memory and storage.
Restrictions on computation power.
Restriction on choice of languages and availability of frameworks for development.
• Suitable choice of Algorithm.
• Compression technologies.
• Lazy loading of components
• Move away from computation intensive technologies.
• Shallow Learning or Rule-based systems instead of Deep Learning.
• Development of components precisely tailored to the specific task.
• Maximize usage of underlying platform functionality
Scalability and Maintenance
Consistent User Experience
Difficult to scale and maintain
Difficulty of consistent update process
• Design analogous to Server architecture.
• Identical in interface, Diverse in Implementation
• Common data representations across Device and Server.
• Robust Tool Chain to selectively download components.
• Strong behaviour lockdown tied to software version.
• Backward compatibility to be considered for both Server and On-Device design.
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