Kerberos – MIT protocol

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Kerberos – MIT protocol

- Motivation behind the design
- Overview of Kerberos Protocol
- Kerberized applications
- Attacks and Security analysis
- Q & A

Motivations behind the design

- The user's password must never travel over the network.
- The user's password must never be stored in any form on the client machine.
- The user's password should never be stored in an unencrypted form.
- Single Sign-On.
- Centralized Authentication information management.
- Mutual authentication.
- Establish an encrypted connection.

Kerberos overview

- A network authentication protocol.
- Client/server authentication by using secret-key cryptography.
- Developed at MIT in the mid 1980s
- Available as open source or in supported commercial software.
- Symmetric key encryption.
- Two versions V4 and V5.

Components and terms

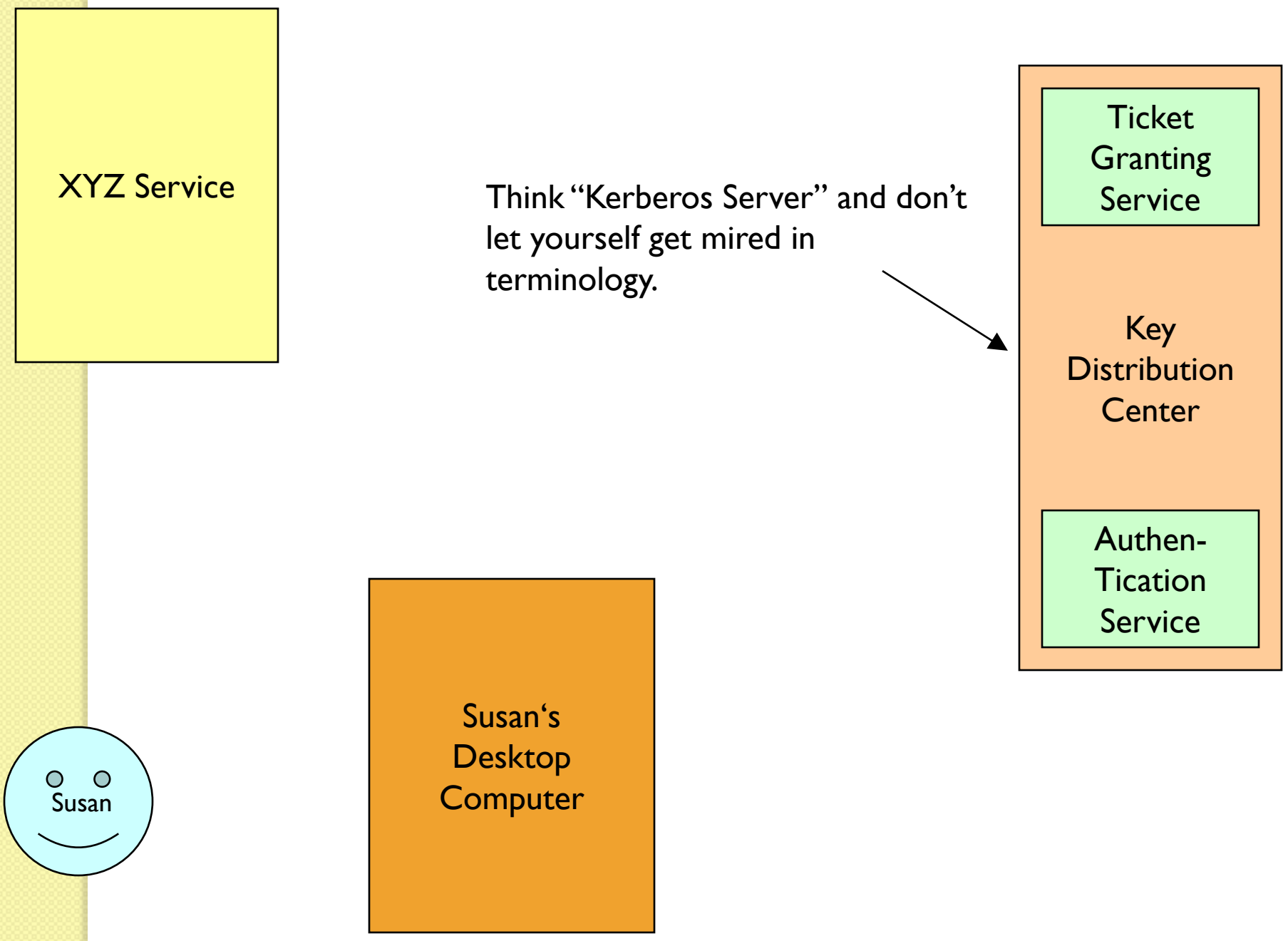
- **Realm-** authentication administrative domain

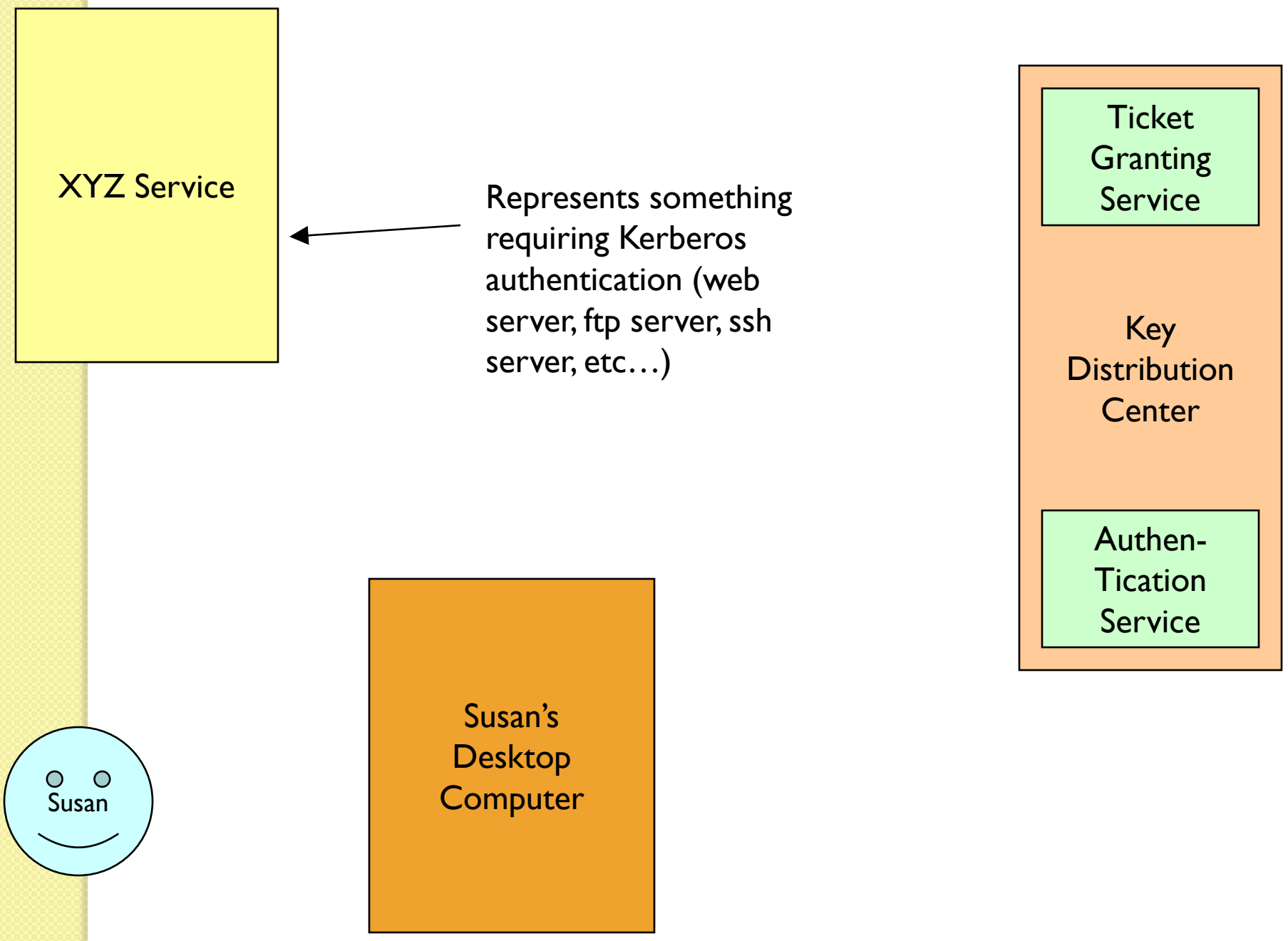
- **Principal -**entries in the authentication server database
  -Name[/Instance]@REALM

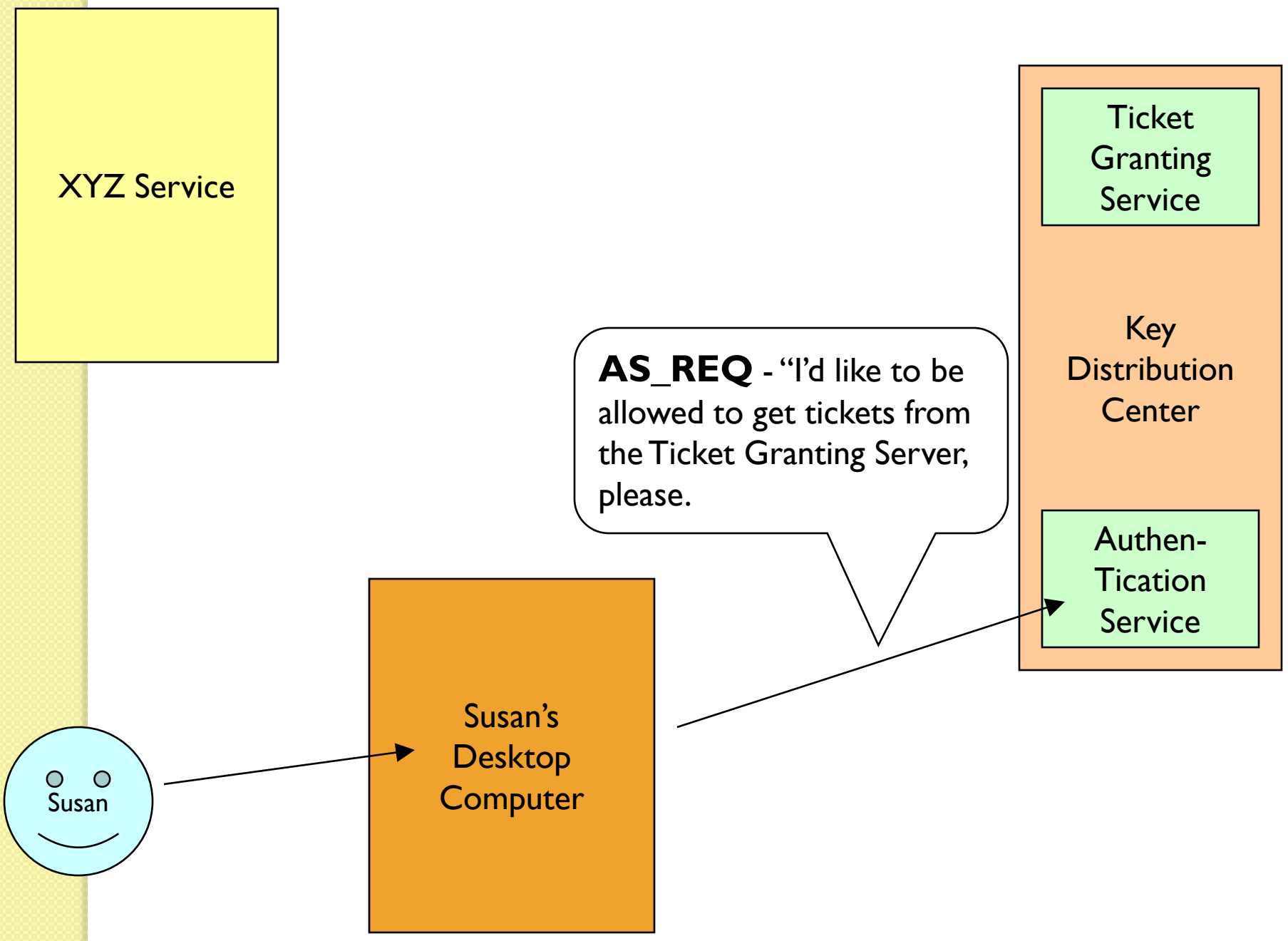
e.g. *pippo*@EXAMPLE.COM,
admin/admin@EXAMPLE.COM
imap/mbox.example.com@EXAMPLE.COM

- **Authenticator –**user principal and time stamp encrypted with the session key.

- **Salt**- K_{pippo} -
  string2key (P_{pippo} + "pippo@EXAMPLE.COM")


XYZ Service
Think "Kerberos Server" and don't let yourself get mired in terminology.
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
Susan's Desktop Computer
Susan


XYZ Service
Represents something requiring Kerberos authentication (web server, ftp server, ssh server, etc…)
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
Susan's Desktop Computer
Susan


XYZ Service
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
AS_REQ - "I'd like to be allowed to get tickets from the Ticket Granting Server, please.
Susan's Desktop Computer
Susan

XYZ Service

AS_REP – (TGT + session key)
"Okay. I locked this box with your secret password. If you can unlock it, you can use its contents to access my Ticket Granting Service."

Ticket Granting Service

Key Distribution Center

Authen-Tication Service

Susan's Desktop Computer

Ticket

- **Ticket** -The requesting user's principal (generally the username);
- The principal of the service it is intended for;
- The IP address of the client machine from which the ticket can be used. In Kerberos 5 this field is optional and may also be multiple in order to be able to run clients under NAT or multihomed.
- The date and time (in timestamp format) when the tickets validity commences;
- The ticket's maximum lifetime
- The session key (this has a fundamental role which is described below);

XYZ Service

Ticket Granting Service

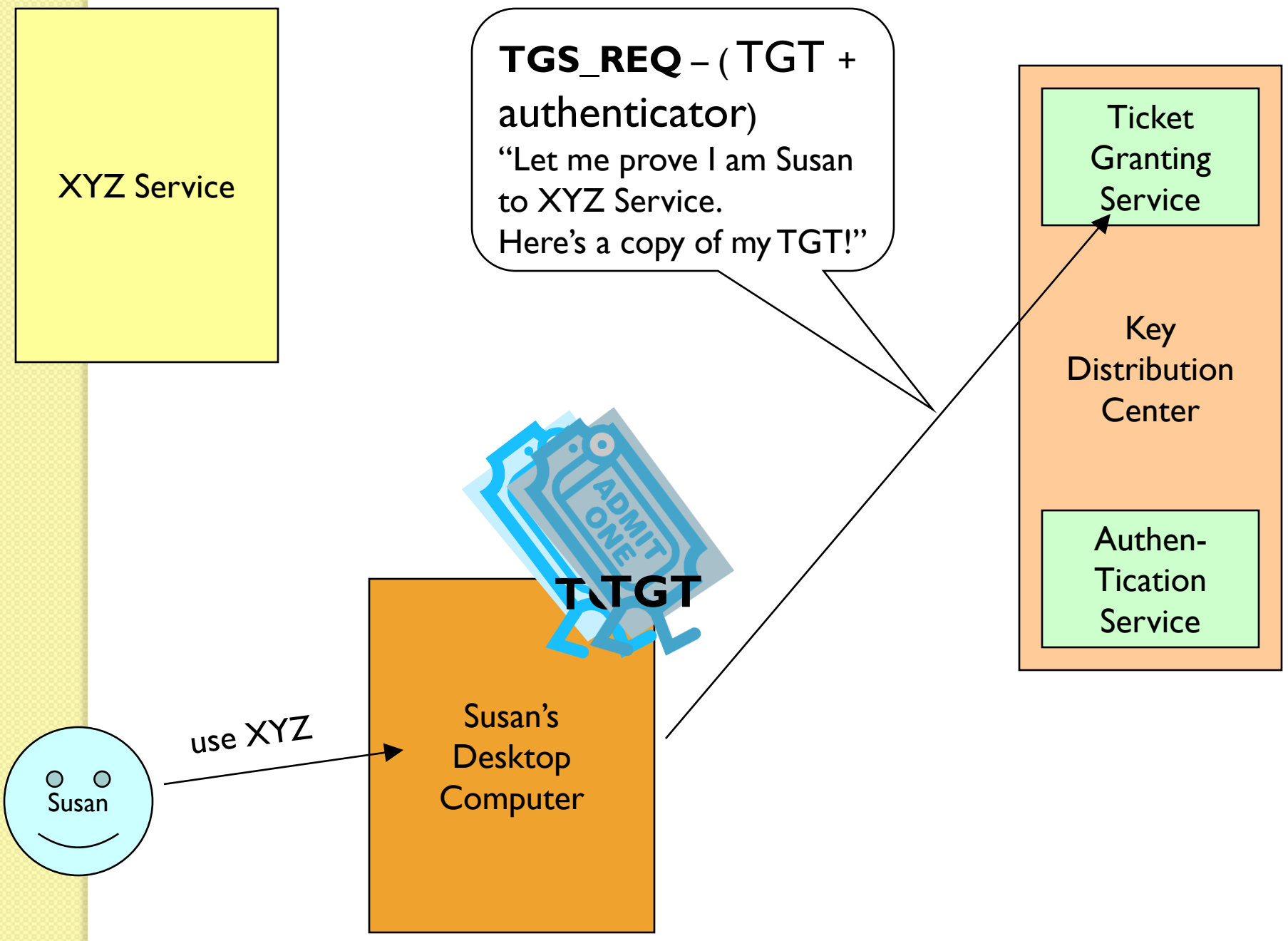
Key Distribution Center

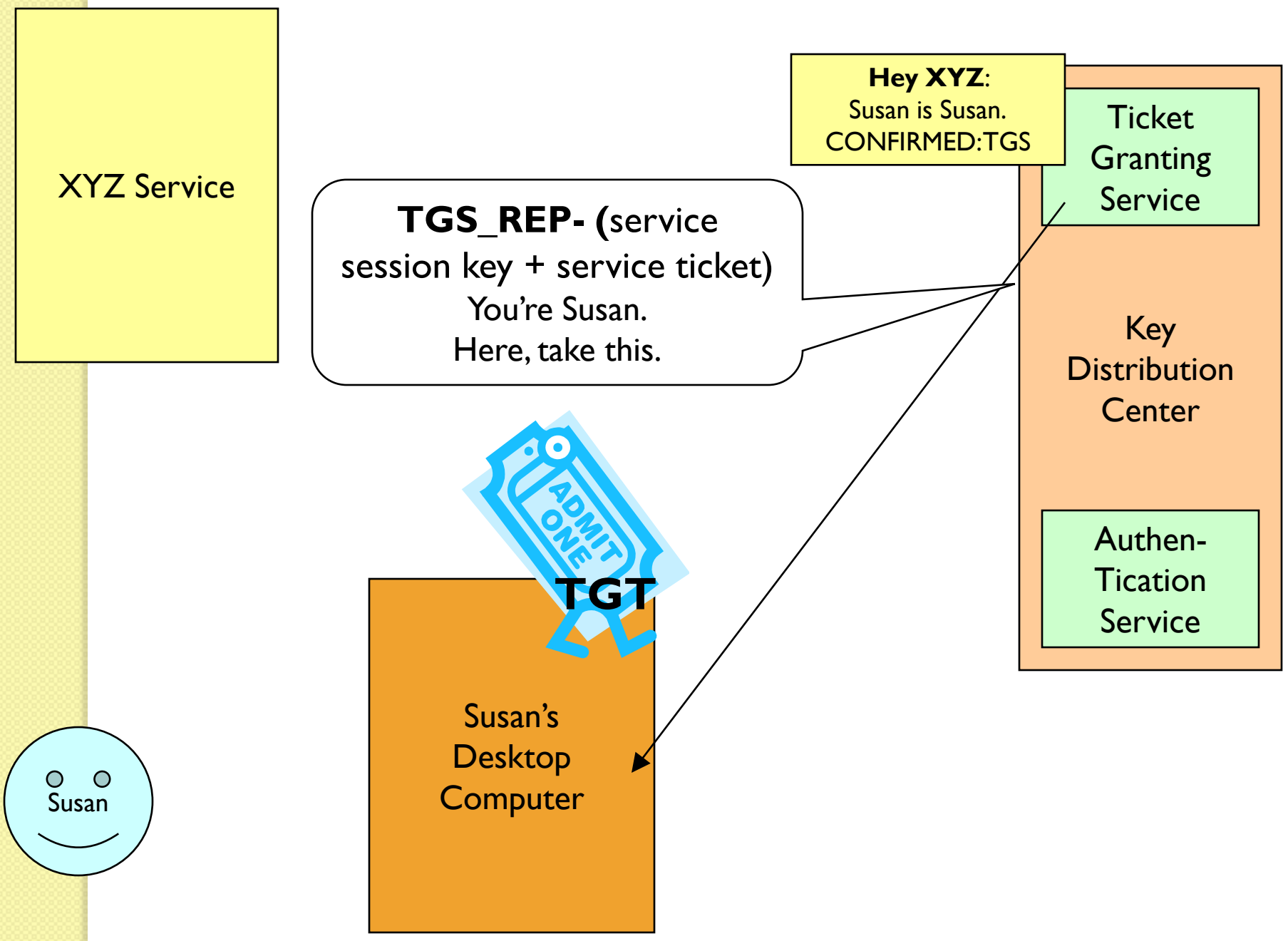
Authen-Tication Service

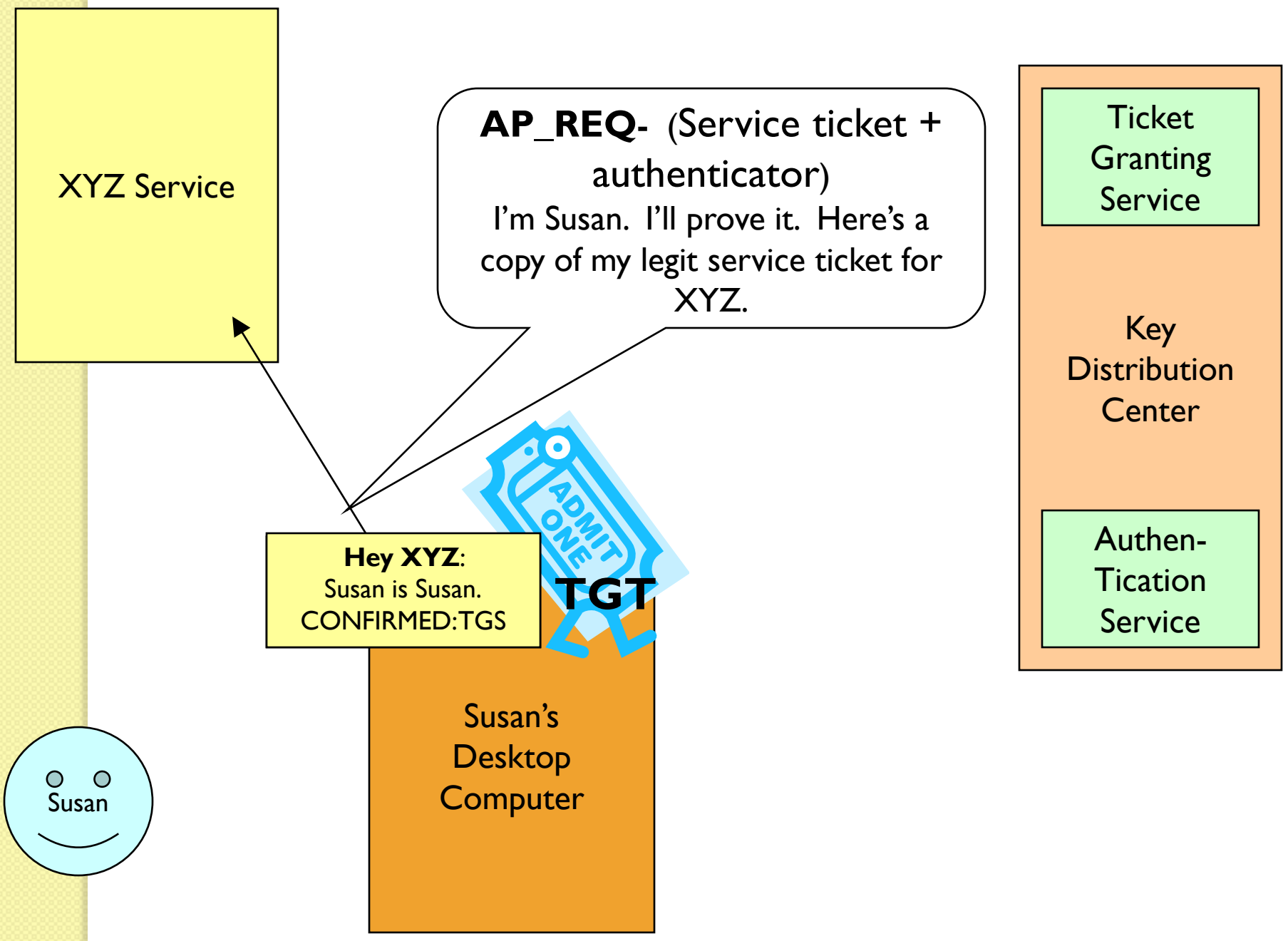
Susan's Desktop Computer

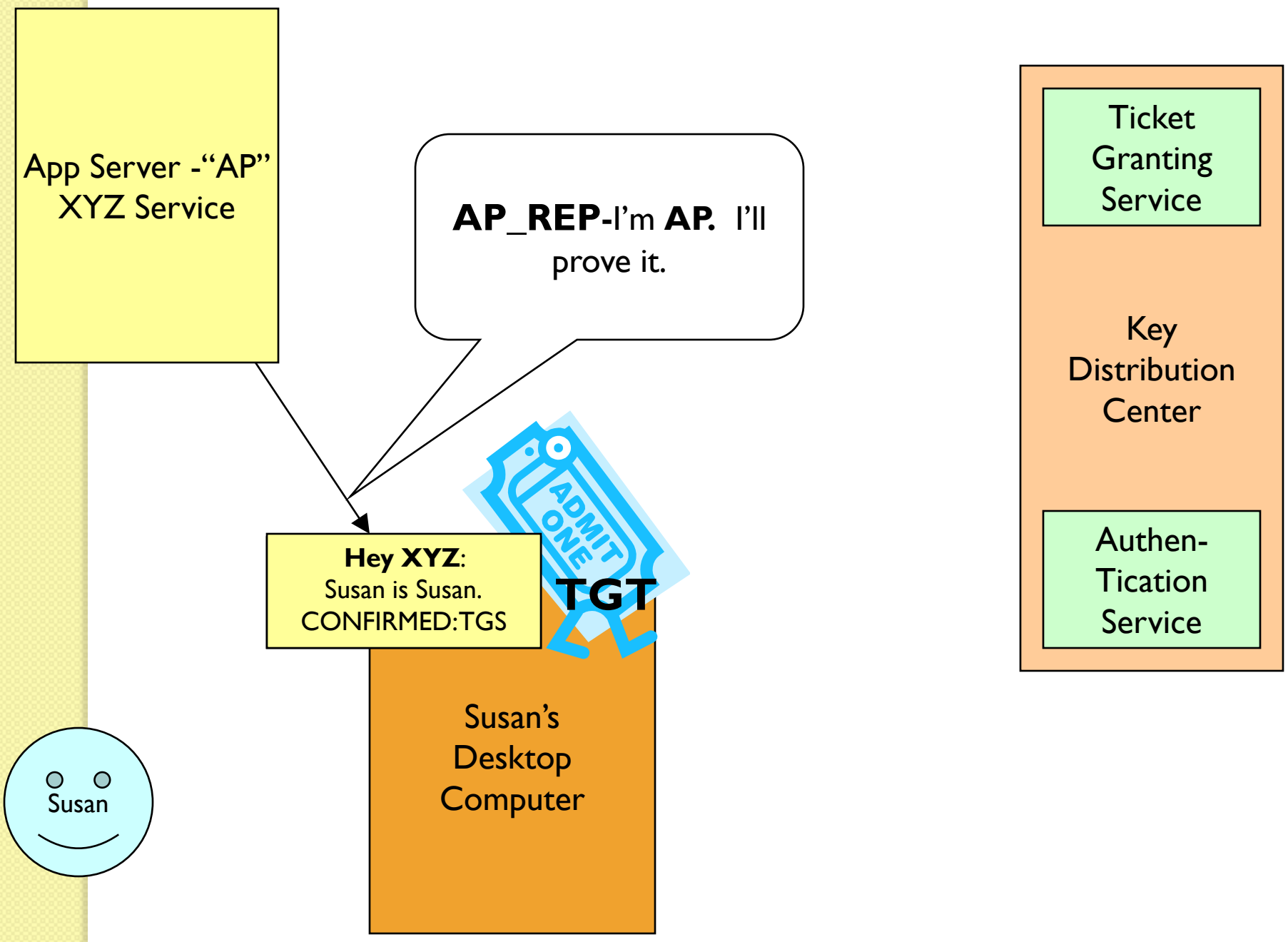
Susan

myPassword


XYZ Service
TGS_REQ – (TGT + authenticator)
"Let me prove I am Susan to XYZ Service.
Here's a copy of my TGT!"
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
TGT
Susan's Desktop Computer
use XYZ
Susan


XYZ Service
Hey XYZ:
Susan is Susan.
CONFIRMED:TGS
Ticket Granting Service
TGS_REP- (service session key + service ticket)
You're Susan.
Here, take this.
Key Distribution Center
Authen-Tication Service
ADMIT ONE
TGT
Susan's Desktop Computer
Susan


XYZ Service
AP_REQ- (Service ticket + authenticator)
I'm Susan. I'll prove it. Here's a copy of my legit service ticket for XYZ.
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
Hey XYZ:
Susan is Susan.
CONFIRMED:TGS
TGT
ADMIT ONE
Susan's Desktop Computer
Susan


App Server -"AP"
XYZ Service
AP_REP-I'm AP. I'll prove it.
Hey XYZ:
Susan is Susan.
CONFIRMED:TGS
TGT
ADMIT ONE
Susan's Desktop Computer
Susan
Ticket Granting Service
Key Distribution Center
Authen-Tication Service

XYZ Service

That's Susan alright. Let me determine if she is **authorized** to use me.

Hey XYZ:
Susan is Susan.
CONFIRMED:TGS

Ticket Granting Service

Key Distribution Center

Authen-Tication Service

TGT

Hey XYZ:
Susan is Susan.
CONFIRMED:TGS

Susan's Desktop Computer

Authorization

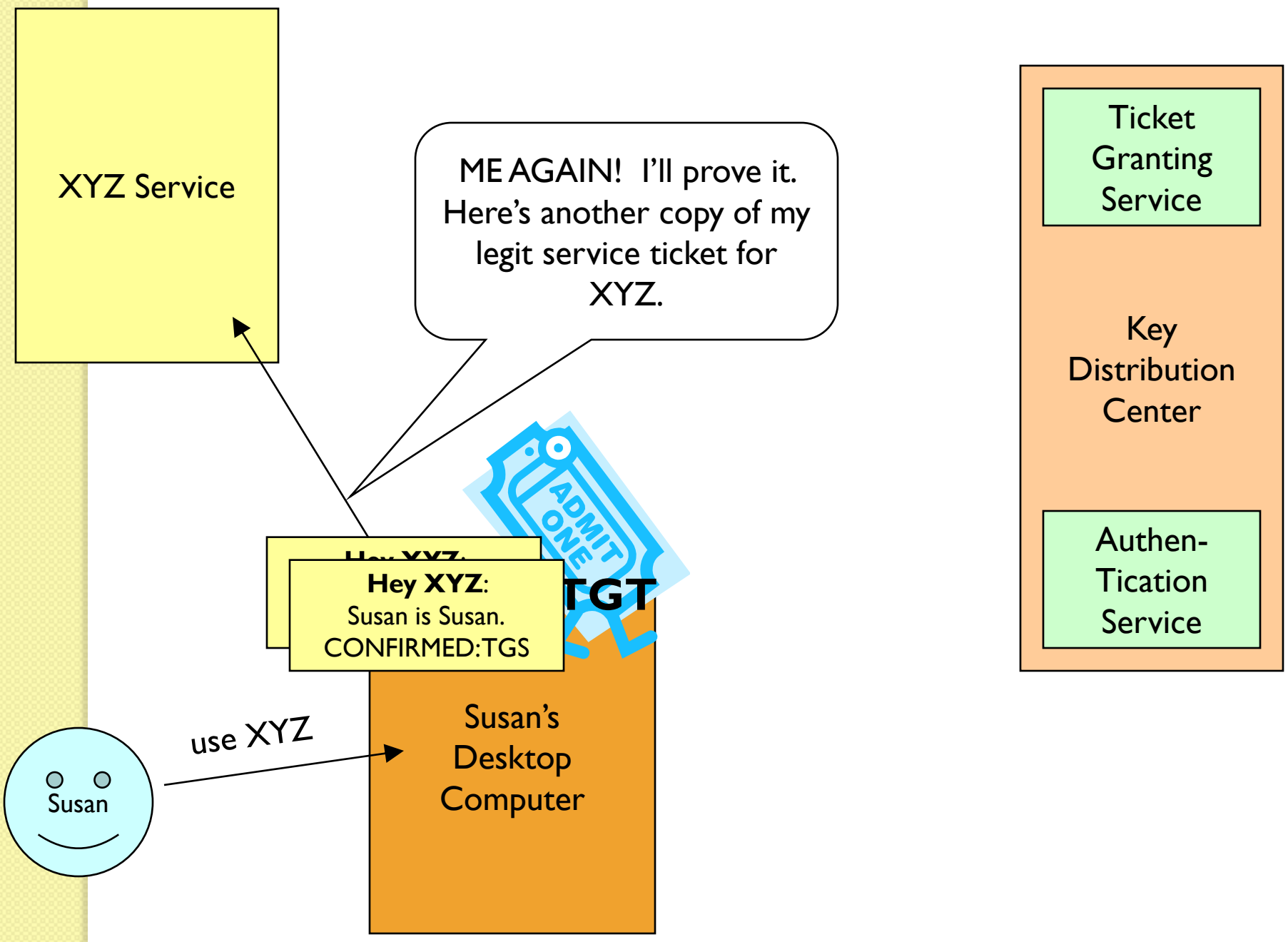
- Authorization checks are performed by the XYZ service…

- Just because Susan has **authenticated** herself does not inherently mean she is **authorized** to make use of the XYZ service

Reuse of ticket TGT

- Tickets (your TGT as well as service-specific tickets) have expiration dates configured by your local system administrator(s). An expired ticket is unusable.

- Until a ticket's expiration, it may be used repeatedly.


XYZ Service
ME AGAIN! I'll prove it. Here's another copy of my legit service ticket for XYZ.
Ticket Granting Service
Key Distribution Center
Authen-Tication Service
ADMIT ONE
TGT
Hey XYZ:
Susan is Susan.
CONFIRMED:TGS
Susan's Desktop Computer
use XYZ
Susan

XYZ Service

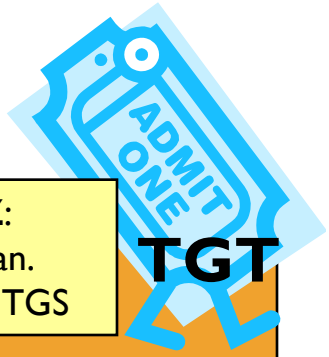
That's Susan… again. Let me determine if she is **authorized** to use me.

Hey XYZ:
Susan is Susan.
CONFIRMED:TGS

Ticket Granting Service

Key Distribution Center

Authen-Tication Service



TGT

Hey XYZ:
Susan is Susan.
CONFIRMED:TGS

Susan's Desktop Computer

Weaknesses in Kerberos

- "Password guessing" attacks are not solved by Kerberos.
- Replay attacks – sniff the network to extract the AP_REQ message.
- Very bad if Authentication Server compromised – steals all of the tickets stored on that machine.

List of Kerberized applications

- NFS (Network File System): Network protocol by allows a client to access files over a network manner similar to how local storage is accessed.
- Telnet.
- Microsoft supports version of Kerberos 5 in Windows 2000.
- Sun ships a basic set of Kerberos 4 utilities with Solaris (kinit, klist, kdestroy), and the RPC that comes with Solaris supports a Kerberos 4 authentication mechanism.
- Cisco routers support Kerberos 5 authentication for incoming and outgoing telnet connections.
- GSS-API , Server message block

Further reading

- An Introduction to Kerberos : http://www.upenn.edu/computing/pennkey/docs/kerbpres/200207Kerberos.htm
- MIT Kerberos Site : http://web.mit.edu/kerberos/
- The Moron's Guide to Kerberos : http://www.isi.edu/~brian/security/kerberos.html
- Kerberos: The Definitive Guide : http://www.oreilly.com/catalog/kerberos/cover.html

Thank you